JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
Version 01 - in effect from 15 June 2006

CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

Increase in efficiency of water resources use at Bratsk HPP, Irkutsk region, Russian Federation
Sectoral scopes:
1. Energy industries (renewable/nonrenewable sources)
Version number: 7 Date: September 2010

A.2. Description of the project:

Bratsk hydroelectric plant (BHPP) is the second HPP of the coordinated hydroelectric system downstream the Angara river and the world's leader in the total volume of electricity production since putting into operation of the first generating unit. The installed capacity of Bratsk HPP is 4500 MW (18 generating units by 250 MW). The annual output under the design is some 21-22 billion kWh. The share of BHPP in the total electricity production of JSC «Irkutskenergo» is about 40%. Due to the unique and sufficiently stable water resources, Bratsk HPP plays an important role in providing the steady-state reliable functioning of Irkutsk region. BHPP supplies the electric energy through the Irkutsk power grid to the regional industrial enterprises, population and to the neighbor deficit power systems.

The project provides extra electricity production due to efficiency increase in water resources use in connection with BHPP efficiency increase caused by replacement of wheels on the 6 hydro generating units. As a result of project activity at BHPP additional 692 million kWh it will be generated a year.

The project is additional and one of the substantiations is that the existing wheels are in an operational conditions and can serve till at least 2013.

The project activity will result in reducing electricity generation by the existing coal fired TPPs of JSC "Irkutskenergo".

Estimated reduction of GHG emissions should be about 4 009 995tCO_2equivalent in the period of 2008-2012 or 801 999t CO_2equivalent per a year. It will lead to additional carbon financing from ERU sales.

BHPP was put in operation in 1961. Because of cavitation wear the turbine's efficiency decreases in time and each 6-8 years overhaul repair works take place at each turbine wheel when they are restored by facing 600-700 kg of metal per one maintenance campaign. Nevertheless maintenance works can't increase efficiency to the initial level and from the time of commissioning the efficiency fell down from initial 93.5% to approximately 88,1.

In the absence of the project activity, the BHPP would continue to provide electricity with the historical average efficiency coefficient, until the time at which the generation facility would likely be replaced or retrofitted. From this point of time onwards, the baseline scenario is assumed to correspond to the project activity, and no emission reductions are assumed to occur.
Emission reduction happens because of BHPP efficiency coefficient increasing.
For the purposes of the project it should be specially noted the following:

- BHPP generates cheap electricity (i.e. it is the «low-cost» energy source) and it is also the «must-run» source in the power system that is loaded in the primary order;
- Water regime of BHPP which means the support of water level in the reservoir in the prescribed range, the control of overflow water in the period of snowmelt flood, etc. is specified by the Yenisei Basin Water Directorate, the requirements of navigation, conservation of fish resources in the river Angara and normal water stream in the lower reach is taken into account. The Operative Group of the Ministry of Natural Resources can give out the recommendations on running the water schedule. Thus, the BHPP generates maximal electricity with the specified

restrictions of water resources utilization. This principle doesn't depend of the retrofit works at BHPP and is true for both baseline scenario and project activity.[1]

- There is electricity demand growth in the region that predetermines also the maximal utilization of BHPP's capacities;
- The electricity loads of BHPP and its concrete units are dispatched by the regional branch of JSC "System Operator of UES".

Table A.2.1. Schedule of capacities retrofit at Bratsk HPP

	The date of putting into operation
Replacement of wheel No. 13	12.2010
Replacement of wheel No. 14	10.2008
Replacement of wheel No. 15	02.2010
Replacement of wheel No. 16	03.2007
Replacement of wheel No. 17	03.2008
Replacement of wheel No. 18	12.2009

Source of data: JSC "Irkutskenergo"

The projected area of BHPP reservoir surface is 5470 km^2, and as JSC «Irkutskenergo» declared, it would remain invariable under project activity, i.e. stay the same under the baseline scenario and project activity. The long-term water schedules of BHPP's operation prescribed by State bodies are expected not to be changed.

The new wheels are made of stainless steel at JSC «Leningradsky Engineering Metal Works», St Petersburg. They have much less cavitations wear of metal (18 kg of metal a year).

The project was considered as a Joint Implementation (JI) from the appearance of the investment proposal in 2004 when JSC Irkutskenergo first took the appropriate decision (the copy of the protocol of 22.04.2004 is attached in Annex 4). Since that time the decision to implement the investment project was made by the Irkutskenergo's Board of the Directors (2004). It should be pointed out that the Kyoto Protocol entered into force only in 2005 when the negotiations with the JI Project developer and a potential carbon investor were started. In 2006 the appropriate agreements were signed. In parallel the investment project's realization was under way.

By the time of developing PDD's version No. 4 (September 2009) three wheels have been already replaced at turbines No. 14, 16 and 17 and refurbishment of No.18 is under way. The increase of efficiency was confirmed by tests carried out for turbine No.16 by "Turboinstitute" (city Ljubljana, Slovenia) in 2007: annual average wheel efficiency was 95.2% at nominal head 100 m. All other new wheels are of the same design, the conditions under which the turbines retrofit is carried out and their operation takes place are the same[2], and there are all reasons to accept the efficiency of 95.2% for all other retrofitted turbines for the purpose of emission reduction assessment. The efficiency 95.2% for all new wheels is guaranteed by the wheels' manufacturer LMW. Increasing of wheel efficiency coefficient till 95,2% will results in hydraulic unit efficiency coefficient increasing till 93,5% taking into account loses between generator and wheel (in the project calculation hydraulic unit efficiency coefficient is taken under capacity 232 MW and equal to 92,9%)

[1] See Analytical note in Annex 9
[2] "Requirements specification for BHPP hydroturbine unit retrofit", JSC "Irkutskenego", 2004

Table A.2.2. BHPP efficiency coefficient before and after the project implementation

Indicator	BHPP Efficiency % [3]
Efficiency coefficient of BHPP turbines in 2002-2007 ($\eta_{baseline}$):	85.92%
Efficiency coefficient of of BHPP turbines in 2008-2012 (average - η_y) :	88.65%

Excel table with the data for each year is presented in Annex 8 (separate file)

[3] Efficiency is calculated by JSC “Irkutskenergo”. Detailed calculation description is presented in “Guidelines for water flow calculation” confirmed by JSC “Irkutskenrgo” and BHPP

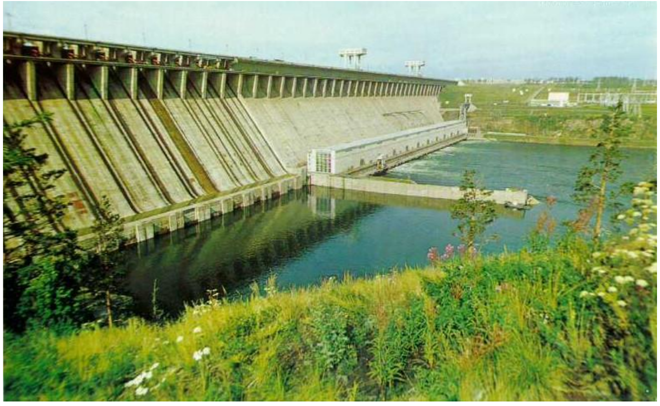
A.3. Project participants:

Party involved	Legal entity project participants (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Party A - Russian Federation (host party)	Irkutsk Joint Stock Company of Energetic and Electrification (JSC Irkutskenergo)	No
Party B - No	-	-

A.4. Technical description of the project:

A.4.1. Location of the project:

Irkutsk Oblast is located in south-eastern Siberia in the basins of Angara, Lena, and Nizhnyaya Tunguska Rivers, and occupies an area of 767,900 km² (4.6% of Russia's territory). See the map below.



Picture A.4.1.4.1. Bratsk Hydropower Plant.

The City of Bratsk is located in the North-West of Irkutsk Oblast near Bratsk water reservoir. The City occupies the territory of 43,000 hectares. It was created in 1955 when the BHPP construction started.

The City is situated in severe climatic conditions. Its economic and geographical location is rather favorable due to well developed infrastructure (transit railways, automobile roads, electricity networks, international airport, etc.), high resource and economic potential (energy resources of Bratsk hydropower plant, huge water resources of Angara River, etc.).

The City population is above 250,000 people. Bratsk is one of the largest industrial centers of Eastern Siberia. The largest industries of the City include Bratsk Aluminium Plant, Bratsk Ferroalloys Plant, Ilim Timber Processing Plant, and some others. In the last years the investment activity in the City was rather stable.

A.4.1.1. Host Party (parties):

The Russian Federation

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

Irkutsk Oblast

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

Bratsk City

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

BHPP is situated on Angara River. The decision about construction of BHPP was taken in September 1954 and the first preparation works started in December 1954. In 1967 the State commission accepted the Bratsk hydraulic station into exploitation.

The installed capacity of BHPP is 4500 MW (18 hydraulic units per 250 MW). The annual power generation is about 22 bln kWh. BHPP has power lines of 500 kW and 220 kW, transformers of 220 kW, and other equipment.

BHPP is owned by "Irkutskenergo" Company with the headquarters in Irkutsk City, the capital of Irkutsk Oblast.

Picture A.4.1.4.1. Location of the project.

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

18 turbines of BHPP were put into operation in 1961-1963
Main data on turbines at BHPP are presented in Table A.4-1.

Table A.4.1. Stock of turbine equipment of Bratskaya HPP

No. of turbine	Mark of turbine	Manufacturer	Installed capacity, MW
	Before retrofit		
№ 1-16, 18	PO-662-BM-550	LMW (“ЛМЗ”)	250
№ 17	PO-669-BM-550	LMW(“ЛМЗ”)	250
	After retrofit		
№ 1-12	PO-662-BM-550	LMW (“ЛМЗ”)	250
№ 13 (since 2010)	P-115-B-558	LMW (“ЛМЗ”)	250
№ 14 (since 2008)	P-115-B-558	LMW (“ЛМЗ”)	250
№ 15 (since 2010)	P-115-B-558	LMW (“ЛМЗ”)	250
№ 16 (since 2007)	P-115-B-558	LMW (“ЛМЗ”)	250
№ 17 (since 2008)	P-115-B-558	LMW (“ЛМЗ”)	250
№ 18 (since 2009)	P-115-B-558	LMW (“ЛМЗ”)	250

Six new wheels of turbines № 13-18 are manufactured by JSC «LMW» (in Russian - OAO «ЛМЗ»), Saint-Petersburg. They are manufactured from stainless steel, have less cavitations wear (18.5 kg of metal per year) than the old ones; they have more optimal design with 15 longer blades instead of 14 short ones. The wheels are lighter which leads to fewer loads on bearings, and have better vibration characteristics. They are fully assembled at the factory and have better labyrinth sealing. All these factors result in higher efficiency and reliability of the retrofitted units.

Turbines of such type are used in Vietnam, India, Greece and some other countries.
The replacement of wheels is an operation that is not creating any additional risk. Works are executed by specialized company CJSC «HydroEnergoService-Remont».

Three wheels have been already replaced at turbines No. 14, 16 and 17 in 2007 and 2008. In 2007 thorough tests of retrofitted turbine No. 16 were undertaken by “Turboinstitut” (city Ljubljana, Slovenia) which has all certificates to act as a professional independent entity. The results are presented in the report “Bratsk HPP. Turbine Site Testing. No. 2921” (Ljubljana, October 2007). The testing was performed using the most precise and representative method of direct water flow measurement according international standards IEC 60041 and ISO 3354. The results show that annual average efficiency at nominal head of 100 m is 95.2%. Since new wheels of turbines No. 13, 14, 15, 17 and 18 are of the same design and the conditions under which the turbines are retrofitted and operation takes place are not changed there are all reasons to accept for them the same efficiency 95.2%. This assumption is also backed by the manufacturer’s guarantee of the wheels efficiency of 95.2% for all of the 6 turbines. The Turboinstitut report states that “all efficiency guarantees are fulfilled” according to the standard IEC 60041.

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:

Realization of the Project will lead to additional electricity generation by the renewable source – BHPP due to increased efficiency. This additional amount of 692 445 MWh will substitute electricity that would be generated by the existing coal fired TPPs of JSC Irkutskenergo. Hence the result of Project activity is GHG emission reduction due to decrease in consumption of organic fuel at those TPPs.

Thus, fossil fuel will be saved and GHG emissions prevented. Calculation methods are presented in the section E.. For defining GHG emission factors (tCO_2/MWh) own approach is used.

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

	Years
Length of the crediting period: **2008-2012**	5
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2008	341 915
2009	580 689
2010	858 328
2011	1 003 002
2012*	1 226 061
Total estimated emission reductions over the crediting period (tones of CO_2 equivalent)	4 009 995
Annual average of emission reductions over the crediting period (tones of CO_2 equivalent)	801 999

* Emission reductions will take place after 2012, the values are to be calculated in the updated version of the PDD. The second crediting period is subject to decisions of the UNFCCC Parties

A.5. Project approval by the Parties involved:

Project “Increase in efficiency of water resources use at Bratsk HPP (BHPP)” was approved by the Ministry of Economic Development of the Russian Federation in the order #326 of 23 July 2010 in accordance with the Statute On the Implementation Of Article 6 Of the Kyoto Protocol to the UN Framework Convention On Climate Change, adopted by the Russian Government in the Decree #843 “On Measures Within the Implementation of Article 6 Of the Kyoto Protocol to the UN Framework Convention On Climate Change” of 28 October 2009.

SECTION B. Baseline

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

According to “Guidelines for users of the JI PDD form” version 04 (Appendix B), the approved CDM methodology and specific approach regarding baseline setting can be chosen.
To describe and justify the chosen baseline the specific own approach is applied. It is developed according to JISC “Guidance on criteria for baseline setting and monitoring” version 02 (paragraph 9a)
The own approach based on alternative scenarios consideration and estimation with help of the following stages that used in this PDD:

Step 1. Indication and description of the approach applied

1. Identification of alternative scenarios.

At this stage all alternative candidates of the baseline scenario are identified and their conformity to the current legislation is checked.

2. Analysis of barriers.

This stage includes definition of the barriers which could interfere to realize the alternative scenarios identified at the previous stage and the influence analysis of the given barriers on alternative scenario realization is carried out. As a result of the barriers analysis makes the conclusion about possibility of alternative scenario realization.

3. Analysis of common practice.

The given stage supplements the researcher conducted at the previous stage by the analysis about degree of technology prevalence offered in the given Project and in others Russian companies. The baseline scenario is the most technically feasible and prevalent alternative.

As a result of the aforesaid stages the definition of the baseline scenario serves. The baseline scenario is the most possible alternative. Realization of the baseline scenario is not interfered by the considered barriers.

Step 2. Application of the approach chosen

1. **Identification of alternative scenarios**

Alternative scenario 1. Continuation of the current situation (without the project activity)

This alternative assumes that Bratsk HPP would continue to provide electricity to the grid at historical average levels, until the time at which the generation facility would likely be replaced or retrofitted. The existing wheels are in operational conditions and can serve till at least 2013 and can be prolonged by repairs. There is electricity demand growth in the region, that is why additional electricity would be generated by the existing coal fired TPPs of JSC Irkutskenergo in condensation mode.

Alternative scenario 2. The proposed project activity undertaken without being registered as a JI project

The project comprises substitution of 6 wheels (blade wheels) of turbines No. 13-18 that provides the increase of BHPPs’ efficiency and generation of additionally about 674 million kWh a year (by estimations in 2004). The project activity will result in reducing electricity generation by the existing coal fired TPPs of JSC Irkutskenergo in condensation mode. This alternative scenario has technological difficulties which resulted in longer manufacturing and equipment installation periods.

Bratsk HPP modernization is reflected in "General Scheme of Allocation of Energy Objects up to 2020" approved by the RF government order # 215-p dated 22/02/2008. This condition doesn't apply any obligations on the project realization and doesn't mean any support of the projects, included in the "General scheme of Allocation of Energy Objects up to 2020" (State supporting, soft loans, co-financing etc.). All plans of JSC "Irkutskenergo" development are confirmed by the Board of directors and their reflection in the "General scheme of Allocation of Energy Objects up to 2020" has informative character.

Conclusion: All of the described above alternative scenarios are consistent with the mandatory laws and regulations, in particular with the Federal Law of 26.03.2003 No. 35-FZ (amended on 04.11.2007 No. 250-FZ) "On the Power Industry" and may be discussed in the further analysis.

2. Analysis of barriers

The analysis of barriers considers the influences exerted on alternative scenarios by the **financial barrier**. This barrier prevents the realization of alternatives from the commercial efficiency viewpoint.

Alternative scenario 1. Continuation of the current situation (without the project activity)

The barrier exerts no effect on alternative scenario 1, since repair works of the existence wheels is a common practice in Russia and its further realization does not constitute an investment activity, which would be assessed from the economic efficiency viewpoint.

Alternative scenario 2. The proposed project activity undertaken without being registered as a JI project

The official "Methodology of JSC Irkutskenergo for calculation of investment projects and financial modeling" issued on 06.04.2004 and the appropriate computer program was applied. The Methodology is based on commonly used formulae for calculation of key financial/economic indicators of an investment project. The calculations were performed under the condition that all project additional electricity will be realized by the tariff, which confirmed by Regional Energy Commission (REC).
REC due to project additional electricity generation takes into account in the tariff (inclusive of inflation rate) the return of the direct costs (water tax), fixed costs (property tax) and standard profit no more than 15%. At that, the tariff confirmed by REC is not exceed the value of maximum tariff confirmed by Government of the Russian Federation in accordance with the Federal low №41 «About state regulation of tariffs on electric and thermal energy in the Russian Federation» from 14.04.1995
Therefore the project without revenue from ERU is not paid back as the tariff does not provide capital return.

Excel table with full calculations of financial/economic indicators is presented in Annex 7.

The table B.1.1 demonstrates economy effectiveness analysis results of alternative scenario 2.

Table B.1.1. Financial/economic indicators

Indicator	Unit	Project activity without carbon credits
Investment	mln. Rbls	370
Average annual revenues (without VAT)	mln. Rbls/year	58.7
Average annual operating cost	mln. Rbls/year	20.4
Average annual amortization (is not included in cash flow analysis)	mln. Rbls/year	9.5
Average annual revenues from ERU's sale	mln. Rbls/year	0
NPV	mln. Rbls	-59179
IRR	%	7
Profitability index	-	0.8
Discount payback period	years	-

Alternative scenario 2 is not economically effective.

Conclusion:

The above analysis showed that the financial barrier impede alternative 2.

Table B 1.2. Results of analysis of barrier

Barrier	Alternative 1	Alternative 2
Financial	Barrier does not exist	Barrier exists

Therefore, the financial **barrier does not exist for alternative scenario 1**. There is substantial financial barrier, which impede alternative scenario 2.

2. Common practice analysis

There are 102 medium and large-scale (10 MW and more) hydro power plants in Russia. Replacement of wheels are undertaken very rarely, in cases when turbines are absolutely worn-out and can't be operated any longer. Some of such rare examples are: Verkhne-Volga Hydro Cascade where some extremely worn-out turbines had to be first put out of operation. The project of retrofitting those turbines is under way there. At Kamskaya HPP (Volga river) turbine No. 21 was retrofitted with replacement of the wheel, this turbine was in operation from 1955. In Murmansk region at Nivskaya HPP old wheels were replaced, they were in operation more than 50 years. At Bratsk HPP turbines can be operated by at least till 2013 (this conclusion is made by the special R&D study which was undertaken in 2003 [13]). Indirectly this can be as well proved by the fact that JSC Irkutskenergo has no plans to retrofit turbines No. 1-12.

In Irkutsk region there are 3 large-scale HPPs with 42 turbines in operation, some were commissioned in early '60s. No project similar to the one under consideration was undertaken in the region.

Conclusion:

Based on the barrier analysis and common practice analysis the alternative scenario 1 - Continuation of the current situation (without the project activity) is most plausible, thus it is identified as the baseline scenario.

Baseline emission determination carries out in accordance with own approach for emission reduction determination,which presented below:

Formula	Parameter	Explanation
$ER = \Delta EG_y \times EF_{grid}$ (formula B.1-1)	Emission reduction as a result of project activity realization	**ΔEG_y** - additional amount of electricity supplied in the grid of Irkutrskenergo by the BHPP, (MWh); **EF_{grid}** – emission factor for condensation mode of Irkutskenergo power system (tCO_2/MWh)
$EF_{grid} = b_{cp,y} \times EF_{CO2,cp,y}$ (formula B.1-2)	Emission factor of Irkutskenergo , (tCO_2/MWh)	**$b_{cp,y}$** - fuel rate per 1 kWh of electricity output by condensation cycle (tCO_2/tce); **$EF_{CO2,y}$** - weighted (for the different types of fuel) emission factor for condensation mode;
$\Delta EG_y = EG_{BHPP} \times \Delta\eta$ (formula B.1-3) **$\Delta\eta = (1- \eta_{baseline}/ \eta_y)$ (formula B.1-4)**	Additional amount of electricity supplied in the grid of Irkutrskenergo by the BHPP, (MWh);	**EG_{BHPP}** – annual BHPP electricity generation(MWh); **$\Delta\eta$** – the difference between baseline's and project's weighted average BHPP efficiency coefficients (%); **η_y** - averaged weight efficiency coefficient in year y(%);
$\eta_{baseline} = \sum(\sum\eta_i \times w_i)/5$ (formula B.1-5) **$\eta i = f(H,N_i,k_w k_{w\ overhaul})$ (formula B.1-6)** **$w_i = EG_i/EG_{BHPP}$ (formula B.1-7)** **$H = H_u - H_l$ (formula B.1-8)** **$N_i = EG_i/t_i$ (formula B.1-9)**	5 years averaged weight data on efficiency coefficient of BHPP turbines before the project activity, (%);	**η_i** – efficiency coefficient of BHPP turbine (%); **w_i** – turbine load in a year; **H_i** – water head (m); **H_u** – upper pool (m); **H_l** – lower pool (m); **N_i** – electric load (on generator clamp) (MW); **k_w** – turbine wear factor till the last actual testing (%); **$k_{w\ overhaul}$** - turbine wear factor in overhaul period (%); **t_i** – operating hours for turbine i (h/year);

$\eta_y = \sum \eta_i \times w_i$ (formula B.1-10)	Averaged weight data on efficiency coefficient of BHPP turbines after the project activity (%)	**η_i** – efficiency coefficient of BHPP turbine (%); **w_i** – turbine load in a year;
$DATE_{baselineRetrofit}$	The date, when the existing equipment should be substituted in the absence of the project implementation).	$DATE_{baselineRetrofit}$ - point in time when the existing equipment would need to be replaced in the absence of the project activity;

The table with the key data and the variables used for the baseline definition is presented below:

Data/Parameter 1	EG_y – Electricity production by turbines № 1-18 in period 2002-2007
Data unit	MWh
Description	Electricity production by turbines №1-18 in period 2002-2007
Time of determination /monitoring	Constant
Source of data	Annual reports of BHPP and/or JSC «Irkutskenergo».
Value of data applied (for ex ante calculations/determinations)	This information you can find in Annex 8 Microsoft Office Excel 97-2003 Worksl
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Determined in direct instrumental measurement by high-precision watthourmeters.
QA/QC procedures (to be) Applied	The high precision, standard, electricity supply meters, type A1R-4-AL-C8-T+ are used. Checking is carried out by LLC "Elster Metronika" every 8 years. All measurements will be conducted with calibrated measurement equipment according to standards in the power industry.
Any comment	

Data/Parameter 2	EG_{BHPP} - Electricity production by BHPP in period 2002-2007
Data unit	MWh
Description	Electricity production by BHPP
Time of determination /monitoring	Constant
Source of data	Annual reports of BHPP and/or JSC «Irkutskenergo».

Value of data applied (for ex ante calculations/determinations)	This information you can find in Annex 8 Microsoft Office Excel 97-2003 Worksl
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The calculations are carried out by summation of electricity generating by each turbine (EG_{1-18})
QA/QC procedures (to be) applied	The result takes from central certified server - Automatic system for commercial accounting of electricity.
Any comment	

Data/Parameter 3	$\eta_{baseline}$- Efficiency coefficient of BHPP turbines in period 2002-2007
Data unit	%
Description	Efficiency coefficient of BHPP turbines in period 2002-2007
Time of determination /monitoring	Determined once in 2009
Source of data	Calculated by JSC "Irkutskenergo" experts
Value of data applied (for ex ante calculations/determinations)	This information you can find in Annex 8 Microsoft Office Excel 97-2003 Worksl
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The calculation are carried out according to the adopted methodology - nomograms supplied by the turbine's manufacturer - JSC «Leningradsky Engineering Metal Works». Detailed calculation description is presented in "Guidelines for water flow calculation" confirmed by JSC "Irkutskenrgo" and BHPP*
QA/QC procedures (to be) applied	All measurements will be conducted with calibrated measurement equipment according to standards in the power industry
Any comment	

*Can be given by request

Data/Parameter 4	EF_{grid} – Emission factor for condensation mode of Irkutskenergo power system
Data unit	tCO_2/MWh
Description	Emission factor for condensation mode of Irkutskenergo power system
Time of determination /monitoring	Determined once in 2009 for the credit period
Source of data	JSC "Irkutskenergo" software: "Program complex of automated collection, processing and fuel use analysis system of CHP-plants and Power and electrification production association"

Value of data applied (for ex ante calculations/determinations)	1.159
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Calculated according to the Regulating document 34.08-559-96 "Methodical guidance for analysis of specific fuel consumption changes at electric power stations and power associations". More detail information see in Annex 2
QA/QC procedures (to be) applied	The result confirms by ORGRES (JSC "Engineering Center UES")
Any comment	

Data/Parameter 5	DATEbaselineRetrofit, Point in time when the existing equipment would need to be replaced in the absence of the project activity
Data unit	Date (year)
Description	Point in time when the existing equipment would need to be replaced in the absence of the project activity
Time of determination /monitoring	Determined once in for the credit period
Source of data	Special research "Evaluation of the lifetime reserve of the turbine wheels No. 6 and 17 of BHPP" was undertaken by an independent research center CKTI.
Value of data applied (for ex ante calculations/determinations)	2013 year
Justification of the choice of data or description of measurement methods and procedures (to be) applied	In 2003 special research "Evaluation of the lifetime reserve of the turbine wheels No. 6 and 17 of BHPP" was undertaken by an independent research center CKTI. The outcome: both wheels can serve at least till 2013. An indirect evidence that the lifetime will exceed 2013 is the absence of plans to replace turbine wheels No.1-12 in the coming 5 years.
QA/QC procedures (to be) applied	Special research "Evaluation of the lifetime reserve of the turbine wheels No. 6 and 17 of BHPP" was undertaken by an independent research center CKTI.
Any comment	

B.2. Description of how the anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the JI project:

According to "Guidelines for users of the JI PDD form" version 04, the approved CDM methodology and specific approach to demonstrate additionality can be chosen.
To demonstrate additionality the specific own approach is applied. It is developed in according with JISC "Guidance on criteria for baseline setting and monitoring" version 02 (Annex 1, paragraph 2b).
The project's additionality is analyzed below by means of the own approach.

Step 1. Indication and description of the approach applied

1. Investment analysis

Investment analysis includes the evaluation of the project's economic efficiency and hence must be resulted in the conclusion of the attractiveness of the project realization without JI registration.

The investment analysis result is quantitative definition of the project economic efficiency indicators, such as NPV, IRR and the discounted payback period.

Additional carbon revenue from ERU's sale is taking into consideration at this stage. Additional revenue can influence on decision making by management of JSC "Irkutskenergo".

In the frame of investment analysis the project sensitivity analysis for such variables, as the electricity price and capital expenses is carried out.

The project is additional if it is not economically attractive without ERU sales.

Step 2. Application of the approach chosen

1. **Investment analysis**

Alternative scenario 2 assumes investment activity.
The table B.2.1 demonstrates economy effectiveness analysis results of alternative scenario 2.

Table B.2.1. Financial/economic indicators

Indicator	Unit	Project activity without carbon credits	Project activity with carbon credits (the price of 1 ERU was assumed 8 euro)
Investment	mln. Rbls	370	
Average annual revenues (without VAT)	mln. Rbls/year	58.7	
Average annual operating cost	mln. Rbls/year	20.4	
Average annual revenues from ERU's sale	mln. Rbls/year	0	156.4
NPV	mln. Rbls	-59179	+127564
IRR	%	7	36
Profitability index	-	0.8	1.5
Discount payback period	years	-	5.43

The official "Methodology of JSC Irkutskenergo for calculation of investment projects and financial modeling" issued on 06.04.2004 and the appropriate computer program was applied. The Methodology is

based on commonly used formulae for calculation of key financial/economic indicators of an investment project. The calculations were performed under the condition that all project additional electricity will be realized by the tariff, which confirmed by Regional Energy Commission (REC).
REC due to project additional electricity generation takes into account in the tariff (inclusive of inflation rate) the return of the direct costs (water tax), fixed costs (property tax) and standard profit no more than 15%. At that, the tariff confirmed by REC is not exceed the value of maximum tariff confirmed by Government of the Russian Federation in accordance with the Federal low №41 «About state regulation of tariffs on electric and thermal energy in the Russian Federation» from 14.04.1995
Therefore the project without revenue from ERU is not paid back as the tariff does not provide capital return.

Excel table with full calculations of financial/economic indicators is presented in Annex 7.

Sensitivity analysis

Table B. 2.2 Project NPV against the investment cost and electricity price changing, th of Rbls

Electricity sales revenue + investment item in the tariff (% deviation from the baseline scenario)	Investments (% deviation from the base variant): -20%	-10%	0	10%	30%
-20%	(90 156)	(101 278)	(112 399)	(123 521)	(145 764)
-10%	(68 022)	(76 906)	(85 789)	(94 672)	(112 439)
0%	(45 888)	(52 534)	(59 179)	(65 824)	(79 114)
10%	(23 754)	(28 162)	(32 569)	(36 976)	(45 790)
20%	(1 892)	(3 877)	(5 958)	(8 127)	(12 465)

-most probable scenario

Table B. 2.3 Project IRR against the investment cost and electricity price changing, th of Rbls

Electricity sales revenue + investment item in the tariff (% deviation from the baseline scenario)	Investments (% deviation from the base variant): -20%	-10%	0	10%	30%
	0,8	0,9	1	1,1	1,3
-20%	N/a	N/a	N/a	N/a	N/a
-10%	0%	0%	0%	0%	-1%
0%	8%	8%	7%	7%	7%
10%	14%	14%	13%	13%	13%
20%	20%	19%	19%	19%	18%

The sensitivity analysis has been performed by varying the following key assumptions: Cost of investment and electricity price.

In the first upside scenario investment cost have been decreased by 10 % (up to 333 million rbls, instead of 370 million Rrls), it would increase project IRR of 0,34 %, Increasing or decreasing of the investment by 10% gives increasing or decreasing of NPV by 6.4 million rbls correspondingly.
In the more pessimistic scenario, under negative tendencies of economy development, the investment cost has been required to increase. Their presumable increasing by 10 % (up to 407 million rbls) would lead to reduction of project IRR by 0.29 %.

The Influence on project economic attraction of electricity price more significant. In the optimistic scenario, with increasing electricity price by 10 %, the project IRR would increase by 6,08 %, NPV by 24 million rbls. As a result of the pessimistic scenario, with elictricity price reduction by 10 %, the project IRR would reduce by 7,67 %, NPV by 24 million rbls.

The project is more sensitive to the electricity price, then investment cost. The size of electricity price gives an essential influence on parameters of economic efficiency. The investments changing give a less essential influence on the project.

The results of variations of both project costs and revenues are presented in Annex 4-5.

Conclusion: The above analysis shows that project can't be acceptable. The project activity is economically unattractive without ERU's sales. Common practice analysis, which carried out in section B.1., shows that project activity is not common practice. Therefore proposed project activity is **additional.**

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

The Project boundaries include the GHG emission sources related to the Project activity. The estimates of emissions take into account greenhouse gases, which contribute significantly (more than 1%) to the total amount of GHG emissions.

The spatial extent of the project boundary includes the project power plant (BHPP) and Irkutsk regional power system, which is effectively JSC "Irkutskenergo" power system . The given decision is based on the following reasons:

1. The Irkutsk power supply system is excessive. Demands in electricity of Irkutsk region customers are covered from the Irkutsk grid, therefore there is no need for extra electricity imports. At present TPPs Irkutskenergo produces about 16-17 TWh of electricity and can expand the generation up 21 TWh at the maximum. In a 5 year run this maximum will not be reached,
2. Electricity cross-flow takes place only in the form of export to the neighbor deficit power systems.
3. Irkutskenergo has ineffective thermal power plants, which will be unloaded in the case of extra electricity production at Bratsk HPP.

According to the item 2.3. Regulations of calculation for the choice of the generating equipment structure (the Annex № 3.1 to the Contract on joining to trading system of the wholesale market) (further under the text – Regulations), Irkutskenergo submits to the System operator the notice on structure and parameters of the generating equipment, containing the information according to section 3 of Regulations of notification submissions by the participants of the wholesale market (the Annex № 4 to the Contract on joining to trading system of the wholesale market), considering information on additional generation due to realization of the Project "Increase in efficiency of water resources use at Bratsk HPP" . On the basis of the received data and the data collected according to section 4 of Regulations, the System operator forms mathematical model of choice of the power-on generating equipment, taking into account forecasting parameters of power system operation, reliability of power supply and minimization of electricity cost.

All factors that influence at reliability of a power system of the Irkutsk region and Siberia considered at forming of mathematical model (according to the Annex 1 to Regulations). Therefore the System operator, for the purpose of possibility of item 6.3 and 6.4 “Regulations of operative dispatch control at electropower mode of UES of Russia objects” leaves transmission capacity reserve on intersystem communications that does not allow to release electricity to the neighbor regions in bigger volume.

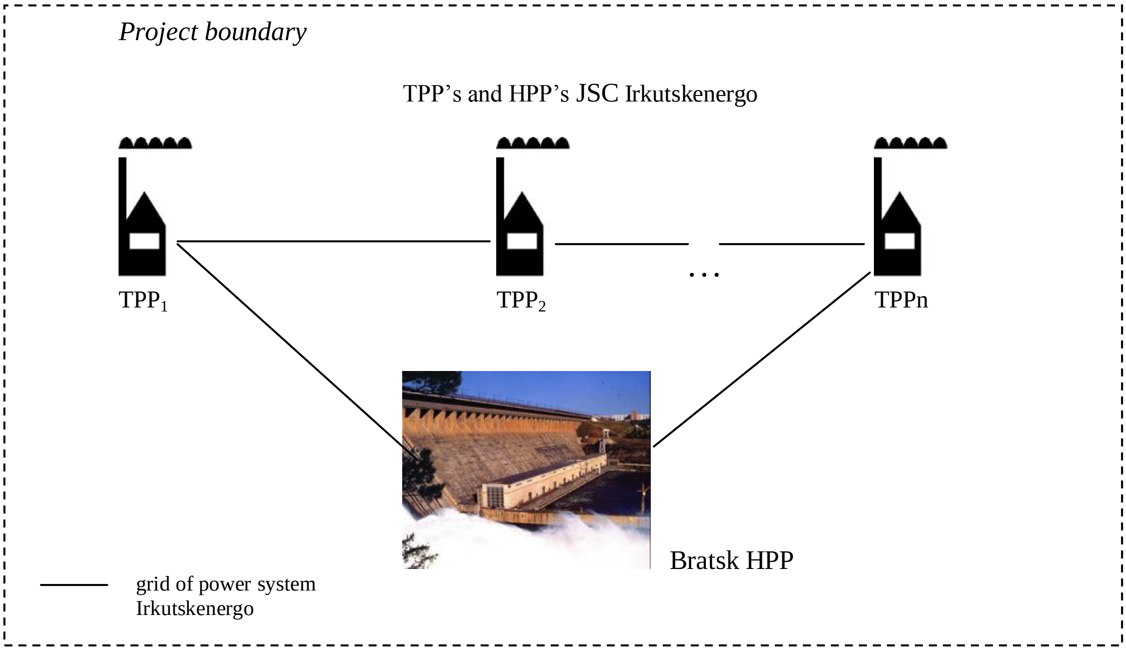
Further, the mathematical model automatically, according to the principle of electricity generating total cost minimization, carries out loading redistribution between thermal stations of the Irkutsk power system, reducing their loading in condensation mode by a rating of price proposals, in case of additional electricity generation at realization of the project «Increase in efficiency of water resources use at Bratsk HPP».

Table B.3.1. GHG sources included /excluded from the project boundary.

	Source	Greenhouse gas (GHG)	Included of not?	Substantiation/explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired TPPs, that are displaced due to the project activity	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source, the emissions are very insignificant. According to the IPCC Guidelines for National Greenhouse Gas Inventories, 2006, Volume 2, Chapter 2, Table 2.2 Default emission factors for stationary combustion in the energy industries for CH_4 is very insignificant (according to the calculation)
		N_2O	No	Minor emission source, the emissions are very insignificant According to the IPCC Guidelines for National Greenhouse Gas Inventories, 2006, Volume 2, Chapter 2, Table 2.2 Default emission factors for stationary combustion in the energy industries for N_2O is very insignificant (according to the calculation)
Project activity	For HPPs CH_4 emissions from the reservoir	CO_2	No	The project is carried out without the reservoir extension
		CH_4	No	
		N_2O	No	

The project boundary is shown in Figure B.3-1

Figure. B.3.1. Project boundary



The key information and data for setting the baseline scenario (variables, parameters, data, sources etc.) are presented in Annex 2.

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 set-up: 09/09/2009.

The baseline has been designed by :

- JSC “Irkutskenergo”
  Contacts : Tel. +7 (3952) 790-682,
  Fax +7 (3952) 790-211
  JSC “Irkutskenergo” is a project participant.

- En+ Magnesium Ltd. (Cyprus)

  Contacts : Tel. +7 (495) 642-79-37,ext. 4828
  Fax +7 (495) 642-79-38
  En+ Magnesium Ltd. (Cyprus) is not a project participant.

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

The project started on 6 of October 2006 when the first wheel was delivered at BHPP and manufacturing works at turbine No. 16. were started.

C.2. Expected operational period of the project:

The operational period of the Project will amount to 40 years or 480 months (in correspondence with the former State standards GOST 27807-88 «Hydraulic vertical turbines. Technical demands and acceptance» and the data of the manufacturer «LMW»- «ЛМЗ»)

C.3. Length of the crediting period:

First phase: 5 years or 60 months : From 01.01.2008 to 31.12.2012 (the first commitment period of the Kyoto Protocol)
Second phase: after 2012 (this PDD is to be updated and the new version determined).

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

According to "Guidelines for users of the JI PDD form" version 04, the approved CDM methodology and specific approach regarding monitoring can be chosen. Monitoring of greenhouse gases emission based on the specific own approach. It is developed in according with JISC "Guidance on criteria for baseline setting and monitoring" version 02 (Section D. Guidance on monitoring)

The project activity represents BHPP efficiency increase by partly retrofit of existing power units which are the renewable source connected to the grid. In this case the BL scenario is the following:

In the absence of the project activity, the BHPP would continue to provide electricity to the grid ($EG_{baseline}$, expressed in MWh/year) at turbines with old wheels with coefficient of efficiency at existent level, until the time at which the generation facility would likely be replaced or retrofitted ($DATE_{baselineRetrofit}$). From this point of time onwards, the baseline scenario is assumed to correspond to the project activity $EG_{baseline} = EG_y$, and no emission reductions are assumed to occur.

GHG emissions will be determined with the use of such parameters like the each turbine's electricity generation and efficiency coefficient as well as the emission factor of Irkutsk regional grid.

For monitoring purpose, the measurements will carry out for BHPP turbines electricity generation, operating hours and head of water. The others parameters will be define by calculation.

To be exact:

- The efficiency coefficient is calculates by JSC "Irkutskenergo" experts on the base of operating hours of BHPP turbines and head of water in accordance with digitized equations released from nomograms, based on empirical tests, taking into account wear factor;
- Regional power supply system emission factor calculates based on specific fuel consumption by condensation cycle.

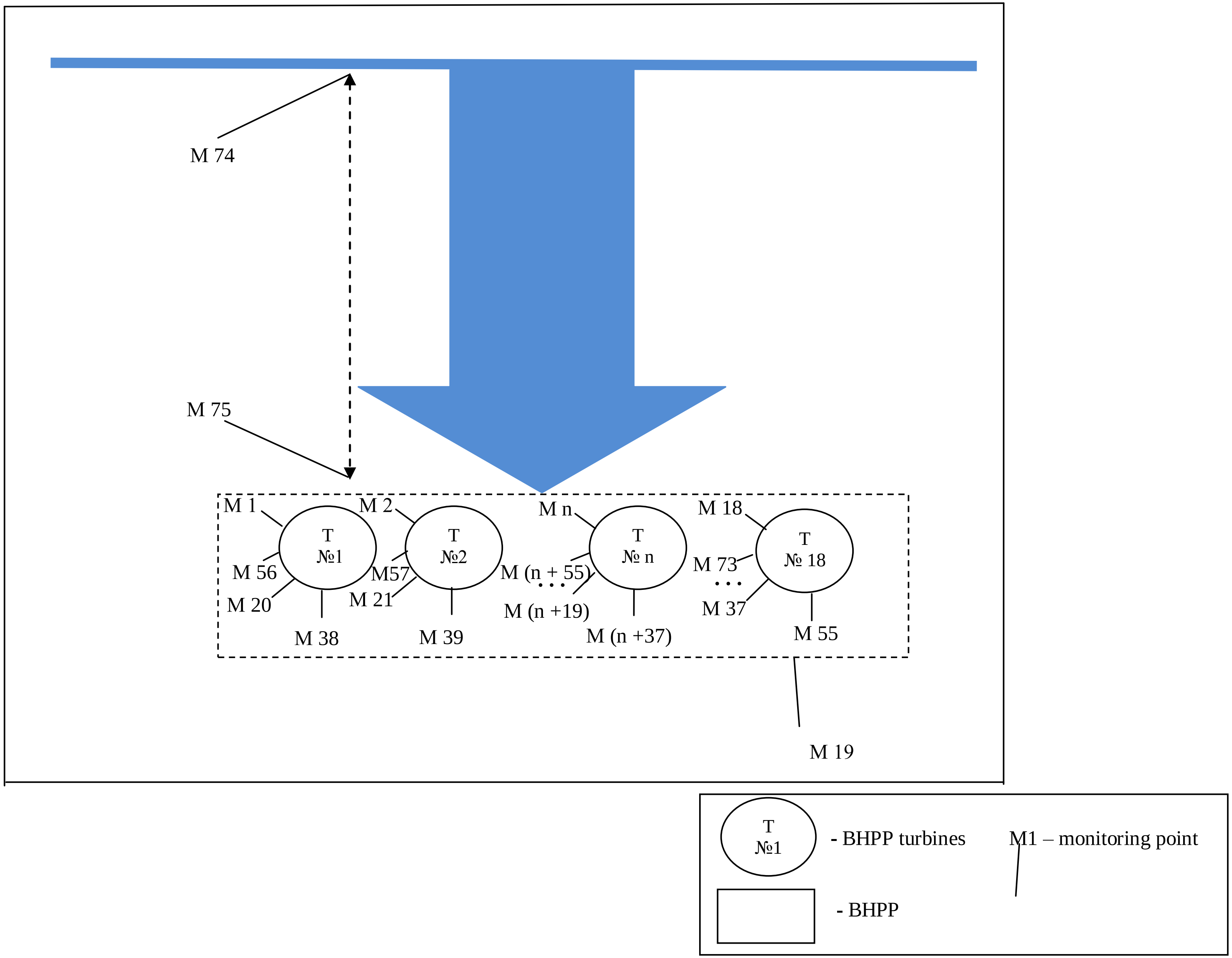
Detailed description and calculation presented in Annex 2

The parameters pointed below **are not subject to** monitoring:

- GWP_{CH4} (tCO_2/tCH_4) - global warming potential of methane; it is equal to 21 according to IPCC data;
- $DATE_{baselineRetrofit}$ – point in time when the existing equipment would need to be replaced in the absence of the project activity; it is after 2012 - according to the substantiations presented in Annex 2;
- EF_{grid}- Emission factor JSC "Irkutskenergo". Calculation based on production and fuel indicators of JSC "Irkutskenergo", determined once for the credit period.

The parameters pointed in Tables below **are subject to** monitoring for the project. All data collected as part of monitoring will be kept at least for 2 years after the end of the crediting period (2014). 100% of the data will be monitored if not indicated otherwise in the tables below. All measurements will be conducted with calibrated measurement equipment according to standards in the power industry.

Activities of JSC "Irkutskenergo" in the field of measurements and monitoring correspond to the requirements of Federal Law No. 4871-1 of 27th April 1993 «On securing the unification of measuring system» and some other national regulation and the regional metrology inspection rules. There are the corresponding plans, documents, schedules of calibration of instruments, etc at BHPP. The measuring devices have the special certificate for implementation, permits for use and are periodically calibrated.
The measurements of the main project parameters come within the metrology system, which is currently active in the country.
The monitoring points scheme presented below:


M 74
M 75
M 1
M 2
M n
M 18
T №1
T №2
T № n
T № 18
M 56
M57
M (n + 55)
M 73
M 20
M 21
M (n +19)
M 37
M 38
M 39
M (n +37)
M 55
M 19
T №1
- BHPP turbines
M1 – monitoring point
- BHPP

Option 2 was chosen from the two suggested for carrying out the monitoring plan.

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

This option is not applicable.

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 ©, estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comments

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

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)	Comments

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

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

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

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comments
M 1 – M 18 EG_i	Electricity production by turbine No.1 - 18	Reports of BHPP and/or JSC «Irkutskenergo»	MWh	(m)	Continuously	100%	Electronic & paper	Is determined in direct instrumental measurement by electricity supply meter,type A1R-4-AL-C8-T+
M 19 EG_{BHPP}	Electricity production by BHPP	Reports of BHPP and/or JSC «Irkutskenergo»	MWh	(c)	Continuously	100%	Electronic & paper	Is determined by summation of EG_{1-18}
M 20 – M 37 t_i	Operating hours for turbine № 1-18	Reports of BHPP and/or JSC «Irkutskenergo»	h/year	(c)	Daily	100%	Electronic & paper	Obtained from daily reports of turbine operator
M 38 – M 55 T_i	The number of years from the last repair for turbine № 1-18	Reports of BHPP and/or JSC «Irkutskenergo»	years	(e)	Daily	100%	Electronic & paper	Obtained from daily reports of turbine operator

M 56 – M 73 η_i	Efficiency coefficient of turbine 1-18	Annex 8 Microsoft Office Excel 97-2003 Worksl	%	(c)	Annually	100%	Electronic & paper	The calculation are carried out according to the adopted methodology - nomograms supplied by the turbine's manufacturer - JSC «Leningradsky Engineering Metal Works». Detailed calculation description is presented in "Guidelines for water flow calculation" confirmed by JSC "Irkutskenrgo" and BHPP*

M74 H_u	Upper pool	Reports of BHPP and/or JSC «Irkutskenergo»	m	(m)	Continuously	100%	Electronic & paper	Is determined in direct instrumental measurement by automated upper and lower pool measurement system of Bratsk HPP JSC “Irkutskenergo”.
M75 H_l	Lower pool	Reports of BHPP and/or JSC «Irkutskenergo»	m	(m)	Continuously	100%	Electronic & paper	Is determined in direct instrumental measurement by automated upper and lower pool measurement system of Bratsk HPP JSC “Irkutskenergo”.

*Can be given by request

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):

The formulas, that reflect own approach for emission reduction calculation are presented in section B1.

The following formula for emission reductions **ER_y** is used:

$ER_y = BE_y – PE_y - LE_y$ **(formula D.1-1)**

where:
ER – emission reduction in year y

BE_y is the baseline emissions in year ***y***;
PE_y are the emissions on project in year ***y*** (PEy should be assumed as equal to zero).
LE_y are the leakages. As it is shown in Section D and E they constitute 640 tCO_2 in 2008, 640 tCO_2 in 2009 and 320 tCO_2 in 2010. In comparison with the design emission reductions, the leakage constitutes much less than 1% and it can be neglected.

Thus, the above presented formula is transformed for the monitoring purposes in:

$$ER_y = BE_y \qquad \textbf{(formula D.1-2)}$$

$$BE_y = \Delta EG_y \times EF_{grid} \qquad \textbf{(formula D.1-3)}$$

ΔEG_y – extra electricity generation (MWh) at BHPP due to increase in efficiency of 6 turbines after retrofit in comparison with BHPP efficiency that would be in the baseline scenario in year y
$EF_{grid,}$ is the emission factor for Irkutskenergo system (tCO_2/MWh). (calculation is presented in Annex 3)

$$\Delta EG_y = EG_{BHPP} \times \Delta\eta, \qquad \textbf{(formula D.1-4)}$$

EG_{BHPP} – electicity generation at BHPP (MWh/year)
$\Delta\eta$ – the difference between baseline's and project's weighted average BHPP efficiency coefficients in year y

$$H_y = f(H, N_i, k_w k_{w\ overhaul}) \qquad \textbf{(formula D.1-5)}$$

H_y – water head (m)
Ni – electric load (on generator clamp) (MW)
k_w – turbine wear factor till the last actual testing (%)
$k_{w\ overhaul}$ - turbine wear factor in overhaul period (%)

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

As it is shown below in Section D.1.3.2, the leakage is equal: 678 tCO_2 – in 2008, 339 tCO_2 in 2009 and 678 tCO_2 – in 2010. The leakage constitutes much less than 1% in comparison with the calculated emission reductions. The leakage during monitoring can be neglected.

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)	Comments

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

The delivery of new wheels (wheels) from St. Petersburg to Irkutsk is carried out by the airplane AN-124; the distance is about 7000 km. The aviation fuel rate for AN-124 is equal 12.6 t/hour, while the cruising speed of AN-124 is 800 km/hour. The IPCC emission factor for aviation fuel is equal to 70-71.5 tCO_2/TJ. The combustion value of aviation fuel is equal to 43 MJ/kg.
The amount of emitted CO_2 caused by transportation of one wheel will be:

$L_{1wheel} = 7000/800 \text{ x } 12.6 \text{ x } 43 \cdot 10^3 \text{ x } 71.5 \cdot 10^{-6} = 339 \ tCO_2$.

The emissions of CH_4 and N_2O are extremely low in comparison with CO_2 in accordance with the IPCC fuel emission factors.
The wheels are delivered by the following schedule: 2007 – 1; 2008 – 2; 2009 – 1 and 2010 – 2. The total leakage in 2008-2012 will constitute 1695 tCO_2 that is much less than 1% of the total emission reductions for the same period.
Conclusion: the monitoring can be carried out without the leakage taken into account.

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

The emission reductions are equal to the emissions in the baseline scenario, and the same formula should be used as in the Section D.1.2.
The needs of new measurements or new data in addition to those presented in Section D.1.2, are absent.
The only greenhouse gas taken into account is CO_2.

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 monitoring of environmental impact is carried out by the counting method based on the coal saving at TPPs of Irkutskenergo due to the additional electric energy generated at BHPP. The reduction of environmental impact is expressed in the reduction of pollutants emission into atmosphere as well as the reduction of ash-and-slag formation.
The numerical evaluation of pollutants emission reduction is carried out in Section E. It is based on the use of the data of specific fuel consumption by condensation cycle from the internal program complex of JSC "Irkutskenergo" 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 BHPP was generalized in Table F.2 of Section F. This Table was suggested for monitoring the environmental impact reductions due to the project activity. The information on achieved environmental impact reduction is included in Monitoring plan (Annex 3).
According to the Rosstat resolution № 157 from 30.04.2004 "About confirmation of statistical instrumentation for statistical monitoring of production wastes by Russian Technical Supervisory Authority" and Rosstat order № 166 from 10.08.2009 "About confirmation of statistical instrumentation for statistical monitoring of agriculture and environment"
BHPP quarterly provides to the Department of environmental security and rational use of nature recourses and then to the profile supervisory subdivision the following reports:
2-tp (air) – garages, welders etc.
2-tp (waste) – household waste, construction waste, oil etc.
And other reports for small rectangular components, according to the auxiliary processes.
There are no any reports for environmental parameters of the general activity provided.

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 the data, or why such procedures are not necessary.
Project activity		
		Not required
In the baseline scenario		
Table D1.2.1., from M 1 to M 18 - electricity generation by turbines No. 1-18 and by BHPP as a whole, (EG_{BHPP})	Low	The high precision, standard, electricity supply meters are used. The meters are certified each 8 years. The more detailed information about meters is presented in Annex 4. Measurement results go into central server - Automatic system for commercial accounting of electricity. The system has certificate of technical conformity to "Contract about trade system connection" technical requirements and quality certificate.
Table D1.1.3., M 19 Electricity generation by BHPP (EG_{BHPP})	Low	The calculations are carried out by summation of electricity generating by each turbine and the result goes into central server - Automatic system for commercial accounting of electricity.
Table D1.2.1. M 20 and M 37 – Operating hours for turbine № 1-18 (t_i)	Low	Turbine operator fixes start and end of the turbine work. He put this information in daily report and give it to Bratsk HPP Production and Technical Department.
Table D1.2.1. M 38 – M 55 The number of years from the last repair for turbine № 1-18(T_i)	Low	Turbine operator fixes start and end of the turbine work. He put this information in daily report and give it to Bratsk HPP Production and Technical Department.
Table D1.2.1. M 56 – M 73	Low	The calculation are carried out according to the adopted methodology - nomograms supplied by the turbine's manufacturer - JSC «Leningradsky Engineering Metal Works». Detailed calculation

Efficiency coefficient of turbine 1-18 (η_i)		description is presented in "Guidelines for water flow calculation" confirmed by JSC "Irkutskenrgo" and BHPP*
Table D1.2.1. M 74 – Upper pool (m)	Low	Is determined in direct instrumental measurement by ultrasonic level meter , which is a part of the automated upper and lower pool measurement system of Bratsk HPP JSC "Irkutskenergo.
Table D1.2.1. M 75 – Lower pool (m)	Low	Is determined in direct instrumental measurement by ultrasonic level meter , which is a part of the automated upper and lower pool measurement system of Bratsk HPP JSC "Irkutskenergo.

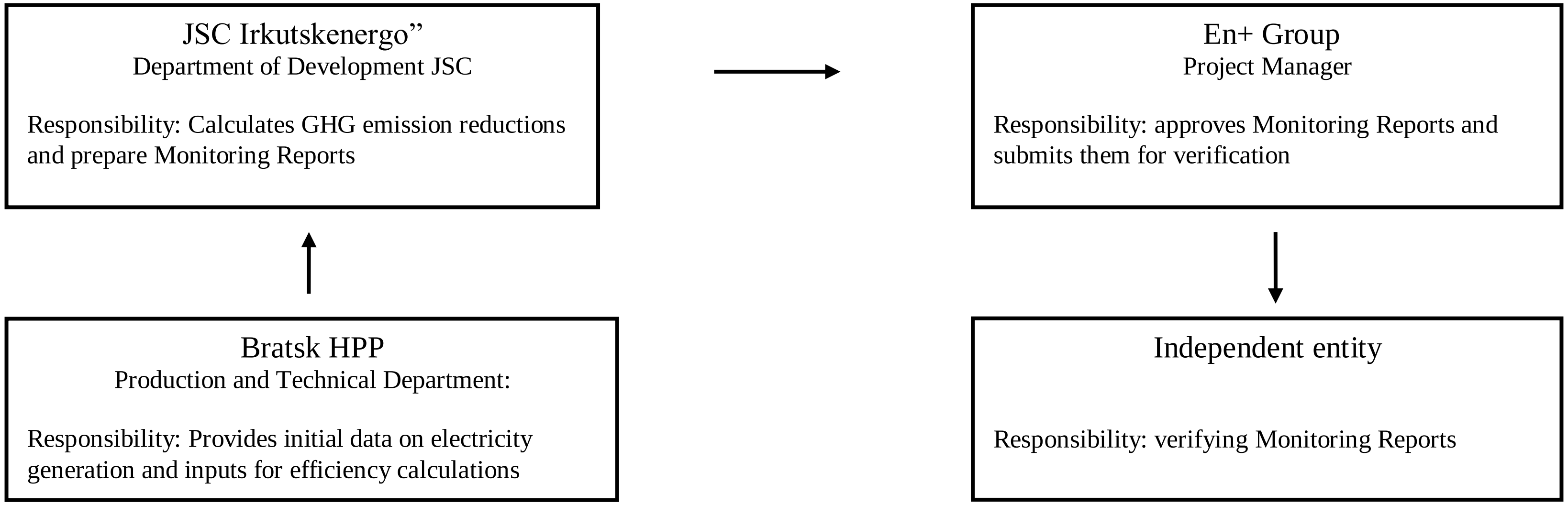
*Can be given by request

Quality Control and Quality Assurance procedures on the above specified parameters are guaranteed by compliance with the following legal documents requirements:

- The Russian Federation Law dated 27.04.1993 No.4871-1 "On ensuring the uniformity of measurements";
- State Register SI ("Measurement Systems");
- Regulation (PR) 50.2.006-94.

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

Scheme D.3. Operational structure of project monitoring



The information on electricity generation at BHPP is submitted by Production and technical department of BHPP . The primary metering of electricity generation is conducted permanently (through self-recording devices) at the BHPP. The information on efficiency coefficient will be collected for each turbine and submitted by the Production and technical department of BHPP.
No extra training and maintenance efforts in order to put into operation and maintain of new wheels are not needed. These skills are provided and controlled by current system of training.

The above specified information will be submitted, in the established by JSC “Irkutskenergo” time, to the Department of Development of JSC «Irkutskenergo» to calculate the actual GHG emissions reductions in accordance with Section D formulas, and to prepare annual monitoring reports. JSC «Irkutskenergo» as the project operator will be responsible for all procedures of measurements, test and analysis required for obtaining the necessary data for monitoring plan execution.

The collection, transfer and archiving of data, as well as calculation of GHG emission reductions procedures are incorporated into the existing reporting system JSC “Irkutskenergo” and its affiliate organizations.

The Monitoring Report will be transferred to EN+ office for the final approval and further be submitted for verification.

The person responsible for application and management of the Monitoring Plan will be:

Chief of the Department of Development of JSC «Irkutskenergo»
Tel. +7 (3952) 790-682
E-mail: shumeev@irkutskenergo.ru

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

The monitoring plan has been designed by JSC “Irkutskenergo”

- JSC “Irkutskenergo”
  Contacts : Tel. +7 (3952) 790-682,
  Fax +7 (3952) 790-211
  JSC “Irkutskenergo” is a project participant.

- En+ Magnesium Ltd. (Cyprus)

  Contacts : Tel. +7 (495) 642-79-37,ext. 4828
  Fax +7 (495) 642-79-38
  En+ Magnesium Ltd. (Cyprus) is not a project participant.

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

The emissions on project were assumed as 0

Table E.1.1

	2008	2009	2010	2011	2012
tCO_2	0	0	0	0	0

E.2. Estimated leakage:

For the project activity takes into account the following leakages appearing due to:

- energy consumption for delivery and substitution of turbine wheels;
- changes of coal handling (extraction, processing and transport) for TPPs of JSC «Irkutskenergo»;
- land inundation for projects with HPPs.

Possible leakage sources, which were included in project or excluded from it, are shown in Table E2-1.

Таблица E.2.1. Possible leakage sources and decisions taken

Source	Gas	Adopted/ excluded	Substantiation / explanation
1. Energy consumption for delivery and substitution of turbine wheels	CO_2	Adopted	Transportation of new wheels is carried out by aircraft AN-124 at the distance of about 7000 km. The GHG emissions occurs due to it; the estimate of emissions amount is made in Section D.1.3. The emissions of CH_4 and N_2O are negligible in comparison with CO_2 in accordance with IPCC emission factors. Power consumption for substitution of wheels are negligible by the estimate of JSC «Irkutskenergo» specialists.
	CH_4	Excluded	
	N_2O	Excluded	
2. Land inundation	CH_4	Excluded	The realization of the project will not result in the additional inundation. The water stream conditions are not changed.
3. Changes of coal handling (extraction, processing and transport)	CO_2 CH_4 N_2O	Excluded	The TPPs of JSC «Irkutskenergo» use local coals, and the energy inputs for additional production and transportation of coal to TPPs are insignificant. The exclusion of leakages of such type corresponds to the conservative approach, because these leakages are negative

As it was shown in Section A.2., taking into account the schedule of new wheels delivery (by 2 - in 2008 and 2009 and 1 - in 2010) the leakage constitutes:

Table E.2.2

	2008	2009	2010	2011	2012
tCO_2	678	339	678	0	0

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

Table E.3.1

	2008	2009	2010	2011	2012
tCO_2	678	339	678	0	0

E.4. Estimated baseline emissions:

The BL emissions are determined in accordance with formulas presented in Section D.1.2.2.

The value per year for BHPP with 6 retrofit turbines is:

Table E.4.1

Line №	Index / year	2008	2009	2010	2011	2012
1	$\eta_{baseline}$ (%)	85.92%				
2	η_y (%)	87.18%	87.89%	88.82%	89.31%	90.06%
3	EG_{BHPP} (MWh)	20 462 425	22 337 349	22 715 105	22 840 448	23 044 510
4	EG_y (MWh)	295 669	501 447	741 351	865 625	1 058 132
5	EF_{grid} (t CO_2/MWh)	1.159				
6	BE (t CO_2)	342 593	581 028	859 006	1 003 002	1 226 061
7	Total BE (2008-2012)	4 009 995				

BE_y = (3) x ((2)/(1)) – 1) x (5)

Detailed calculation presented in original excel table.

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

The emission reductions is determined as the difference of data presented in Tables E.4-1 (line (6)) and E.3-1

Table E.5.1

	2008	2009	2010	2011	2012
tCO_2	341 915	580 689	858 328	1 003 002	1 226 061
Total (2008-2012)	4 009 995				

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

Table E.6.1

Year	Estimated project emissions (tones of CO_2 equivalent)	Estimated leakage (tones of CO_2 equivalent)	Estimated baseline emissions (tones of CO_2 equivalent)	Estimated emission reductions (tones of CO_2 equivalent)
2008	0	678	342 593	341 915
2009	0	339	581 028	580 689
2010	0	678	859 006	858 328
2011	0	0	1 003 002	1 003 002
2012	0	0	1 226 061	1 226 061
Total (tones of CO_2 equivalent)	0	1695	4 011 690	4 009 995

Excel table is attached in the separate file, Annex 8

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:

On the field of the environment protection BHPP is guided by following regulatory acts:

- Federal low № 7-FL from 10.01.2002 " On Protection of Environment"
- Federal low № 96-FL from 04.05.1999" On Protection of Atmospheric air"
- Federal low № 52-FL from 30.03.1999 "On Sanitary and Epidemiologic Weil-Being of the Population"
- Water Code RF № 74-FL from 03.06.2006
- Federal low № 174-FL from 23.11.1995 "On Ecological Examinations"
- Federal low № 116-FL from 21.07.1997 "On industrial safety"
- Federal low № 117-FL from 21.07.1997 "On Safety of Hydrotechnical Constructions"
- Federal low № 89-FL from 24.06.1998 "On Production and Consumption Wastes"
- Land Code RF № 136 from 25.10.2001

The Project activity doesn't conflict with all these regulatory acts. Russian law doesn't demand to assess environmental impacts of this project, because this project is not connected with the volume and surface area of the BHPP's reservoir and doesn't influence on the water condition and its composition.

There is no any environmental reported at BHPP general activity (electricity production) provided.

At the same time the prevention of additional electricity generated by coal-fired power plants will result in the improvement of environment in Irkutsk region.

The emissions into atmosphere and the formation of ash-and-slag waste caused by heat and electricity production by TPPs according to the data of Irkutskenergo from the forms of State statistical accountancy No. 2-tp "air" and No. 2-tp "waste" constituted in 2007:

Total emissions into atmosphere = 220 985 t,
including particulates = 55 423 t,
Sulfur oxides = 123 717 t,
Nitrogen oxides = 41 267 t,
Output of ash-and-slag waste = 1 391 367 t.

Evaluation of emission reductions

In 2007 the electricity production by TPPs constituted 10 840 000 MWh.

The total fuel consumption in Irkutskenergo was 6,263 million t c.e., while 2.97 million t c.e. or 47.4 % was used for electricity production. The environmental emissions connected only with electricity production constituted 47.4% of the above presented values (the emissions into atmosphere are assumed proportional to the fuel rate) or:

total emissions into atmosphere = 104 746 t,
output of ash-and-slag waste = 659 508 t.

The calculated additional electricity generated by new BHPP turbines No. 13-18 (or the reduction of its production at TPPs) constitutes due to the project 692 445 MWh or 6.38% of the value 10 840 000 MWh generated by TPPs. The emission reductions takes place by the same percentage, namely:

into atmosphere in all: by 6 682 t; or about 0.01 kg per 1 kWh of the saved power;
output of ash-and-slag wastes: by 42 076 t or 0.06 kg per 1 kWh of the saved power.

Monitoring of environmental impacts' reductions caused by traditional pollutants can be carried out using the obtained specific emissions per 1 kWh. The monitoring plan for traditional pollutants is presented in Annex 3.

The trans-boundary impacts, if they exists indeed, will be reduced because of the reduction of pollutants' emissions into atmosphere.

General conclusion: The calculated reduction of emissions into atmosphere due to the project activity is estimated as 5530 ton per year and the reduction of ash-and-slag waste output more than 34 822 ton per year. The project activity will lead only to reduction of environmental impacts in Irkutsk region.

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:

The evaluation of negative environmental impacts is not needed, because the project implementation results only in the reduction of such impacts in Irkutsk region.

SECTION G. Stakeholders' comments

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

The project was developed and is realized openly and avowedly. The information on it was regularly given in mass media and at the informational portal of Irkutskenergo: www.irkutskenergo.ru. Since 2005 there are more than 10 publications in mass media and references on the site including the data on project on the whole, the delivery of wheels from St Petersburg to BHPP, their assembly and tests. The examples of four last publications are presented in Annex 4. During all this time there were not a single negative reference on the project. There is a letter of mayor of Bratsk city Mr. S.V. Serebrennikov of 29.04.2008 No. 01-914, where he expressed the support of the project including joint implementation (this letter is also presented in Annex 4).
A list of stakeholders, who could have commented on the project, and information how the comments were acquired, are given in Table G.1-1.

Table G.1.1. Stakeholders comments' information

Stakeholder	Type of comments	How the comments have been addressed
Administration of city Bratsk	Positive reference	A letter to the Mayor Mr. Serebrennikov S.V. from BHPP
All interested parties and persons	There were no references	Multiple publications of information on the project in mass media
All interested parties and persons	There were no references	Regular placement of information on the project at the site of Irkutskenergo at the page intended for communication with public

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organisation:	JSC "Irkutskenergo"
Street/P.O.Box:	Sukhe-Bator
Building:	3
City:	Irkutsk
State/Region:	
Postal code:	664025
Country:	Russian Federation
Phone:	+7 (495) 642 7937
Fax:	+7 (495) 642 7938
E-mail:	
URL:	http://www.irkutskenergo.ru
Represented by:	
Title:	Project Director
Salutation:	
Last name:	Sakharov
Middle name:	Alexandrovich
First name:	Nikolay
Department:	-
Phone (direct):	+7 (495) 642 7938 ext.4828
Fax (direct):	+7 (495) 642 7938
Mobile:	
Personal e-mail:	NikolayAS@enplus.ru

Annex 2

BASELINE INFORMATION

The table with the key data and the variables used for the baseline definition is presented below:

Data/Parameter 1	EG_y – Electricity production by turbines № 1-18 in period 2002-2007
Data unit	MWh
Description	Electricity production by turbines №1-18 in period 2002-2007
Time of determination /monitoring	Constant
Source of data	Annual reports of BHPP and/or JSC «Irkutskenergo».
Value of data applied (for ex ante calculations/determinations)	This information you can find in Annex 8 Microsoft Office Excel 97-2003 Worksl
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Determined in direct instrumental measurement by high-precision watthourmeters.
QA/QC procedures (to be) Applied	The high precision, standard, electricity supply meters, type A1R-4-AL-C8-T+ are used. Checking is carried out by LLC "Elster Metronika" every 8 years. All measurements will be conducted with calibrated measurement equipment according to standards in the power industry.
Any comment	

Data/Parameter 2	EG_{BHPP} - Electricity production by BHPP in period 2002-2007
Data unit	MWh
Description	Electricity production by BHPP
Time of determination /monitoring	Constant
Source of data	Annual reports of BHPP and/or JSC «Irkutskenergo».
Value of data applied (for ex ante calculations/determinations)	This information you can find in Annex 8 Microsoft Office Excel 97-2003 Worksl
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The calculations are carried out by summation of electricity generating by each turbine (EG_{1-18})

QA/QC procedures (to be) applied	The result takes from central certified server - Automatic system for commercial accounting of electricity.
Any comment	

Data/Parameter 3	$\eta_{baseline}$- Efficiency coefficient of BHPP turbines in period 2002-2007
Data unit	%
Description	Efficiency coefficient of BHPP turbines in period 2002-2007
Time of determination /monitoring	Determined once in 2009
Source of data	Calculated by JSC "Irkutskenergo" experts
Value of data applied (for ex ante calculations/determinations)	Microsoft Office Excel 97-2003 Worksl This information you can find in Annex 8
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The calculation are carried out according to the adopted methodology - nomograms supplied by the turbine's manufacturer - JSC «Leningradsky Engineering Metal Works». Detailed calculation description is presented in "Guidelines for water flow calculation" confirmed by JSC "Irkutskenrgo" and BHPP*
QA/QC procedures (to be) applied	All measurements will be conducted with calibrated measurement equipment according to standards in the power industry
Any comment	

*Can be given by request

Data/Parameter 4	EF_{grid} – Emission factor for condensation mode of Irkutskenergo power system
Data unit	tCO_2/MWh
Description	Emission factor for condensation mode of Irkutskenergo power system
Time of determination /monitoring	Determined once in 2009 for the credit period
Source of data	JSC "Irkutskenergo" software: "Program complex of automated collection, processing and fuel use analysis system of CHP-plants and Power and electrification production association"
Value of data applied (for ex ante calculations/determinations)	1.159
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Calculated according to the Regulating document 34.08-559-96 "Methodical guidance for analysis of specific fuel consumption changes at electric power stations and power associations".

QA/QC procedures (to be) applied	The result confirms by ORGRES (JSC "Engineering Center UES")
Any comment	

Data/Parameter 5	DATEbaselineRetrofit, Point in time when the existing equipment would need to be replaced in the absence of the project activity
Data unit	Date (year)
Description	Point in time when the existing equipment would need to be replaced in the absence of the project activity
Time of determination /monitoring	Determined once in for the credit period
Source of data	Special research "Evaluation of the lifetime reserve of the turbine wheels No. 6 and 17 of BHPP" was undertaken by an independent research center CKTI.
Value of data applied (for ex ante calculations/determinations)	2013 year
Justification of the choice of data or description of measurement methods and procedures (to be) applied	In 2003 special research "Evaluation of the lifetime reserve of the turbine wheels No. 6 and 17 of BHPP" was undertaken by an independent research center CKTI. The outcome: both wheels can serve at least till 2013. An indirect evidence that the lifetime will exceed 2013 is the absence of plans to replace turbine wheels No.1-12 in the coming 5 years.
QA/QC procedures (to be) applied	Special research "Evaluation of the lifetime reserve of the turbine wheels No. 6 and 17 of BHPP" was undertaken by an independent research center CKTI.
Any comment	

In accordance with developers own approach a determination of the following parameters is required for the calculation of emission reduction values:

(1) Additional amount of electricity supplied in the grid of Irkutrskenergo by the BHPP (EG_{BHPP} x $\Delta\eta$), MWh;

(2) Emission factor of Irkutskenergo (EF_{grid}), tCO_2/MWh;

(3) 5-years averaged weight data on efficiency coefficient of BHPP turbines before the project activity ($\eta_{baseline}$),%;

(4) Averaged weight data on efficiency coefficient of BHPP turbines after the project activity (η_y),%;

(5) The date, when the existing equipment should be substituted in the absence of the project implementation ($DATE_{baselineRetrofit}$).

(1) Additional amount of electricity generation (EG_{BHPP} x $\Delta\eta$)

(EG_{BHPP} x $\Delta\eta$) is calculated for the purpose of calculating evaluation of BL emissions in the following way. The tests of efficiency for old and retrofitted turbines were carried out in 2001-2007. They showed that the annual average efficiency of units No. 13 and 15 is equal to 88.1%, while for retrofitted No. 16 and 17 it is equal to 95.2%. The manufacturer (LMW) claimed that the efficiency of new wheels would be 95.2%. So, efficiency coefficient of hydraulic unit forms from efficiency coefficient of wheel and loses between generator and wheel and amount 92.9% (under capacity 232 MW).

EG_{BHPP} x $\Delta\eta$ = EG_{BHPP} x (1-($\eta_{baseline}$ /η_y)) = 22 715 105x (1-(85.92%/88.82%) = 741 351MWh (in 2010)

(2) Calculation of emission factor for Irkutskenergo

The calculation was carried out according to the following steps:

Step 1. Determine the corresponding power system:

The appropriate power system was determined as Irkutskenergo: the system is energy-redundant; there are connected power systems with which exchange of electricity takes place but Irkutskenergo's export stably and significantly exceeds imports. The price of Irkutskenergo electricity is one of the most cheap in Russian Federation (http://www.irkutskenergo.ru/news/712.html).

Step 2. Description of the EFgrid calculation methodology.

EF_{grid} – emission factor for condensation mode of Irkutskenergo power system (tCO_2/MWh).
The Emission factor is calculated as the generation-weighted average CO2 emissions per unit net electricity generation (tCO2/MWh) of all generating power plants of JSC "Irkutskenergo" serving the system in condensation mode.
For EF calculating "plant by plant" data on fuel consumption at condensation mode and its low heat calorific value, net electricity generation, etc. for the last 3 years is used.
$EF_{grid,}$ calculates using the formula:

$$EF_{grid,} = \frac{\sum_{im} FC_{i,m,y} \text{ x } NCV_{i,y} \text{ x } EF_{CO2,i,y}}{\sum_{m} EG_{m,y}} \qquad \text{(formula An. 2-1)}$$

where:

FC – fuel consumption for condensation cycle, (g.c.e)
NCV – net calorific value (kCal/kg.c.e)
EF_{CO2} – fuel emission factor (kg CO_2/TJ)
EG – net electricity generation in condensation cycle (kWh)
y – year
i – fuel (type)
m – refers to all electric power stations of the power system.

Step 3. Calculate EF

Such indicator as the fuel rate per 1 kWh of electricity output by condensation cycle.
1 kg of fuel equivalent has NCV_b = 7000 kCal/kg or 29.33 MJ/kg. It is expressed for TPP using the above presented designations as:

$$b = \frac{FC \text{ x } NCV}{EG \text{ x } NCV_b} \quad \text{(g c.e./kWh)} \qquad \text{(formula An. 2-2)}$$

This indicator for each TPP of JSC "Irkutskenergo" is included in the internal registers form of JSC "Irkutskenergo. Its use will simplify substantially the calculations not affecting accuracy of calculations. For the purpose of calculation used average value for the JSC "Irkutskenergo".
It constitutes according to the Company's reports :

2006= 403.8 g c.e./kWh
2007 = 399.9 g c.e./kWh
2008 =392.4 g c.e./kWh

In this case the above presented formula is transformed into:

$EF_{grid} = b_{cp,y} \times EF_{CO2,cp,y} *29,33 MJ/kg.c.e*10^{-9}$ (formula An. 2-3)

where $EF_{CO2,cp,y}$ – weighted (for the different types of fuel) emission factor. It is calculated as:

$EF_{CO2,cp,y} = d_{coal,y} \times EF_{CO2,coal} + d_{gas,y} \times EF_{CO2,gas} + d_{mazut,y} \times EF_{CO2,mazut}$, (formula An. 2-4)

where d_y is a share of coal, gas and residual fuel oil (mazut) at TPPs of Irkutskenergo per year ***y***.

2006: coal = more than 99%, residual oil (mazut) = less than 1%, gas = 0%
2007: coal = more than 99%, residual oil (mazut) = less than 1%, gas = 0%
2008: coal = more than 99%, residual oil (mazut) = less than 1%, gas = 0%

EF_{CO2} – IPCC default emission factor expressed in appropriate units for the present calculation:

- brown coal (lignite) = 2.962 tCO_2/t c.e. (101 tCO_2/TJ) – 80% of consumption (statistic form 6-tp)
- bituminous coal = 2.775 tCO_2/t c.e. (94.6 tCO_2/TJ) - 20% of consumption (statistic form 6-tp)
- residual oil = 2.27 tCO_2/t c.e. (77.4 tCO_2/TJ)

Taking into account the above presented fuel balance average weighted $EF_{CO2,cp}$ = 2,925 tCO_2/t c.e..

Table for calculation of EF

Indicator	2006	2007	2008
(1) $EF_{CO2,cp,y}$, (tCO_2/tce)	2.925	2.925	2.925
(2) b, (tce/MWh)	0.403	0.399	0.392
(3) EF_{grid} (tCO_2/MWh) [calculated as: (1)x(2)]	1,181	1,170	1,148
(4) Electricity output (by condensation cycle), 10^3 MWh	2177	3179	7561
(5) 3 years average electricity weighted EF_{OM} (tCO_2/MWh) [calculated as: ∑ [(4)*(5)]/∑(4)]		**1. 159**	

Original excel table is attached in Annex 8

In the nearest future there will be no any new capacity introduce in the regional power system. And if it will happens, the characteristics of its capacities won't be much different from existence plants and it won't be any influence at emission factor of the whole regional power system.

<u>Monitoring</u>

The emission factor value is determined once in 2009 for the credit period (2008-2012)

In accordance with Regulating document 34.08.552-95 " Methodical guidance for drawing up the thermal profitability of the equipment report for electric power station and joint-stock company of power and electrification", JSC "Irkutskenergo" fill in the form, composed of 70 indexes.

On the base of this data, with use of Regulating document 34.08-559-96 "Methodical guidance for analysis of specific fuel consumption changes at electric power stations and power associations" generation at condensation cycle and specific fuel consumption for electricity output by condensation cycle are determine. For calculating simplification at the base of this regulating document developed bundled software: "Program complex of automated collection, processing and fuel use analysis system of CHP-plants and Power and electrification production association"

Calculating results of this complex unloads in *txt files and goes to ORGRES (JSC "Engineering Center UES"). Condensate cycle data takes form this program complex.

(3) 5-years weighted average data on efficiency coefficient of BHPP turbines before the project activity ($\eta_{baseline}$),%;

The data of BHPP's turbines averaged weight efficiency coefficient in 2002-2007 (with the exception of the 2003 year), is presented in the separate Excel file (attached in Annex 4). For the purpose of calculating, the year 2003 was excluded from the sample, because it is atypical-low water year.
Calculation makes by determine:

1) Efficiency coefficient of each BHPP turbine (η_y) in the year y (2002-2007, 2003 is excluded)
2) Load (w_{iy}) of each BHPP turbine in year y (2002-2007, 2003 is excluded) by ratio determining between turbine №i electricity generation and total BHPP electricity generation in year y.
3) Weighted average efficiency coefficient of all BHPP by summation of each turbine weighted efficiency coefficient in year y
4) Average weighted average efficiency coefficient in 2002-2007 (2003 is excluded)

$\eta_{baseline} = \sum(\sum\eta_i \text{ x } w_i)/5 = 85.92\%$ (from Excel table)

(4) Weighted average data on efficiency coefficient of BHPP turbines after the project activity (ηy),%

Calculation makes by determine:

1) Efficiency coefficient of each BHPP turbine (η_y) in the year y
2) Load (w_{iy}) of each BHPP turbine in year y by ratio determining between turbine №i electricity generation and total BHPP electricity generation in year y.
3) Weighted average efficiency coefficient of all BHPP by summation of each turbine weighted efficiency coefficient in year y

$\eta_y = \sum \eta_i \text{ x } w_i = 88.82\%$ (in 2010)

(5) Point in time when the existing equipment would need to be replaced in the absence of the project activity ($DATE_{baselineRetrofit}$)

This is determined by one of two methods:

(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 practice of the responsible company regarding replacement schedules of equipment 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.

By (a): according to the national standard GOST 27807-88 the tecnical lifetime for radial-axial turbines manufactured before 01.01.91 is no less than 30 years. At present time in Russia there are no criteria for the retirement of hydro turbines due to lifetime. Only technical-and-economic indicators represent the main criterion. The radial-axial turbine under conditions similar to those at Bratskaya HPP are in operation for 50-80 years and more both in Russia and abroad.

By (b): before 2006, when JSC «Irkutskenergo» made a decision on the present joint implementation project, non such projects were implemented either at BHPP or at another HPPs of JSC «Irkutskenergo».

In addition to (a) and (b). In 2003 special research "Evaluation of the lifetime reserve of the turbine wheels No. 6 and 17 of BHPP" was undertaken by an independent research center CKTI (in Russian – ЦКТИ). The outcome: both wheels can serve at least till 2013. An indirect evidence that the lifetime will exceed 2013 is the absence of plans to replace turbine wheels No.1-12 in the coming 5 years.

Conclusion. The date $DATE_{baselineRetrofit}$ for turbines No.13-18 exceeds 2012, when the first phase of this JI Project activity comes to an end. For the second commitment period (after 2012) this parameter is to be checked once again.

Calculation of BL emissions

Additional electricity generated by BHPP with 6 retrofitted turbines:

$EG_y = EG_{BHPP}$ x $\Delta\eta = \sum EG_i$ x $(1- \eta_{baseline} / \eta_y))$- =741 351MWh (in 2010)

Emission reduction in 2010

$ER_y = BE_y = \Delta\ EG_y$ x $EF_{grid,CM,y}$ = 741 351x1.159 = 859 006tCO_2

This calculation are presented in Excel Table attached in Annex 8.

Annex 3

MONITORING PLAN

Table D1.4-1. Monitoring plan for the year ***y*** (20…)

ID number	Variable parameters	Unit of measurement	Measured/calculated as/obtained from	Value in year ***y***
Project activity - the monitoring is not required, the emissions were assumed to be 0				
Baseline				
Table D1.2.1; M1	Electricity generated by new turbine No. 1	MWh	Direct measurement	
Table D1.1.3; M2	Electricity generated by new turbine No. 2	MWh	Direct measurement	
Table D1.1.3; M3	Electricity generated by new turbine No. 3	MWh	Direct measurement	
Table D1.1.3; M4	Electricity generated by new turbine No. 4	MWh	Direct measurement	
Table D1.1.3; M5	Electricity generated by new turbine No. 5	MWh	Direct measurement	
Table D1.1.3; M6	Electricity generated by new turbine No. 6	MWh	Direct measurement	
Table D1.1.3; M7	Electricity generated by new turbine No. 7	MWh	Direct measurement	
Table D1.1.3; M8	Electricity generated by new turbine No. 8	MWh	Direct measurement	
Table D1.1.3; M9	Electricity generated by new turbine No. 9	MWh	Direct measurement	
Table D1.1.3; M10	Electricity generated by new turbine No. 10	MWh	Direct measurement	
Table D1.1.3; M11	Electricity generated by new turbine No. 11	MWh	Direct measurement	
Table D1.1.3; M12	Electricity generated by new turbine No. 12	MWh	Direct measurement	
Table D1.1.3; M13	Electricity generated by new turbine No. 13	MWh	Direct measurement	
Table D1.1.3; M14	Electricity generated by new turbine No. 14	MWh	Direct measurement	
Table D1.1.3; M15	Electricity generated by new turbine No. 15	MWh	Direct measurement	
Table D1.1.3; M16	Electricity generated by new turbine No. 16	MWh	Direct measurement	
Table D1.1.3;	Electricity generated	MWh	Direct measurement	

M17	by new turbine No. 17			
Table D1.1.3; M18	Electricity generated by new turbine No. 18	MWh	Direct measurement	
Table D1.1.3; M19	Electricity generated by BHPP	MWh	Calculates by summation M1-M18	
Table D1.1.3; M20	Operating hours for turbine № 1	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M21	Operating hours for turbine № 2	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M22	Operating hours for turbine № 3	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M23	Operating hours for turbine № 4	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M24	Operating hours for turbine № 5	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M25	Operating hours for turbine № 6	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M26	Operating hours for turbine № 7	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M27	Operating hours for turbine № 8	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M28	Operating hours for turbine № 9	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M29	Operating hours for turbine № 10	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M30	Operating hours for turbine № 11	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M31	Operating hours for turbine № 12	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M32	Operating hours for turbine № 13	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M33	Operating hours for turbine № 14	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M34	Operating hours for turbine № 15	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M35	Operating hours for turbine № 16	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M36	Operating hours for turbine № 17	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M37	Operating hours for turbine № 18	h/year	Obtained from daily reports of turbine operator	
Table D1.1.3; M38	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M39	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M40	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	

Table D1.1.3; M41	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M42	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M43	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M44	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M45	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M46	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M47	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M48	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M49	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M50	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M51	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M52	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M53	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M54	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M55	The number of years from the last repair for turbine № 1-18	years	Obtained from daily reports of turbine operator	
Table D1.1.3; M56	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3; M57	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3;	Efficiency	%	Calculates. Annex 8	

M58	coefficient of turbine 1-18			
Table D1.1.3; M59	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3; M60	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3; M61	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3; M62	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3; M63	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3; M64	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3; M65	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3; M66	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3; M67	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3; M68	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3; M69	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3; M70	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3; M71	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3; M72	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3; M73	Efficiency coefficient of turbine 1-18	%	Calculates. Annex 8	
Table D1.1.3; M74	Upper pool	m	Direct measurement	
Table D1.1.3; M75	Lower pool	m	Direct measurement	

BE	BL emissions	tCO_2	BE_y= [$\sum M_{1-18}$ x (($\sum$((M_{1-18}/M_{19}) x f (($M_{38}-M_{39}$);(M_{1-19}/M_{20-37})/ 85.92%)-1)] x 1.159	
ER	Emission reductions	tCO_2	ER [$\sum M_{1-18}$ x (($\sum$((M_{1-18}/M_{19}) x f (($M_{38}-M_{39}$);(M_{1-19}/M_{20-37})/85.92%)-1)] x 1.159	

Table D1.4-2. Monitoring plan for determining the emission reductions of traditional pollutants in 20__ .

Variable parameter	Unit of measurement	Value in year ***y***
Reduction of emissions of ash, sulfur oxides and nitrogen oxides, $ERP_{total} = 0.01 \cdot 10^{-3}$ (EG_y x $\Delta\eta$), where (EG_y x $\Delta\eta$) is taken from Table D 1.4-1 above [in rectangular brackets].	tones	
Reduction of output of ash-and-slad waste, $ERP_{ash\&slag} = 0.06 \cdot 10^{-3}$ (EG_y x $\Delta\eta$), where (EG_y x $\Delta\eta$) is taken from Table D 1.4-1 above [in rectangular brackets].	tones	

Annex 4

PROTOCOL OF THE MEETING AT JSC "IRKUTSKENERGO" OF 22.04.2004 (COPY AND TRANSLATION)

ИРКУТСКОЕ ОТКРЫТОЕ
АКЦИОНЕРНОЕ ОБЩЕСТВО
ЭНЕРГЕТИКИ И ЭЛЕКТРИФИКАЦИИ
(ОАО «Иркутскэнерго»)

ПРОТОКОЛ СОВЕЩАНИЯ

22.04.2004

О проекте замены рабочих колес БГЭС

Присутствовали:

Участники совещания:

Наименование должности	Ф.И.О.
1. Исполнительный директор	Эмдин С.В.
2. Директор по снабжению	Шарабурак В.А.
3. Заместитель директора по финансам и экономике	Фильш Е.А.
4. Заместитель главного инженера по общетехническим вопросам	Перетокин А.Я.
5. Заместитель главного инженера - главный менеджер по экологической безопасности и рациональному использованию природных ресурсов	Горбунов В.В.

Повестка дня:
1. О рассмотрении инвестиционного проекта «Замена рабочих колес БГЭС».

СЛУШАЛИ:
1. Перетокина А.Я. о мировой практике подобных проектов, об улучшении технических параметров оборудования в случае реализации проекта – улучшение КПД гидроагрегатов может составить 5-8%,
2. Шарабурака В.А. о возможных поставщиках оборудования – Voith Siemens Hydro Power Generation, ЛМЗ, Altstom, о возможных временных параметрах проекта, об ориентировочной величине инвестиций (2,1 млн. долл США за одно рабочее колесо).
3. Горбунова В.В. об экологической составляющей проекта: проект может быть реализован в рамках Киотского протокола как проект совместного осуществления. Проблемным моментом является отсутствие ратификации Киотского протокола со стороны Российской Федерации, однако принимая во внимание имеющиеся намерения ратификации данного протокола в ближайшее время, при оценке экономической эффективности проекта можно учесть дополнительные доходы от продажи сокращений выбросов CO2.
4. Эмдина С.В. о результатах оценки экономической эффективности проекта: рассмотрены варианты проекта без и с учётом реализации сокращённых выбросов парниковых газов. Вариант без учёта реализации сокращённых выбросов парниковых газов неэффективен (отрицательный NPV = – 59,2 млн. руб.). Вариант с учётом

реализации сокращённых выбросов парниковых газов эффективен и имеет следующие параметры: NPV = 87,8 млн. руб., срок окупаемости (простой) = 4,2 года.

РЕШИЛИ:

Признать проект эффективным и окупаемым при условии реализации ЕСВ в рамках Киотского протокола в 2008-2012 гг.

Исполнительному директору (Эмдину С.В.) подготовить пакет документов проекта к вынесению на Совет директоров ОАО «Иркутскэнерго».

Срок – 30.04.2004.

Подписи участников:

Исполнительный директор

__________С.В. Эмдин

Директор по снабжению

__________В.А. Шарабурак

Заместитель директора по финансам и экономике

__________Е.Г. Фильшин

Заместитель главного инженера по общетехническим вопросам

__________А.Я. Перетокин

Заместитель главного инженера - главный менеджер по экологической безопасности и рациональному использованию природных ресурсов

__________В.В. Горбунов

TRANSLATION

IRKUTSK OPEN
JOINT STOCK COMPANY
FOR ENERGY AND ELECTRIFICATION
(JSC Irkutskenergo)

MINUTES OF MEETING

22.04.2004

Re the project "Replacement of the working wheels at the Bratsk HPP"

Sederunt

Participant of the meeting:

Position	Name
Executive Director	Emdin S.V.
Sourcing Director	Sharaburak V.A.
Deputy of Director for Finance and Economy	Filsh E.A.
Deputy of Chief Engineer for general technical issues	Peretokin A.Y
Deputy of Chief Engineer – Chief Manager for the environmental safety and rational using of natural sources	Gorbunov V.V.

Agenda
Consideration of the investment project "Replacement of the working wheels at the BHHP"

DISCUSSED:

1. Peretokin A.Y. re the world practice of such kind of projects, optimization of the technical parameters of the equipment in the case of the project realization – increasing of the turbines efficiency can make 5-8%

2. Sharaburak V.A. re the possible equipment delivery – Voith Siemens Hydro Power Generation, LMZ, Altstom, re the potential period of the project realization, re the approximate investment volume (2.1 Mio. USD per one wheel)

3. Gobunov V.V. re the environmental issue of the project: the project can be realized within the framework of Kyoto Protocol as Joint Implementation Project. The problem is the absence of the Kyoto Protocol ratification in the Russian Federation, however, given the intends to ratify the Protocol in the closest time as well the economical efficiency of the project, the additional revenues from the selling of CO2 emission reduction can be calculated.

4. Emdin S.V. re the results of the estimation of the economical efficiency of the project: the project models given the selling of CO2 and without it have been considered. The model without the calculation or the CO2 selling is not efficient (NPV is negative -59,2 Mio RUB) The model with account of the CO2 emission reduction selling is efficient and provide the following results: NPV= 87.8 RUB, payback period = 4,2 years.

DECIDED:
To consider the project as efficient and recouped given the ERUs selling within the framework of the Kyoto Protocol in 2008-2012.

The Executive Director (Emdin S.V.) has to prepare the project document package for the meeting of the Management Board of JSC Irkutskenergo. Deadline: 30th April 2004

Subscription:

Executive Director – Emdin S.V.
Signature

Deputy of Director fro Finance and Economy – Filsh E.A.
Signature

Sourcing Director - Sharaburak V.A.
Signature

Deputy of chief engineer for general technical issues – Peretokin A.Y.
Signature

Deputy of chief engineer – chief manager for environmental safety and rational using of natural sources – Gorbunov V.V.

Signature

Annex 5

INFORMATION ON ELECTRICITY METERS AT BHPP

	Supply meter			Current transformer		Voltage transformer	
Point of metering	Type	No.	Accuracy rate (max. error)	Type	Current transformation coefficient Accuracy rating	Type	Voltage transformation coefficient Accuracy rating
1Г	A1R-4-AL-C8-T+	1105356	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
2Г	A1R-4-AL-C8-T+	1105357	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
3Г	A1R-4-AL-C8-T+	1105358	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
4Г	A1R-4-AL-C8-T+	1105359	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
5Г	A1R-4-AL-C8-T+	1105360	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
6Г	A1R-4-AL-C8-T+	1105361	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
7Г	A1R-4-AL-C8-T+	1105362	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
8Г	A1R-4-AL-C8-T+	1105363	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
9Г	A1R-4-AL-C8-T+	1105364	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
10Г	A1R-4-AL-C8-T+	1105365	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
11Г	A1R-4-AL-C8-T+	1105366	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
12Г	A1R-4-AL-C8-T+	1105367	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
13Г	A1R-4-AL-C8-T+	1105368	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
14Г	A1R-4-AL-C8-T+	1105369	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
15Г	A1R-4-AL-C8-T+	1105370	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
16Г	A1R-4-AL-C8-T+	1105371	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
17Г	A1R-4-AL-C8-T+	1105372	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-15	15000/100 0,5
18Г	A1R-4-AL-	1105373	0,2	ТШЛ-20	10000/5 0,5	ЗНОМ-	15000/100

	C8-T+					15	0,5

Annex 6

APPROVAL LETTER FROM MAYOR OF CITY BRATSK

RUSSIAN FEDERATION
IRKUTSK REGION

MAYOR OF CITY BRATSK

32, Lenin prospect, Bratsk, 664707
Tel.: (3953) 349-010
Fax: (3953) 349-349
E-mail; admin_ bratsk@city.ru

To: Director of Bratsk HPP
of a branch of JSC
"Irkutskenergo

Rudykh V.V.

29.04.2008 №01-914

On project of substitution of the wheels
of hydro units of Bratsk HPP

Dear Viktor Vasiljevich,

It was established as a result of considering the materials of design-technical documentation on Joint Implementation project « Increasing the efficiency of electricity generation at Bratsk hydroelectric station" that: Project supposes the substitution of 6 wheels, which began to operate in the period of filling water reservoir of BHPP and have the largest wear because of the decreased head. In the process of operation the wheels are subject to the action of cavitation damage, which result in the accelerated wear of hydro unit elements. In the process of servicing the wheels are recovered by means of welding deposition of 600-700-kg metal. In this case the strength properties of deposited metal concede to those of one-piece-cast. Within the framework of BHPP project it is planned to substitute the blade wheels by new ones made of stainless steel, having much less cavitation wear of metal (15 kg in 8000 hours of operation). It will allow increasing the overhaul period from 6 to 9 years. In this case the maximum efficiency of typical hydro unit subject to substitution constitutes 88.1% after major overhaul without taking into account the reduction in the overhaul period. The new blade wheels will allow to achieve the maximum turbine efficiency 95.3%. It will made possible to increase the real efficiency of wheels on the average by 8%, what will allow to generate additionally 147.2 million kWh per year for one unit or totally 883.2 million kWh per year.
Additional electricity generated at BHPP will substitute the electricity production at the coal-fired power plants of Irkutskenergo including the TPP of city Bratsk. The greenhouse emissions will be decreased due to the project realization by increasing the efficiency of electricity generation at BHPP and producing the additional electricity in condensation cycle of TPP of JSC "Irkurskenergo". It will allow to reduce the fuel (coal) consumption and correspondingly to reduce the emissions. Emissions connected with construction and wheels transportation are estimated as insignificant and are not taken into consideration in the project. The reduction of emission connected with repair and maintenance of old blade wheels, hydro units and equipment of BHPP will be achieved during the project realization in connection with the increase of overhaul period from 6 to 9 years.
Disposition of production and consumption waste in the period of substitution ad maintenance of BHPP wheels is carried out in accordance with the standards on formation of BHPP waste and limits of its disposition (GK-768/INNOOLR-2006).

The analysis of materials on the project of wheels substitution at Bratsk HPP showed that there are not negative environmental impacts during the project realization, because the change of parameters of functioning water facilities at Bratsk water reservoir is not supposed. There will be not restrictions or increasing of water drain, not extension of water reservoir, no flooding of new territories etc. In the same time the substitution of fuel combustion at TPP for energy generation will result in the considerable reduction of environmental impact. In connection with the active legislation of Russian Federation and taking into account the absence of negative environmental impact of the substitution of Bratsk HPP hydro unit wheels, the carrying out of public hearings is not expedient. The administration of city Bratsk approves the realization of this project within the frameworks Joint Implementation project"Increasing of electricity production efficiency at Bransk HPP".

Annex 7

DETAILS OF CALCULATION OF FINANCIAL/ECONOMICAL INDICATORS AND SENSITIVITY ANALYSIS (attached in a separate excel file)

Microsoft Office
Excel 97-2003 Worksl

Annex 8

EXCEL TABLES WITH INITIAL DATA AND CALCULATIONS

Microsoft Office
Excel 97-2003 Worksl

Annex 9

ANALYTICAL NOTE FOR THE PROJECT: "INCREASE IN EFFICIENCY OF WATER RESOURCES USE AT BRATSK HPP"

1.Water rate at Bratsk HPP

The Angara river flow out from Baikal lake whereupon it has rather (in comparison with the majority of the Russian Federation HPP stations) the equal water flow rate (both between years, and in a year). There are following HPPs located on Angara river (in a current direction): Irkutsk HPP, Bratsk HPP, Ust Ylym HPP and under construction Boguchanskaya HPP.

Water flow rate through HPP are strictly regulated by Rules of water use and decisions of interdepartmental working group (IWG) in Yeniseisk basin authority (YBA) of Federal agency of water resources. Structure IWG includes representatives: YBA, the System operator (SO), generating companies, tritons, fishing industry. Flow rate confirmed by IWG should answer: preflood decrease of storage, navigating releases. HPP release modes during winter time (freeze up, slush ice run, etc.), HPP operating modes at high (small) water content also confirms.

At theoretical decrease in the water flow rate through HPP the level in the top water basin will increase whereupon there is a threat of dam durability increases, settlements can be impounded. At same the water flow rate for HPP decreases, because of what the river below a dam can become shallow that will create difficulties for navigation, problems on water fences of settlements.

At HPP water flow increasing arises opposite the consequence aforesaid.

Thus, the water flow rate for electricity generation will be identical as without realization of the project «Increase in efficiency of water resources use at Bratsk HPP », and at its realization.

2.Definition of water rate of Bratsk HPP

Due to the fact that majority of HPPs is not equipped by devices of water rate direct measurement, water rate definition makes by a calculation method at HPP with the subsequent verification with calculations of Hydrometeorological service, executed on the base of the data from their water posts. According to RD 153-34.2-21.564-00 "Methodical instructions for the account of water flow at HPPs » water rate (and hydrounits efficiency coefficient) determines on the base of operational characteristics. Operational characteristics constructed on the base of the factory data, with the account of actual power tests results.

According to abovementioned RD, operational characteristics can be issued in the form of set of isolines. Possibility of algorithms for calculations automation with the help of the computer is provided also.

For water rate definition measured indicators are used: electric capacity of hydrounits, an operating time of units in a generation mode and a water pressure (as a difference of levels top and bottom pools).

Electrical capacity is measured by the electric meters at every aggregate. The results of measurement goes to the central server – the Automated monitoring system of the electricity account.

The water pressure is defined as a difference of levels top and bottom pools measured by ultrasonic level gauges (over a distance of 500 m from water outlet).