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

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Annexes

SECTION A. General description of the project

A.1. Title of the project:

Biomass wastes-to-energy project at JSC "Volga"
Report version number: 1.0
Date: 20 October 2007

A.2. Description of the project:

Purpose of the project

The project is aimed at utilization of bark and wood wastes (BWW) as well as sludge from wastewater treatment facilities (WWS) as a fuel to produce heat for auxiliary needs of JSC "Volga" (further – "Volga PPM").

The project envisages installation of a 45 MW (65 t/h of steam) boiler on the production site of Volga PPM for combustion of BWW and sludge generated at paper production and for production of heat for auxiliary needs of the mill. The project also envisages installation of facilities for preparation of BWW and sludge for combustion.

The project will result in reduced need for purchased heat produced by combustion of fossil fuels (natural gas), and will lead to complete elimination of BWW and sludge disposal at landfills[1].

Expected results of the project:

- Supply of biomass based heat by the new boiler house will amount to 1 174 428 GJ per year, which will replace fossil fuel based energy generated at the existing Nizhniy Novgorod CHP plant (NiGRES);
- Supply of heat by Nizhniy Novgorod CHP plant will reduce by 1 174 428 GJ per year, with corresponding decrease in natural gas consumption by 27.7 million m^3 per year;
- Dumping of BWW and sludge generated at the mill will be completely eliminated;
- Up to 60 new jobs will be created.

Implementation schedule and costs of the project

Boiler house construction started – November 2006

Construction completion – December 2007

Total project investments – EUR 28 million

Grounds for the project implementation

Volga PPM has all the required permits and licenses for its current operation and for the project implementation, those have been duly issued in accordance with the Russian laws and regulations.

The technological processes to be implemented in the project meet the world's up-to-date standards and environmental requirements.

The project implementation is associated with overcoming of a whole range of serious technological, operational and financial barriers. The decision to implement the project was made taking into account

[1] Henceforth "landfill" means specially conditioned site for wastes disposal

the possibility to cover some investment costs and to offset risks by ERUs selling within the mechanisms provided by the Kyoto Protocol.

Before the project implementation, on 14th of February 2006, Volga PPM and CAMCO International signed Carbon Finance Service Agreement (CFSA), which envisages development of carbon assets and selling those in the market as GHG emission reductions generated by the project.

A.3. Project participants:

Party involved	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
Party A: Russia (host Party)	Legal entity A1: Open Joint Stock Company "Volga"	No
Party B: EU countries	Legal entity B1: Private company "Camco International GmbH"	No

JSC "Volga" was established in 1991 through privatization of Balakhna Pulp and Paper Mill. The main product of the mill is newsprint paper. Volga PPM is the leading manufacturer in this industry in Russia.

Design work and construction of the mill started in 1925. Production of newsprint paper was launched in October 1928.

Paper production amounted to 536 000 tonnes in 2006 and is planed to increase up to 700 000 tonnes by the year 2012.

Fig. A.3-1. Paper machine

The mill has advantageous geographical location. It is situated not far from Moscow, which is the major newsprint consumer in Russia, at only 5 km distance from Nizhniy Novgorod CHP plant, the existing energy source. Wood for paper production is supplied from the neighboring areas while water resources are provided by the Volga River. The transport infrastructure is rather developed and includes the Volga River as well as motorways and the railway system.

The mill does not have its own sources of heat and electricity apart from the old sawdust fired boiler house, which meets the heating needs of the wastewater treatment plant, this accounts for a small proportion of the mill's total heat consumption (0.2%). Because of its small capacity and technical shortcomings this boiler house can not be regarded as an industrially significant source of energy.

Camco International GmbH is a subsidiary of Camco International Ltd., a Jersey based public company listed at AIM in London. Camco International is the world leading carbon asset developer and projects promoter under both joint implementation and clean development mechanism of the Kyoto Protocol. Camco's project portfolio consists of more than 125 projects, generating altogether over 140 MT CO_2e of GHG reductions all over the world. Camco operates in Eastern Europe, Africa, China, and Southeast Asia. The company has been actively operating in Russia since 2005.

A.4. Technical description of the project:

A.4.1. Location of the project:

The project activity is located at the OJSC "Volga", Balakhna, Russia.

A.4.1.1. Host Party(ies):

Russian Federation

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

Nizhniy Novgorod Region

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

City of Balakhna

Fig. A.4-1. Location of the city of Balakhna

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

Balakhna is a city in Nizhniy Novgorod Region, Russia. It is located on the right bank of the Volga River, 32 km north of Nizhniy Novgorod and 450 km far from Moscow.

Position data: geographic latitude: 56°30'N, geographic longitude: 43°36'E.

Time zone: MSK (UTC+3, summer time UTC+4)

The population of Balakhna is 55 700 people (as of 2005).

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

Boiler house

The boiler house is designed to produce steam by combustion of bark and wood wastes (BWW) and sludge from the wastewater treatment plant operated by Volga PPM. Upon commissioning of the boiler house disposal of the specified wastes at landfills will be stopped.

The process solutions for the boiler house were developed by Wellons, USA. The supplied equipment (boiler unit) is also manufactured by Wellons.

Thermal performance of the boiler house is given in Table A.4-1.

Table A.4-1. Thermal performance of the boiler house [R1]

Data name	Value
Installed steam capacity, t/hour	65
Installed thermal capacity, MW	45
Annual fuel consumption (as-received basis), t/ year:	233 024
including:	
bark and wood waste, t/year	172 141
sludge from wastewater treatment facilities, t/year	60 883
Net calorific value of biomixture as fired, GJ/t	5.98
Annual heat supply, GJ/year	1 174 428

Main performance parameters of the boiler are shown in Table A.4-2.

Table A.4-2. Main technical characteristics of the boiler [R1]

Date name	Value	Comment
Rated steam output, t/hour	65	
Steam parameters:		
Pressure, MPa	1.3	Possible to increase up to 5.7 MPa
Temperature, °C	250	Possible to increase up to 440 °C
Feed water temperature, °C	105	

The thermal scheme provides for steam supply (pressure – 1.3 MPa and temperature – 250 °C) to consumers and for consumption of steam with the same parameters for auxiliary needs of the boiler house. Return condensate from the production process is used to prepare feed water.

The possibility of boiler operation with higher steam parameters gives the opportunity to generate electricity provided a low-capacity turbine is installed in the future.

Fuel is combusted in a certified chamber furnace. The furnace has four chambers 2 740 mm in diameter each, capable for operating both simultaneously and separately. Each furnace chamber is fitted with a moving grate consisting of paired running shafts.

Fuel is fed into the furnace by screw conveyors via measuring hoppers – one for each furnace chamber.

Design fuel combustion capacity of the boiler is shown in Table A.4-3.

Table A.4-3. Design fuel combustion capacity of the boiler [R1]

Fuel type	Available fuel combustion capacity (as-received basis)	
	t/hour	t/year
Bark and wood waste	23.10	172 141
Sludge	8.17	60 883
Mixture of bark, wood waste and sludge	31.27	233 024

Hourly available capacity is assumed as per the boiler house design. Annual capacity is determined based on the mill's operation mode and availability of wastes for combustion (345 d/year, 24 h/day) with allowance for standard plant use factor of 0.9. The plant use factor takes into account possible decrease in output resulting from fluctuation of process conditions (variance of fuel composition and quality, and accidental shutdowns for repair, etc.).

Design fuel characteristics are shown in Table A.4-4.

Table A.4-4. Design fuel characteristics [R1]

Fuel type	Fuel characteristics (as-received basis)		
	Water content, %	Ash content, %	Net calorific value, MJ/kg
Bark and wood waste	58	maximum 1.26	not less than 6.78
Sludge (wastewater sludge)	68-70	maximum 5.36	not less than 3.73
Mixture of bark, wood waste and sludge	61	maximum 2.30	not less than 5.98

Ash is produced as a result of fuel combustion in the amount of 0.836 tonnes per hour (6 229 t/year).

According to the data provided by Wellons, the expected ash distribution per boiler unit is as follows:

- 50% of ash is deposited in the furnace itself;
- 40% of ash builds up on the heating surfaces of boiler and air preheater, and in multicyclone;
- 10% of ash is carried with flue gases to electrostatic precipitators.

In accordance with the above ash distribution pattern the boiler will be equipped with two ash collection and handling systems.

The first system collects large ash particles from the moving grates of the furnace chambers, from the multicyclone and air preheater. The collected ash is fed by screw conveyors to the collecting conveyor and is transported to the receiving hopper No.1. The amount of ash expected to be collected in the first system is 0.76 t/h (5 663 t/year).

The second system provides for collection of ash precipitated from flue gases by electrofilters. The precipitated ash is fed by screw conveyors to the receiving hopper No.2. The amount of ash precipitated in electrofilters and collected by the second system will amount to 0.076 t/h (566 to 600 t/year) depending on the efficiency of the electrostatic precipitators.

Ash conditioning is envisaged to avoid dust blowing when ash is discharged from the conveyors to the hoppers.

In the future, it is envisaged that ash will be stored in silos for further utilization (as a fertilizer and in construction industry), from where it can be delivered to consumers by motor transport or transported to the ash disposal site. The possible applications of ash shall be determined through investigation and testing of its properties.

Fig. A.4-2. Erection of the boiler house equipment

The principal water consumption needs of the boiler house are cooling of equipment and steam and water sampling.

The special feature of the boiler house design is that no chemical treatment of make-up water is needed. Instead, the return condensate from the production process is used as feed water. This causes significant reduction of water consumption by the boiler house and, thus, eliminates a need for construction of a water treatment plant for the boiler house and helps to avoid discharge of salty effluents to the sewerage.

Bark and wood waste preparation line

BWW are fed to the preparation line from the operating raw wood preparation facilities: the wood chips production facility and the new debarking unit. These wastes are fed by belt conveyors. A new conveyor is installed for feeding BWW from the truck loading point to the fuel preparation area. The conveyor which feeds wastes from the new debarking unit is designed to be reversible. As the need arises, this reversible conveyor will be able to feed all bark and wood wastes to a temporary storage facility, by-passing the wastes preparation line. As necessary, wastes from the storage will be returned to the waste preparation line via the bark receiving area. Wastes are transported to and from the storage by motor transport.

BWW supplied directly from the production are fed by a conveyor system to the bark crusher and then to the bark press for dewatering.

Before the bark crusher a metal detector and an iron separator are installed for detection and removal of metallic inclusions from the bark layer.

When BWW from the temporary storage area are unloaded from a motor vehicle they are discharged into the receiving bunker and further delivered by a chain conveyor to the waste preparation line.

Large wood wastes are handled by a hydraulic manipulator. Large particles are fed to the rotary shredder with a charging hole measuring 3.2×1.8 m.

After shredding the wastes are transported via a belt conveyor to the disk screen for screening, where fractions larger than 150 mm are removed. The removed fractions are fed for additional crushing to the bark crusher and the fractions going through the screen are fed to the belt conveyor, by-passing the bark crusher and the bark press.

Dewatered wastewater sludge is fed from treatment facilities to the same belt conveyor as follows:

- directly from the sludge dewatering section – by belt conveyor;
- from the temporary storage area – by dump trucks to the receiving bunker and further by a screw system to the belt conveyor.

The gathering belt delivers the prepared wastes to the chain conveyor, which takes them to the bark silos.

The system provides for weight metering of BWW supplied for preparation and of biofuel prepared for combustion. Weighs are installed at the belt conveyors.

BWW from the chain conveyor are distributed by a rotary distributor against the entire area of the silos. The silo capacity is sufficient to ensure 12 hours of boiler operation.

Wastes are unloaded by a screw discharger from the silo onto the chain conveyor and are further fed to the boiler.

The equipment for BWW preparation line is supplied by Saalasti, Finland.

Sludge processing line

Sludge, which is to be utilized, is a mixture of fibrous stock recovered from the mechanical wastewater treatment facilities and surplus activated sludge from biological wastewater treatment facilities approximately in equal proportion (50/50).

The water content of the initial sludge is 99%. The sludge is dewatered before feeding for combustion.

Technical solutions and equipment for sludge dewatering are based on the assumption of the sludge water content being 99% and required water content of dewatered sludge being 68-70%.

Technological equipment for sludge dewatering is supplied by MCE, Austria.

The untreated sludge is delivered by the existing pumping station via the existing and the newly designed sludge pipelines to a 50 m^3 capacity sludge tank of the dewatering unit.

The sludge is pumped from the tank by slurry pumps to the injector mixer, where 0.1%-flocculent solution is added to assist in the dewatering process.

Then the sludge is fed to the deckle box of the thickener, and at the outlet of the thickener the sludge with 92-94 % water content is fed to the deckle box of the filter-press. The dewatered sludge is discharged to the conveyor and transported to the inside intermediate storage.

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:

Fossil fuel combustion results in considerable GHG emissions. CO_2 is the main greenhouse gas from fossil fuel combustion. N_2O and CH_4 emissions from combustion are not considered, as these emissions are negligibly small compared to emissions of CO_2. CO_2 emissions from burning biomass are climatically neutral and are, therefore, assumed to be equal to zero.

The principal source of CO_2 emissions under the baseline is Nizhniy Novgorod CHP plant fuelled with natural gas and heavy fuel oil. Nizhniy Novgorod CHPP supplies heat to the neighboring consumers, including Volga PPM.

The second most important source of CO_2 emissions is the landfills, where bark and wood wastes and wastewater sludge are disposed. Methane is emitted in the process of anaerobic decay of these wastes. Methane is a greenhouse gas with GWP=21.

The project envisages that 100% of BWW and sludge will be utilized in the new boiler house constructed on the Volga PPM production site, which will result in correspondent reduction of natural gas consumption by Nizhniy Novgorod CHPP and in elimination of BWW and sludge disposal at landfills. All this leads to reduction of GHG emissions.

Without the project, the specified reductions of GHG emissions would not be achieved, as:

- The mill could successfully continue to operate and develop relying on the nearby CHP plant as its principal and only source of steam supply;

- All necessary permits for operation of disposal sites, including environmental permits, duly issued by the relevant regulatory bodies were available;

- It would have been possible to avoid sizeable and rather risky investments in construction of the mill's own boiler house.

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

Length of the crediting period	**Years**
5 years	**2008-2012**
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2008	62 830
2009	73 467
2010	83 623
2011	93 321
2012	102 580
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	**415 821**
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	**83 164**

A.5. Project approval by the Parties involved:

The Parties' Approval Letters will be received later.

SECTION B. Baseline

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

The baseline was chosen basing on a critical analysis of the steam supply alternatives available for the mill (see Section B.2).

The baseline has been developed on an assumption that without JI project implementation and GHG emission reductions sale the mill would receive steam from Nizhny Novgorod CHP plant working on natural gas and fuel oil. This scenario is not only the most probable but also the most conservative one as compared with construction of any fossil fuel fired boiler house on VPPM's site. This scenario is also the least risky and does not require any material investments.

In working out the baseline and making calculations, the developer used the elements of the approved CDM methodologies AM0036 [R2].

Key factors that determine GHG emissions in both the baseline and the project scenarios are reviewed below. These factors are:
- combustion of BWW and sludge;
- heat generation;
- decreased consumption of fossil fuel (natural gas) at the Nizhny Novgorod CHP plant;
- dumping of BWW and sludge;
- electricity consumption;
- fugitive methane emissions at natural gas production and transporting.

Let us analyze each factor in detail.

Combustion of BWW and sludge

The amounts of BWW and sludge combustion under the base line and the project are shown in Table B.1-1.

Table B.1-1. Combustion of BWW and sludge at Volga PPM

Value name	Symbol	Unit	Justification	Base line	Project
BWW combustion	$FC_{BWW,y}$	t/year	$FC_{BWW,y} = FC_{BWW,old,y} + FC_{BWW,new,y}$	1 239	173 380
including					
old boiler house	$FC_{BWW,old,y}$	t/year	Average value for 2004-2006	1 239	1 239
new boiler house	$FC_{BWW,new,y}$	t/year	According to design [R1]	0	172 141
Sludge combustion (new boiler house)	$FC_{sludge,new,y}$	t/year	According to design [R1]	0	60 883
Total biomass combustion	$FC_{bio,y}$	t/year	$FC_{bio,y} = FC_{bio,new,y} + FC_{bio,old,y}$	1 239	234 263
including					
old boiler house	$FC_{bio,old,y}$	t/year	$FC_{bio,old,y} = FC_{BWW,old,y}$	1 239	1 239
new boiler house	$FC_{bio,new,y}$	t/year	$FC_{bio,new,y} = FC_{BWW,new,y} + FC_{sludge,new,y}$	0	233 024

It is assumed here that the boiler house is supplied with BWW produced at Volga PPM site. However, BWW can be also supplied from outside which option is taken into consideration in the monitoring plan.

Heat generation

Calculations for heat generation at Volga PPM for the baseline and the project are given in Table B.1-2.

Table B.1-2. Calculation of heat generation at Volga PPM

Value name	Symbol	Unit	Justification	Baseline	Project
Combustion of biomass (sawdust) in the old boiler house	$FC_{bio,old,y}$	t/year	See Table B.1-1.	1 239	1 239
Combustion of combined biofuel (bark, wood waste and sludge) in the new boiler house	$FC_{bio,new,y}$	t/year	See Table B.1-1.	-	233 024
Net calorific value of BWW	$NCV_{BWW,y}$	GJ/t	Test report №06-35 of the 14th June 2005	7.072	7.072
Net calorific value of combined biofuel	$NCV_{biomix,y}$	GJ/t	According to design [R1]	-	5.98
Efficiency factor of the old boilers	η_{old}	-	Assumed	0.8	0.8
Efficiency factor of the new boiler	η_{new}	-	According to design [R1]	-	0,86
The proportion of heat for auxiliary needs of the old boiler house	HA_{old}	-	Assumed	0.020	0.020
The proportion of heat for auxiliary needs of the new boiler house	HA_{new}	-	According to design [R1]	-	0.020
Heat generation, total	HG_y	GJ/year	$HG_y = HG_{old,y} + HG_{new,y}$	7 010	1 205 406
including:					
old boiler house	$HG_{old,y}$	GJ/year	$HG_{old,y} = FC_{bio,old,y} \times NCV_{sawdust,y} \times \eta_{old}$	7 010	7 010
new boiler house	$HG_{new,y}$	GJ/year	$HG_{new,y} = FC_{bio,new,y} \times NCV_{biomix,y} \times \eta_{new}$	0	1 198 396
Heat supply, total	HS_y	GJ/year	$HS_y = HS_{old,y} + HS_{new,y}$	6 870	1 181 298
including:					
old boiler house	$HS_{old,y}$	GJ/year	$HS_{old,y} = HG_{old,y} \times (1 - HA_{old})$	6 870	6 870
new boiler house	$HS_{new,y}$	GJ/year	$HS_{new,y} = HG_{new,y} \times (1 - HA_{new})$	0	1 174 428

Decreased consumption of fossil fuel (natural gas) at Nizhny Novgorod CHP plant.

Volga PPM is supplied with steam (pressure – about 1.3 MP) and hot water from Nizhny Novgorod CHP plant. The supplied steam will be partly replaced under the project by the steam generated at the new boiler house while hot water will still be supplied from outside.

The expected reductions of fuel use at Nizhny Novgorod CHP plant due to the project were calculated taking the following into consideration. According to the data available, installed electric capacity of the plant is 144 MW. One of the turbines, namely ПТ-80/100-12.8/1.3 with nominal capacity 80 MW, is a condensing type turbine while the rest are backpressure turbines, 1.3 MPa each. As a rule, when there is a stable demand for steam from the consumers, power is produced at the backpressure turbines while the condensing type turbine is only loaded to cover the remaining needs in power. We assume, following conservative approach, that power generation by Nizhny Novgorod CHP plant will remain the same.

Thus the task is to define the change of live steam heat consumption by ПТ-80/100-12.8/1.3 turbine unit. The change of heat output from production steam extraction at the backpressure of 1.3 MP is the input parameter. Steam output from heating extraction used for grid water heating will remain unchanged. Heat output from peak-load boilers will not depend on the project as well.

Change of steam consumption in a turbine can be defined using graphic diagram of modes. However a more precise analytically presented [R3] energy parameter of ПТ-80/100-12,8/1,3 turbine was used here:

$$Q_{tur}=16.3+1.98N-0.965N_h+Q_h+Q_p,, \quad (B.1\text{-}1)$$

$$N_h=0.542Q_h/(10P_h)^{0,14}+0.301Q_p(1.3/P_p)^{0,34}-(11.6-0.0217Q_h), \quad (B.1\text{-}2)$$

where Q_{tur} is heat consumption by a turbine, MW;

Q_p and Q_h are heat loads of production and heating extractions of a turbine, MW;

N is nominal capacity of a turbine, MW;

N_h is power output from heat consumption, MW;

P_p and P_h steam pressure in production and heating extractions, MPa.

To define the change of steam consumption by the turbine caused by the change of heat output for production extraction energy parameter of the turbine was transformed by mathematical manipulations to the following:

$$\Delta Q_{tur}=0.7095\ \Delta Q_p, \quad (B.1\text{-}3)$$

where ΔQ_{tur} change of steam consumption by the turbine, MW;

ΔQ_p change of heat output from production extraction, MW.

As for the replaced heat energy, steam consumption from production extraction used for the plant's auxiliary needs can be considered unchanged though its delivery for auxiliary needs of the turbine unit technological cycle depends on its supply to outside consumers (that is already taken into account in the energy characteristic of the turbine).

Natural gas (87.2%) and fuel oil (12.8%) are burnt at Nizhny Novgorod CHP plant. Reduction of heat output from Nizhny Novgorod CHP plant is referred to natural gas.

Calculations of reduced natural gas use at Nizhny Novgorod CHP plant are given below in Table B.1-3.

Table B.1-3. Calculation of natural gas consumption reduction Nizhny Novgorod CHP plant

Value name	Symbol	Unit	Justification	Value
Heat supply from the new boiler house	$HS_{new,y}$	GJ/year	See Table B.1-2	1 174 428
Factor of heat flow at CHP plant	K_{HF}	-	Reference data [R9]	0.98
Cogeneration factor	K_{cog}	-	According to power characteristic of turbine	0.7095
Natural gas calorific value	NCV_{NG}	GJ/thousand m^3	According to statistic data of Nizhny Novgorod CHP	33.49
Efficiency factor of gas fired boilers	η_{NG}	-	Reference data [R4]	0.94

The proportion of heat for auxiliary needs of gas fired boilers	HA_{NG}	-	Reference data [R5]	0.0232
Decrease of natural gas consumption at Nizhny Novgorod CHP plant	$\Delta FC_{NG,y}$	GJ /year	$\Delta FC_{NG,y} = \frac{HS_{new,y} K_{cog}}{\eta_{NG}(1 - HA_{NG})K_{HF}}$	926 017
	$\Delta FC^{V}_{NG,y}$	thousand m^3/year	$\Delta FC^{V}_{NG,y} = \frac{FC_{NG,y}}{NCV_{NG}}$	27 654

As Table B.1-3 shows, reduction of natural gas consumption at Nizhny Novgorod CHP plant will make 926 017 GJ/year, or 27 654 thousand m^3/year.

Electricity consumption

Electricity is supplied from the grid. The project does not stipulate for power generation at Volga PPM's site so far.

Electricity consumption for auxiliary needs of the mill will increase by 16 058 MWh/year as a result of the project implementation (Table B.1-4). This will result in increase of electricity production in the grid and correspondingly in the increase of GHG emissions.

However this was excluded from further analysis as increased GHG emissions in the grid will be fully compensated by reduced fugitive leakages of methane at natural gas production and transportation (see Section B.2 for details).

Table B.1-4. Electricity consumption under the project [R1]

Value name	Units	Sludge preparation unit	Bark preparation unit	Boiler house	Total under the project
Voltage:					
supply	kV	6	6	6	-
power collectors	kV	0.4	0.4	0.4	-
electrical lightning	V	220	220	220	-
Total design load	kW	136	802	1024	1 962
including:					
power consumers	kW	126	790	1003	1 919
electrical lightning	kW	10	12	21	43
Total annual electricity consumption	MWh	1 080	6 589	8 389	**16 058**
including:					
technological needs	MWh	850	6 541	8 280	15 671
ventilation	MWh	190	-	25	215
electrical lightning	MWh	40	48	84	172

Dumping of BWW and sludge

As a result of the project, the amount of BWW and sludge dumped will decrease by the amount of BWW and sludge utilized in the new boiler house (see Table B.1-1). This would not effect absolute methane emissions from the landfill related to the BWW and sludge dumped there in the previous years.

That's why there is no need to use historic values of dumped BWW and sludge. The project would help to avoid additional methane emissions related to BWW and sludge utilized in the new boiler house. The relevant calculations are provided in Section E.

The results of the calculations for the whole reporting period 2008-2012 are provided in Annex 2.1-2.2.

Fugitive methane emissions at natural gas production and transporting

As a result of the project fugitive methane emissions at natural gas production and transporting will be decreased due to reduction of natural gas use at Nizhny Novgorod CHP plant (see Table B.1-3). However these reductions were excluded from further review as they were compensated by increased grid electricity consumption for auxiliary needs of the boiler house (see detailed description in Section B.3).

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:

The additionality is reviewed according to "Tool for the demonstration and assessment of additionality (Version 03)" [R6].

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

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

The following alternatives to the project activity have been identified:

Alternative 1: Heat supply from nearby Nizhny Novgorod CHP plant.

Alternative 2: Construction of Volga PPM's own BWW and sludge boiler house as not JI project.

Alternative 3: Construction of Volga PPM's own fossil fuel fired boiler house.

Below the detailed analysis of each alternative is provided.

Alternative 1: Heat supply from Nizhny Novgorod CHP plant.

Nizhniy Novgorod CHP plant is located 5 km away from Volga PPM. It is fired with natural gas (87.2%) and fuel oil (12.8%). At present (before the project) heat supply from the CHP plant covers all technological loads of the mill. On this basis the mill could successfully go on working and developing without investing material resources into construction of its own boiler house.

Basing on the above, *Alternative 1* can be considered business-as-usual and has been selected as the most probable baseline.

Alternative 2: Construction of BWW and sludge boiler house as not JI project.

Since BWW and sludge from treatment facilities are formed at the mill's site they can be used as a fuel to generate heat for the mill's needs. The construction of the boiler house would allow replacing part of the heat supplied from Nizhny Novgorod CHP plant. However the implementation of this alternative is connected with considerable difficulties (see Investment and Barrier analyses).

Alternative 3: Construction of Volga PPM's own fossil fuel fired boiler house.

This alternative is the least probable as nearby there is an existing energy source working on natural gas (Nizhny Novgorod CHP plant). First, construction of its own boiler house working on natural gas would face the problem with granting quota for gas consumption. Secondly, efficiency of gas consumption in the boiler house would be considerably lower as compared to Nizhny Novgorod CHP plant working on the cogeneration principle and production cost would be higher correspondingly.

Construction of fuel oil boiler house is unlikely due to the high prices of fuel oil (currently 200 €/t). It is the most expensive power-plant fuel. It is evident that fuel oil consumption as fuel is the most unreasonable variant from the economic point of view.

Construction of boiler house running on coal is unlikely as coal combustion technology would require alienation of large territories for fuel store and ash-and-slag landfill. This would be problematic as the place for construction of the boiler house is located within the enterprise. Besides more harmful emissions into the atmosphere are produced at coal combustion compared with combustion of other kinds of fuel. In this connection there could arise restrictions for the project implementation from environmental legislation of Russia.

Based on the above *Alternative 3* is considered unlikely and was excluded.

Thus the two alternatives to the project scenario that can serve as the baseline remains, namely:

Alternative 1: Heat supply from nearby Nizhny Novgorod CHP plant.
Alternative 2: Construction of Volga PPM's own BWW and sludge boiler house as not JI project.

Sub-step 1b. Consistency with mandatory laws and regulation

There are no prohibitions of Russia legislation for implementation of the above listed alternatives.

STEP 2. Investment analysis

Main economic parameters for the two variants of the project implementation were compared:

(a) project as not JI;

(b) project as JI.

Estimated project investment costs are 28 million euro.

ERU price (2008-2012) is assumed 12 euro/t CO_2.

Time horizon of the analysis is limited to 25 years (2008-2032).

The applicable discount rate was determined using one of the most widespread methods, which is the cumulative method of risk premium estimation[1]. This method is based on the following formula:

$$R = R_f + R_1 + ... + R_n, \quad (B.2\text{-}1)$$

where R is desired discount rate;
R_f is risk free profit rate;
R_1, ..., R_n are risk premiums on various risk factors.

Government securities are usually considered as (conventionally) risk free. Eurobonds Russia-30 with the 30 years maturity period can be considered as such at the moment in Russia. The profit rate of the Eurobonds was a bit higher than 5.5% per annum as of March 2007[2].

Besides, country risk, the risk of insecure partners (suppliers) and the risk not to receive the projected profit can be considered applicable to the project. The fact that Volga PPM has no vast experience in energy generation should also be taken into account. Assuming that each of the above risks requires at least 5% risk premium on average, the total risk premium could be set at 15% as minimum which leads to a final discount rate of 5.5%+3x5%=20.5%.

However, following the conservative approach, the discount rate for the project was set at 20%. This discount rate corresponds to the profitability (yield) of investments into pulp and paper production that is the core business of Volga PPM.

[1] http://www.fd.ru/article/1716.html

[2] http://analitika.aton.ru/themes/analitika/key-figures-index.asp?folder=1631

The results of NPV and IRR calculations of two variants of the project implementation are given in Table B.2-1. According to the calculations, the project implementation as not JI shows negative NPV and IRR less than 20% whereas additional revenues from emission reduction sale considerably increase the attractiveness of the project: NPV = 34 828 EUR, IRR = 22,02% > 20%.

Table B.2-1. Comparison of NPV and IRR

Value name	Unit	Project as not JI	Project as JI
NPV	000 EUR	-48 471	34 828
IRR	%	17.50	22.02

The project sensitivity to the change of main parameters is analyzed below (see Table B.2-2). The project is more stable against risks due to the revenues from GHG emission reduction sale.

Table B.2-2. Sensitivity analysis

Data name	Unit	Project as not JI	Project as JI
1) Increase of investment costs by 5%			
NPV	thousand euro	-63 022	20 278
IRR	%	16.87%	21.13%
2) Steam underproduction by 5%			
NPV	thousand euro	-71 410	11 889
IRR	%	16.34%	20.69%
3) Current costs increase by 5%			
NPV	thousand euro	-61 414	21 885
IRR	%	16.87%	21.27%

Thus the project only becomes financially viable if the revenues from CO_2 emission reduction sale are considered and can not be considered viable otherwise.

STEP 3. Barrier analysis

Three types of barriers for the project implementation can be singled out:

1. technological barriers;
2. operational barriers;
3. financial barriers;

Technological barriers

BWW and sludge from waste water treatment facilities are both difficult-to-burn fuels. The main reasons for that are:

- high moisture content of both BWW and sludge, and

- heterogeneous fraction structure of BWW.

Because of that, technologies applicable for mixed BWW and sludge combustion are more complicated and expensive as compared to natural gas or liquid fuel combustion. Besides, a complicated multistage system for BWW and sludge preparation and feeding into the boiler shall be implemented which is not the case for natural gas or liquid fuel combustion.

High moisture content of BWW and sludge makes the calorific value as well as the adiabatic combustion temperature, and hence, the stability of the combustion process decrease that leads to lower efficiency of the boiler unit operation. Compare: efficiency factor of fuel oil and gas boilers is 89-94% while that of BWW boiler is 70-85%. Besides, BWW boilers should have bigger tail and convective heating surfaces to provide for decrease of effluent gases temperature to 110...120 ^{o}C. No boilers fired with sludge only exist so far.

BWW fraction structure should be optimized to fit the requirements of combustion unit. If the particles are too small they can fall through the fire grate or be carried out of furnace with smoke fumes without burning. On the contrary, the particles that are too big can disable the fuel feeding system and prevent normal furnace burning mode. In both cases the efficiency of combustion would decrease. Moreover, for the stable operation of the boiler, BWW and sludge should be uniformly mixed at feeding into the boiler which in practice is extremely difficult (and sometimes even impossible) to implement. To provide for BWW and sludge preparation and prior treatment before feeding into the boiler, the bark preparation unit was procured from Saalasti Oy (Finland), and the sludge preparation unit – from MCE (Austria).

It should be noted that metal contamination (wire, metal plates, tracks, etc.) and other foreign inclusions come to conveyor belts together with BWW. Electric magnets are used for metal collection from the conveyor belt; however they are far from collecting 100% of metal. Part of inclusions has to be removed from conveyors manually. Therefore permanent presence of the operational personnel on site is required unlike in the case of natural gas or fuel oil combustion.

As BWW contain mineral admixtures which form ash and slag at burning it is necessary to install additional high-performance ash collector. For this purpose, Volga PPM will install multistage effluent gas treatment system which includes multicyclones (the first treatment stage) and electrofilter (the second stage) that in addition makes the project more complicated and expensive. Slag and ash formed in the combustion process are necessary to be carried out of furnace and ash collectors and transported to ash and slag disposal area.

Finally, sharply varying moisture content and fraction structure of BWW and sludge mixture require more complicated and expensive automation and control system to provide for efficient combustion of mixed BWW and sludge fuel while in the meantime making this system less reliable. Thus, the mill had to develop and install integrated automatic control system that allows centralized automatic control of all BWW and sludge preparation, feeding and combustion stages. At implementing this, Volga PPM faced even higher challenge since the equipment was designed and supplied by different companies from various countries. As was mentioned above, the equipment for the bark preparation was supplied by Saalasti (Finland), for sludge preparation – by MCE (Austria), and for the boiler itself – by Wellons (USA).

Due to high cost of equipment for feeding water preparation, the decision was made to use the steam condensate instead of fresh water. However according to the agreement between Volga PPM and Nizhny Novgorod CHP plant, the amount of return condensate should not be less than 50% of the incoming steam. In order to maintain this proportion, Volga PPM had to implement additional measures aimed at saving of condensate in the main production.

On the whole, the implementation of the project appeared to be a real technological challenge for Volga PPM.

Operational barriers

Volga PPM has never installed and used the boiler of this type and capacity. The mill has faced certain difficulties already at the equipment assembly stage and will undoubtedly suffer further difficulties at the operation stage as well.

First of all, instable parameters of BWW and sludge can result in the instability of the parameters of the generated steam. Moreover, since only one boiler is being installed under the project there is a risk for the mill to run out of heat in case of the boiler breakdown. Altogether this can impact badly upon the operation of the mill.

Secondly, to operate such complicated equipment it is necessary to employ highly qualified personnel and organize its training and certification. Volga PPM had to send some of its employees to the USA where they were trained to maintain and operate the new boiler house. This was both cash and time consuming. Besides, higher motivation, culture, skills and knowledge of the personnel (workers, engineers and managers) are required for the operation of high technology equipment.

Financial barriers

High costs of imported equipment, its delivery, custom clearance, commissioning and personnel training as well as high costs of equipment operation and repair are the main financial barriers of the project.

Due to the lack of the mill's own funds, the main equipment under the project was procured via financial leasing that resulted in further increase of the project costs due to the lease payments.

High opportunity cost of capital should also be mentioned as a kind of financial barrier. Investments into extension and modernization of the main production facilities including introduction of modern energy saving technologies of paper production could bring good profit at lower risks compared to the project under consideration.

Because of relatively low investment attractiveness of the project and the barriers for its implementation, Volga PPM's management from the very beginning considered the opportunity of attracting funds for the project through greenhouse gas emission reduction sale under the Kyoto Protocol. For this purpose in September 2005, Volga PPM asked ANO "Environmental investment center" to estimate greenhouse gas emission reductions under the project and later, in February 2006, basing on the report prepared by the Center, signed an Agreement with CAMCO International GmbH for carbon assets development and trade.

STEP 4. Common practice analysis

The common practice for the pulp-and-paper industry in Russia is self-production of energy at there own energy sources (CHP plants, boiler houses) using fossil fuels, i.e. natural gas, coal or fuel oil, and partly – wood waste. At pulping mills, black liquor which is a by-product of pulping is also used as a fuel. Among the wood waste sawdust, nonstandard chips, as well as furniture and plywood production wastes are used.

Bark is basically dumped as its combustion is rather difficult. Only a small portion of bark is normally combusted together with sawdust and other low-moister wood waste. Sludge coming from waste water treatment facilities is traditionally stored at the specialized landfills (reservoirs) for liquid wastes which practice is not restricted and considered acceptable by the Russian environmental legislation.

In our point of view the given reasons prove quite evidently that GHG emission reductions from JI project implementation are additional to any that would otherwise occur.

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

Main components and boundaries of the project are shown at Figure B.3-1.

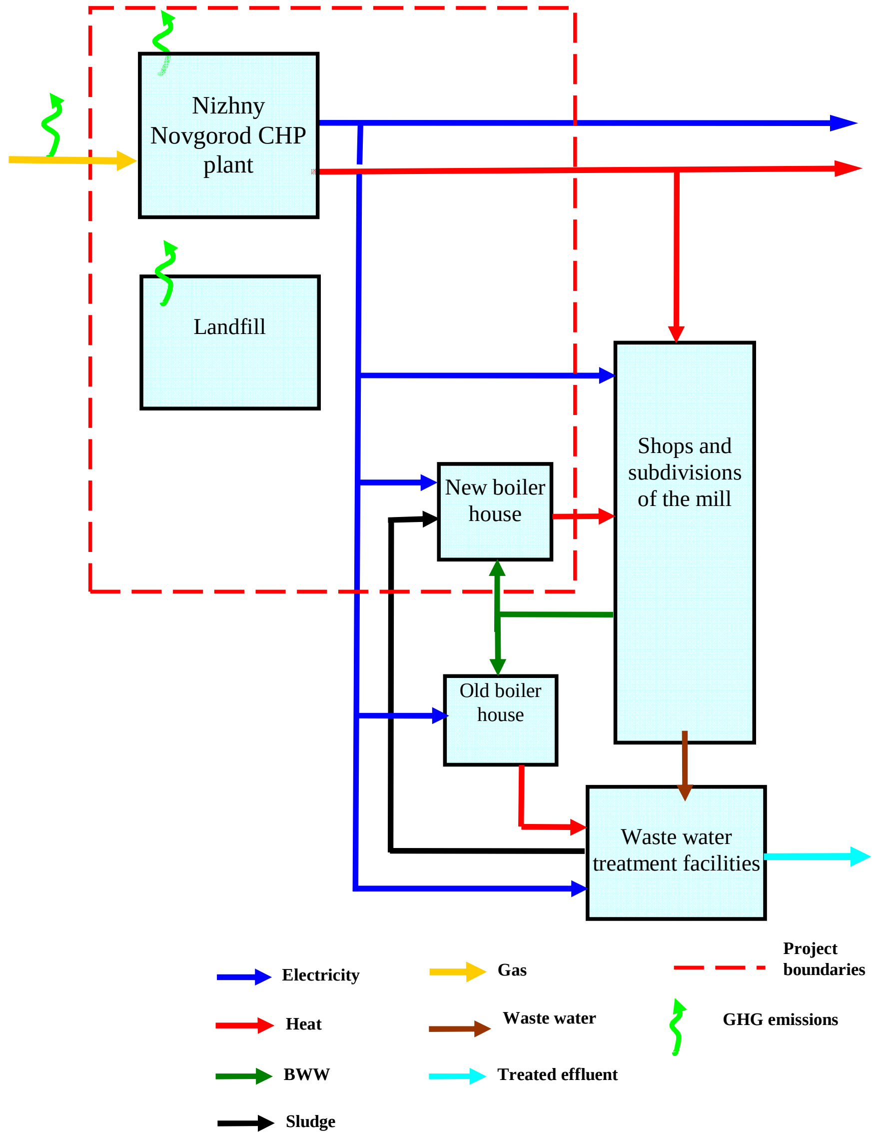

Figure B.3-1. Main components and boundaries of the project

Table B.3-1 illustrates which gases emission sources are included in or excluded from the project boundaries. Possible leakages are also specified here.

Table B.3-1. Emission sources included in or excluded from consideration

	Source	Gas	Incl./Excl.	Justification / Explanation
Baseline	Nizhny Novgorod CHP plant, natural gas and fuel oil combustion for heat supply of Volga PPM	**CO_2**	**Incl.**	**Main emission source**
		CH_4	Excl.	Considered negligible. This is conservative.
		N_2O	Excl.	Considered negligible. This is conservative.
	Dump of industrial waste, waste from anaerobic BWW and sludge decomposition	CO_2	Excl.	Considered equal zero.
		CH_4	**Incl.**	**Main emission source**
		N_2O	Excl.	Considered negligible. This is conservative.
	Old boiler house (sawdust burning at the waste water treatment facilities)	CO_2	Excl.	Considered equal zero.
		CH_4	Excl.	Considered negligible.
		N_2O	Excl.	Considered negligible.
Project Activity	Nizhny Novgorod CHP plant, natural gas and fuel oil combustion for heat supply of Volga PPM	**CO_2**	**Incl.**	**Main emission source**
		CH_4	Excl.	Considered negligible.
		N_2O	Excl.	Considered negligible.
	Dump of industrial waste, waste from anaerobic BWW and sludge decomposition	CO_2	Excl.	Considered equal zero.
		CH_4	**Incl.**	**Main emission source**
		N_2O	Excl.	Considered negligible.
	Old boiler house (sawdust burning at treatment facilities)	CO_2	Excl.	Considered equal zero.
		CH_4	Excl.	Considered negligible.
		N_2O	Excl.	Considered negligible.
	New boiler house of the enterprise, BWW and sludge burning	CO_2	Excl.	Considered equal zero.
		CH_4	Excl.	Considered negligible.
		N_2O	Excl.	Considered negligible.
Leakage	Reduction of natural gas production and transportation	CO_2	Excl.	Considered negligible. This is conservative.
		CH_4	Excl.	Excluded from consideration as leakages reduction is compensated by the increase of electricity production for grid under the project
		N_2O	Excl.	Considered negligible. This is conservative.

According to IPCC [R7], average amount of fugitive methane emissions for developing countries and countries with transitional economics is given in Table B.3-2:

Table B.3-2. Fugitive CH_4 emissions from Natural Gas System

Category	Sub-category	CH4	Units
Gas production	Fugitives	0.01219	$Gg/10^6$ m³
	Flaring	0.00000088	$Gg/10^6$ m³
Gas transmission	Fugitives	0.000633	$Gg/10^6$ m³
	Venting	0.000392	$Gg/10^6$ m³
Gas distribution	All	0.0018	$Gg/10^6$ m³
Total	-	**0.015016**	**$Gg/10^6$ m³**

If natural gas consumption decreases in the amount of 27.654×10^6 m^3 per year under the baseline scenario fugitive methane emissions will decrease by 27.654×0.015016×1000=415.25 t CH_4 or 415.25×21= 8 720 t CO_2-e/year.

Increase of GHG emissions from grid electric power plants was 8 825 t CO_2-e/year (see Table B.3-3).

Table B.3-3. GHG emissions from increase of fuel consumption by grid CHP plants

Parameter	Symbol	Units	Justification	Value
Electricity consumption for auxiliary needs of the boiler house	ΔEC_{aux}	MWh/year	See Table B.1-3.	16 058
CO_2 emission factor fro grid electricity	$EF_{CO2,grid}$	t CO_2-e/MWh	According to [R8]	0.5496
Increase of CO_2 emissions from fossil fuel combustion at grid CHP plants	ΔE_{grid}	t CO_2-e/year	$\Delta E_{grid} = EC_{aux} \times EF_{CO2,grid}$	**8 825**

Thus increase of GHG emissions from grid electric power plants (8 825 t CO_2-e/year) is compensated with fugitive methane emission reductions at natural gas production and transporting (8 720 t CO_2/year). Therefore fugitive methane emissions and GHG emissions from grid electric power plants are excluded from consideration.

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 BL setting – 3 September 2007

BL was developed by Camco International GmbH

Contact person: Vladimir Dyachkov

E-mail: vladimir.dyachkov@camco-international.com

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

November 2006 (start of construction works).

C.2. Expected operational lifetime of the project:

25 years/300 months

C.3. Length of the crediting period:

5 years/ 60 months (the first crediting period under the Kyoto Protocol – from the 1st January 2008 till the 31st December 2012)

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

On the whole, all the key parameters required for determination of GHG emissions reductions will be collected in accordance with the developed system of fuel, energy and wastes metering and record keeping and environmental impact assessment system.

Location of the monitoring points is shown in Annex 3.

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

This Option is not applied to the project monitoring.

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:

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

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)	Comment

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 from the project (values should be consistent with those in section E.):

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

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1. $HS_{new,y}$	Heat supply from the new boiler house	Department of the Chief Energy Engineer	GJ	m	Continuously	100 %	Electronic and paper	Heat meter readings
2. $FC_{BWW,new,y}$	Total BWW consumption at the new boiler house	Department of the Chief Energy Engineer	t	m	Continuously	100 %	Electronic and paper	Weigher (on the conveyor)
3. $FC^{outside}_{BWW,new,y}$	Consumption of BWW delivered from outside in the new boiler house	Department of the Chief Energy Engineer	t	m	As BWW are delivered	100 %	Electronic and paper	A metering and weighing unit for BWW, delivered by motor transport from outside
4. $FC_{sludge,y}$	Sludge consumption in the boiler house	Department of the Chief Energy Engineer	t	m	Continuously	100 %	Electronic and paper	Weigher (on the conveyor)
5. $W_{sludge,y}$	Moisture of sludge	Chemical laboratory	%	m	Daily	100 %	Electronic and paper	The average value is determined at the end of the year

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):

GHG emission reductions over a year *y*, t of CO_2-eq:

$$ER_y = ER_{CHP,y} + ER_{BWW,dump,y} + ER_{sludge,dump,y}, \quad \text{(D.1-1)}$$

where $ER_{CHP,y}$ is reduction of CO_2 emission from natural gas combustion at Nizhniy Novgorod CHP plant over a year *y*, t CO_2;

$ER_{BWW,dump,y}$ is reduction of CH_4 emission from anaerobic decay of dumped BWW over a year *y*, t CO_2-eq;

$ER_{sludge,dump,y}$ is reduction of CH_4 emission from anaerobic decay of dumped sludge over a year *y*, t CO_2-eq.

$$ER_{CHP,y} = \frac{HS_{new.y}\ K_{cog}}{\eta_{NG}(1 - HA_{NG})K_{HF}} \times EF_{CO2,NG}, \quad \text{(D.1-2)}$$

where $HS_{new.y}$ is heat supply from the new boiler house, GJ/year;

K_{cog} is cogeneration factor, K_{cog} = 0.7095 (power characteristic of turbine);

η_{NG} is efficiency factor of gas boilers, normative value η_{NG} = 0.94 [R4];

HA_{NG} is share of heat for auxiliary needs of gas boilers, normative value HA_{NG} = 0.0232 [R5];

K_{HF} is factor of heat flow at CHP plant, normative value K_{HF} = 0.98 [R9];

$EF_{CO2,NG}$ is CO_2 emission factor for natural gas, according to IPCC [R7] CO_2 emission factor for natural gas combustion for the whole project period is taken equal to the constant value: $EF_{CO2,NG}$ =56.10× 0.995= 55.82 kg CO_2/GJ (taking into account oxidation factor).

Numerical values of $ER_{BWW,dump,y}$ are determined by the "Calculation of CO_2-equivalent emission reduction from BWW prevented from stockpiling or taken from stockpiles" model developed by BTG biomass technology group B.V. The values of constants used in the model are explained and justified in Section E.

In this model variable parameters for a year y are mass amounts of BWW $FC_{BWW,new,y}^{inside}$ and sludge $FC_{sludge,y}^{dry}$ generated at the mill and burnt in the new boiler house over a year y. For BWW we take as-received mass in tonnes, and for sludge we take absolutely dry mass in tonnes of a.d.m.

$$FC_{BWW,new,y}^{inside} = FC_{BWW,new,y} - FC_{BWW,new,y}^{outside}, \qquad (D.1\text{-}3)$$

where $FC_{BWW,new,y}$ is total consumption of BWW in the new boiler house over a year y, t;

$FC_{BWW,new,y}^{outside}$ is consumption of BWW delivered from outside in the new boiler house over a year y, t.

$$FC_{sludge,y}^{dry} = FC_{sludge,y} \frac{100 - W_{sludge,y}}{100}, \qquad (D.1\text{-}4)$$

where $FC_{sludge,y}$ is as-received (wet) mass amount of sludge, burnt in the new boiler house over a year y, t;

$W_{sludge,y}$ is sludge moisture, %.

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

As shown in Section B.3 all of the leakages 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)	Comment

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

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

See Section D.1.2.2.

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:

A special environmental department is operating at the enterprise. The department's activities are guided by the current legislation, orders and instructions of the Director General, prescriptions of the State Environmental Monitoring Service, the Committee on Natural Resources of Nizhniy Novgorod Region. The department has highly qualified personnel at its disposal and is able to ensure appropriate environmental monitoring under the project.

The department monitors:

- gas-dust emissions;
- quality of waste water and river water;
- utilization, storage, transportation and disposal of industrial waste.

In the process of the project implementation, analytical control over various environmental effects will, as it is today, be exercised in compliance with the existing rules and regulations. The data obtained by the analytical laboratory are processed and summarized in monthly and annual reports, which specify all the required detailed data, including data for the sections affected by the project.

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:		
Data *(Indicate table and ID number)*	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
Tabl. D.1.2.1 ID 1	Low	Heat meters are regularly calibrated and the readings are regularly cross-checked with the balance data.
Tabl. D.1.2.1 ID 2, 3, 4	Low	Weighing equipment is regularly calibrated (once/twice per year).
Tabl. D.1.2.3 ID 5	Low	Laboratory equipment is regularly calibrated (once per year).

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

Input data for emissions monitoring will be provided by the Ecological Department, the Chief Energy Engineer Departments and by the Production and Technical Department.

Calculations of emission reductions will be prepared by specialists of "Camco International" at the end of each reporting year.

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

Monitoring plan was developed by Camco International GmbH

Contact person: Vladimir Dyachkov
E-mail: vladimir.dyachkov@camco-international.com

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

This Option is not applied to estimation of greenhouse gas emission reductions

E.2. Estimated leakage:

Leakages can be neglected.

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

Since leakages and estimated project emissions can be neglected, then: E.1+E.2=0.

E.4. Estimated baseline emissions:

In this section we consider baseline GHG emissions to be GHG emissions at Nizhniy Novgorod CHPP from natural gas combustion for heat production, which will be covered by the new boiler house, as well as emissions from stockpiling of those BWW and sludge, which will be burnt in the new boiler house:

$$BE_y = BE_{NG,CHP,y} + BE_{BWW,dump,y} + BE_{sludge,dump,y}, \quad \text{(E.4-1)}$$

where $BE_{NG,CHP,y}$ is GHG emission from combustion of natural gas at Nizhniy Novgorod CHPP to cover for production of heat, which will be supplied by the new boiler house, t CO_2-e;

$BE_{BWW,dump,y}$ is GHG emission from decay of the dumped bark and wood wastes, which will be burnt in the new boiler house under the project, tCO_2-e;

$BE_{sludge,dump,y}$ is GHG emission from decay of the dumped sludge, which will be burnt in the new boiler house under the project, tCO_2-e.

$$BE_{NG,CHP,y} = FC_{NG,CHP,y} \times EF_{CO2,NG} \quad , \quad \text{(E.4-2)}$$

where $FC_{NG,CHP,y}$ is amount of natural gas burnt at Nizhniy Novgorod CHPP , GJ/year;

$EF_{CO2,NG}$ is CO_2 emission factor for natural gas, according to IPCC [R7] CO_2 emission factor for natural gas combustion for the whole project period is taken equal to the constant value: $EF_{CO2,NG}$ =56.10× 0.995= 55.82 kg CO_2/GJ (taking into account oxidation factor).

$$FC_{NG,CHP,y} = \frac{HS_{new.y} \ K_{cog}}{\eta_{NG}(1 - HA_{NG})K_{HF}}, \quad \text{(E.4-3)}$$

where $HS_{new.y}$ is heat supply from the new boiler house, GJ/year;

K_{cog} is cogeneration factor, K_{cog} =0.7095 (power characteristic of turbine);

η_{NG} is efficiency factor of gas boilers, normative value η_{NG} = 0.94 [R4];

HA_{NG} is share of heat for auxiliary needs of gas boilers, normative value HA_{NG} = 0.0232 [R5];

K_{HF} is factor of heat flow at CHPP, normative value K_{HF} = 0.98 [R9];

$EF_{CO2,NG}$ is CO_2 emission factor for natural gas, according to IPCC [R7] CO_2 emission factor for natural gas combustion for the whole project period is taken equal to the constant value: $EF_{CO2,NG}$ =56.10× 0.995= 55.82 kg CO_2/GJ (taking into account oxidation factor).

Numerical estimations of avoided landfill methane emissions from anaerobic decay of BWW and sludge were conducted with the help of the model *"Calculation of CO_2-equivalent emission reduction from BWW prevented from stockpiling or taken from stockpiles»* developed by the *"BTG biomass technology group B.V."* for the World Bank. The model is based on the *First Order Decay method* with experimental specification of a number of parameters for waste wood landfills.

The input values for estimation of methane emission reductions allowed to be changed in this model (or accepted on default) are as follows:

1. *Methane concentration biogas*. Default value: 60%. Due to the conservative approach the value for BWW and sludge was accepted equal 50%.
2. *Half-life biomass.* The accepted default recommended value for BWW and sludge: 15 years.
3. *Generation factor*. The accepted default recommended value for BWW and sludge: 0.77.
4. *Methane oxidation factor.* The accepted default recommended value for BWW and sludge: 0.10.
5. *Percentage of the stockpile under aerobic conditions.* Default value: 10%. Taking into consideration that the new landfill has been opened quite recently, a more conservative value of 20% was accepted for BWW and sludge.
6. *Organic carbon content (dry basis).* The default value proposed for BWW is 53.6%; we accepted a more conservative value of 50%. Based on a number of analyses conducted, the same value for WWS fluctuates between 34-55%; the value accepted was smaller: 34%.
7. *Moisture content.* The default value proposed for BWW is 55%; we accepted a more conservative value of 55%. Moisture for WWS is 0% as its quantity is input recalculated into absolutely dry matter.
8. *Lignin fraction of C.* The accepted default recommended value for BWW and WWS: 0.25.
9. *Year in which fresh biomass is utilized instead of stockpiled*. 2008 was accepted.
10. *Year for which to calculate the CO_2-equivalent reduction.* 2008 was accepted.
11. *Amount of fresh biomass utilized.* Annual data on the reduced amounts of BWW (tons per year) and sludge (tons of a.d.m. per year) taken to the landfill resulting from the project for the period till 2012 were input.

The results of baseline GHG emissions estimation for the period up to 2012 are presented in Table E.4-1 and in Annexes 2.1, 2.2.

Table E.4-1. Baseline GHG emissions, t CO_2

Value name	Reporting year					2008-2012
	2008	2009	2010	2011	2012	
Total GHG emissions	62 830	73 467	83 623	93 321	102 580	**415 821**
CO_2 from fossil fuel combustion	51 690	51 690	51 690	51 690	51 690	258 451
CH_4 from BWW decay at landfills	9 556	18 681	27 394	35 713	43 657	135 002
CH_4 from sludge decay at landfills	1 583	3 095	4 539	5 917	7 233	22 367

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

GHG emissions reduction is shown in Table E.5-1.

Table E.5-1. Reduction of GHG emissions, t CO_2-eq.

Value name	Reporting year					2008-2012
	2008	2009	2010	2011	2012	
Total GHG emissions	62 830	73 467	83 623	93 321	102 580	**415 821**
CO_2 from fossil fuel combustion	51 690	51 690	51 690	51 690	51 690	258 451
CH_4 from BWW decay at landfills	9 556	18 681	27 394	35 713	43 657	135 002
CH_4 from sludge decay at landfills	1 583	3 095	4 539	5 917	7 233	22 367

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

Year	Estimated project emissions (tonnes of CO2 equivalent)	Estimated leakage (tonnes of CO2 equivalent)	Estimated baseline emissions (tonnes of CO2 equivalent)	Estimated emission reductions (tonnes of CO2 equivalent)
2008	0	0	62 830	62 830
2009	0	0	73 467	73 467
2010	0	0	83 623	83 623
2011	0	0	93 321	93 321
2012	0	0	102 580	102 580
Total (tonnes of CO_2 equivalent)	**0**	**0**	**415 821**	**415 821**

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts of the project, including transboundary impacts, in accordance with procedures as determined by the host Party:

The project underwent the state environmental review in compliance with the Federal Law "On Environmental Review" and received the environmental seal of approval Ref No. 01-02/347 dated 22.03.2006.

Estimated data on pollutant emissions under the project as compared to the baseline are presented in Table F.1-1.

Table F.1-1. The specification and amount of pollutants emitted into the atmosphere by Volga PPM before and after the project, t/year; (+) - increase, (-) - decrease)

Substance	Emissions, t/year		
	Under the baseline	Under the project	Change in emissions
Iron trioxide (iron oxide)	0.523	0.523	-
Manganese and its compounds	0.026	0.026	-
Sodium hydroxide (sodium hydroxide)	0.000106	0.000106	-
Sodium sulphite	0.029	0.029	-
Tin oxide	0.0000098	0.0000098	-
Lead and its inorganic compounds	0.0000196	0.0000196	-
Hexavalent chromiun (calculated as chromium (VI) oxide)	0.002	0.002	-
Nitrogen dioxide (nitrogen (IV) oxide)	1.225	280.383	+279.158
Ammonia	0.098	0.098028	+0.000028
Nitrogen (II) oxide (nitrogen oxide)	0.019	45.519	+45.5
Carbon (soot)	3.806	3.698508	-0.107492
Sulfur dioxide (sulphurous anhydride)	1.176	421.13373	+419.95773
Hydrogen sulphide (dihydrosulphide)	1.466	0.61582	-0.85018
Carbon oxide	2.834	351.9767	+349.1427
Gaseous fluorides	0.017	0.017	-
Inorganic fluorides very soluble	0.02	0.02	-
Mixture of saturated hydrocarbons C1-C5	0.204	0.204	-
Mixture of saturated hydrocarbons C6-C10	0.11	0.11	-
Pentylene (amylene - isomeric mixture)	0.015	0.015	-
Aromatic hydrocarbons	0.00018	0.00018	-

Substance	Emissions, t/year		
	Under the base-line	Under the pro-ject	Change in emis-sions
Benzene	0.012	0.012	-
Xylol (dimethylbenzene)	0.00089	0.00089	-
Toluene	0.421	0.421	-
Ethyl benzene	0.000298	0.000298	-
Benzpyrene (3,4- benzpyrene)	0.000015	0.000018	+0.000003
Butanol (butyl alcohol)	0.139	0.139	-
Ethanol (ethyl alcohol)	0.139	0.139	-
Hydroxy benzene (phenol)	0.011	0.011002	+0.000002
2-cellosolve	0.074	0.074	-
Butyl acetate	0.092	0.092	-
Acetone (2-propanone)	0.531	0.531	-
Petroleum hydrocarbon	0.088	0.088	-
Kerosene	0.815	0.610393	-0.204607
Mineral petroluem oil	0.000016	0.000016	-
Saturated hydrocarbon C12-C19	0,193	0,193	-
Suspended matter	0.143	58.483	+58.34
Nonorganic dust: 70-20% SiO2	0.029	0.029	-
Fly grit (White corundum)	0.005	0.005	-
Wood dust	1.084	1.084	-
Paper dust	3.281	3.281	-
Total	**18.629**	**1169.565**	**+1150.936**

Overall increase in emissions of NOx, sulphur dioxide, carbon oxide, benzpyrene, suspended particles at the mill will be mainly caused by combustion of BWW and sludge in a new boiler manufactured by Wellons. At the same time upon commissioning of the boiler, emissions of nitrogen dioxide, soot, sulphur dioxide, carbon oxide and hydrocarbons (kerosene) from source No.0071 are eliminated because operation of bulldozer engine is no longer required for leveling and profiling the disposal site.

By means of recultivation of the disposal site, emissions of hydrogen sulphide from the enterprise will be reduced (emission source No.0071 is eliminated).

At the same time construction of the BWW and sludge utilization line will enable to avoid land alienation for waste dumping.

Furthermore, since Volga PPM is switching to heat supply from its own boiler house, the load of Nizhniy Novgorod CHPP, which is now supplying heat to Volga PPM, will decrease, and therefore emissions from the CHPP will be reduced accordingly.

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:

Environmental impacts are not considered significant.

SECTION G. Stakeholders' comments

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

The letter of approval has been received from the government of Nizhniy Novgorod region dated May,15, 2006. The government decided to grant priority status to JSC Volga's investment project "Combustion of Bark and Wood Waste and Sludge in Boiler" with state support in a non-financial form (backing (submission) of petitions and appeals to the federal authorities of the Russian Federation related to rendering assistance to investors in implementation of investment projects and/or dissemination of positive information about investors).

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[R5] Methodological guidelines for determination of fuel, energy and water consumption by heating boiler houses of municipal heat-and-power utilities for generating heat (4^{th} Edition). Moscow, 2002.

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[R7] 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2, Energy

[R8] Operational Guidelines for Project Design Documents of Joint Implementation Projects.Volume 1. General guidelines./ Version 2.2. Ministry of Economic Affairs of the Netherlands. June 2003

[R9] V.Y.Ryzhkin Thermal Power Plants. – M.: Energoatomizdat, 1987.

Annex 1

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Annex 2
BASELINE INFORMATION

Annex 2.1.
Estimated reductions of methane emissions from landfill because of anaerobic decay of BWW

Calculation of CO_2-equivalent emission reduction from BWW prevented from stockpiling or taken from stockpiles

General input data		
Conversion factor organic carbon to biogas (a)	1,87	m^3 biogas/kg carbon
GWP CH_4	21	
Density methane	0,654	kg/m^3
Methane concentration biogas	50%	
Half-life biomass (tau)	15	year
Decomposition constant (k)	0,046	$year^{-1}$
Generation factor (zeta)	0,77	
Methane oxidation factor	0,10	
Percentage of the stockpile under aerobic conditions	20%	

BWW - bark wood waste

LEGEND

db = dry basis
wb = wet basis
yellow cells = unprotected cells
red marks = comment field included

Spreadsheet model developed by:

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Biomass specific input data	Biomass from stockpile	Fresh	
Organic carbon content (db)		50,0%	db
Moisture content		55%	wb
Organic carbon content (wb)	0,0%	22,5%	wb
Lignin fraction of C		0,25	

Year	Fresh biomass prevented from stockpiling or taken from stockpile			Year									
	Biomass from stockpile (ton$_w$)	Age of biomass (years)	Fresh (ton$_w$)	2004 ton CO2-eq	2005	2006	2007	2008	2009	2010	2011	2012	Total
2004			0	0	0	0	0	0	0	0	0	0	0
2005			0		0	0	0	0	0	0	0	0	0
2006			0			0	0	0	0	0	0	0	0
2007			0				0	0	0	0	0	0	0
2008			172 141					9 556	9 125	8 713	8 319	7 944	84 328
2009			172 141						9 556	9 125	8 713	8 319	78 308
2010			172 141							9 556	9 125	8 713	72 003
2011			172 141								9 556	9 125	65 400
2012			172 141									9 556	58 484
2013													0
2014													0
2015													0
2016													0
2017													0
2018													0
2019													0
Total	0		**860 705**										
	Total emission prevention			**0**	**0**	**0**	**0**	**9 556**	**18 681**	**27 394**	**35 713**	**43 657**	**135 002**
	Cumulative total emission prevention			**0**	**0**	**0**	**0**	**9 556**	**28 238**	**55 632**	**91 345**	**135 002**	

Annex 2.2.

Estimated reductions of methane emissions from landfill because of anaerobic decay of sludge

Calculation of CO_2-equivalent emission reduction from WWS prevented from stockpiling or taken from stockpiles

WWS - waste water sludge

General input data		
Conversion factor organic carbon to biogas (a)	1,87	m^3 biogas/kg carbon
GWP CH_4	21	
Density methane	0,654	kg/m^3
Methane concentration biogas	50%	
Half-life biomass (tau)	15	year
Decomposition constant (k)	0,046	$year^{-1}$
Generation factor (zeta)	0,77	
Methane oxidation factor	0,10	
Percentage of the stockpile under aerobic conditions	20%	

LEGEND

db = dry basis
wb = wet basis
yellow cells = unprotected cells
red marks = comment field included

Spreadsheet model developed by:

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Biomass specific input data	Biomass from stockpile	Fresh	
Organic carbon content (db)		34,0%	db
Moisture content		0%	wb
Organic carbon content (wb)	0,0%	34,0%	wb
Lignin fraction of C		0,25	

Year	Fresh biomass prevented from stockpiling or taken from stockpile			Year									Total
	Biomass from stockpile (ton$_w$)	Age of biomass (years)	Fresh (ton$_w$)	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
				ton CO2-eq									
2004			0	0	0	0	0	0	0	0	0	0	0
2005			0		0	0	0	0	0	0	0	0	0
2006			0			0	0	0	0	0	0	0	0
2007			0				0	0	0	0	0	0	0
2008			18 874					1 583	1 512	1 444	1 378	1 316	13 971
2009			18 874						1 583	1 512	1 444	1 378	12 974
2010			18 874							1 583	1 512	1 444	11 929
2011			18 874								1 583	1 512	10 835
2012			18 874									1 583	9 690
2013													0
2014													0
2015													0
2016													0
2017													0
2018													0
2019													0
Total	**0**		**94 369**										
	Total emission prevention			**0**	**0**	**0**	**0**	**1 583**	**3 095**	**4 539**	**5 917**	**7 233**	**22 367**
	Cumulative total emission prevention			**0**	**0**	**0**	**0**	**1 583**	**4 678**	**9 217**	**15 134**	**22 367**	

Annex 3

MONITORING PLAN

Location of the Monitoring Points