



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

CONTENTS

- A. General description of the project
- B. Baseline
- C. Duration of the project / crediting period
- D. Monitoring plan
- E. Estimation of greenhouse gas emission reductions
- F. Environmental impacts
- G. Stakeholders' comments

Annexes

- Annex 1: Contact information on project participants
- Annex 2: Baseline information
- Annex 3: Monitoring plan

**SECTION A. General description of the project****A.1. Title of the project:**

Waste heat recovery using “Alfa Laval” heat exchangers at OJSC “Ilim Group” Branch in the town of Ust-Ilimsk, Russian Federation

Sectoral scope¹: Manufacturing industries (4)

Version: 1.1

Date: September 18, 2009

A.2. Description of the project:

The aim of the project is to recover low-grade heat of acid and alkaline waste streams from the pulp bleaching process at OJSC “Ilim Group” Branch in the town of Ust-Ilimsk (the former OJSC “Production Association “Ust-Ilimsk Timber Processing Complex””), the Irkutsk Region, Russia.

The principal product of Ust-Ilimsk Pulp and Paper Mill (UI PPM) is market bleached pulp. A large quantity of acid and alkaline waste streams with the temperature of about 60°C is produced in the pulp bleaching process. Prior to the project the heat of these waste streams had not been utilized. Bleaching waste streams are delivered for neutralization, mixed with cold water (in order to bring the temperature down to the permissible level of 40°C) and then to the waste water treatment plant. Such scheme of bleaching waste streams management was implemented in accordance with the design developed the whole enterprise. The baseline scenario is “business as usual”.

The central project measure is installation of coolers for bleaching waste streams – four plate heat exchangers manufactured by “Alfa Laval” with the total thermal capacity of about 50 MW, designed for cooling of acid and alkaline streams at two bleached pulp production lines. The cooling medium is water which is fed to the heat exchangers from the evaporator plant at 40°C. The water is heated up to 55°C by the heat of the waste streams and is further used for process needs in the Cooking-and-Washing (CWD), Bleaching-and-Cleaning (BCD) and in the Drying Departments. Thus, an additional water heating stage emerges due to which some of the heat carried by the bleaching waste streams is returned into the pulp production cycle, thus reducing the heating steam demand. The bleaching streams, in turn, are cooled down to the temperature of around 50°C, thereby reducing the consumption of fresh water required for diluting the waste streams before discharge.

At the same time the installation of bleaching waste stream coolers affected the operation of the heat exchangers designed for black liquor cooling and for condensation of waste gas-vapour streams from digesters in the CWD. Since the water temperature at the inlet to the heat exchangers has increased from 40°C to 55°C, the heat-exchange surface area is no longer adequate for efficient and stable performance of the equipment. Therefore, the project also involves replacing twelve shell-and-tube and plate-type coolers for black liquor and condensers for waste gas-vapour streams from the 1st and the 2nd digesters. These are to be replaced with Alfa Laval heat-exchangers that can ensure the required heat flow at a higher inlet temperature of water. In the absence of the project, there would be no need to replace the above mentioned heat exchangers of the CWD, because at the inlet water temperature of 40°C the heat exchange surface area would be quite sufficient, and the technical condition of the heat exchangers would allow their operation in customary mode for a long time yet.

Besides the installation of new heat exchangers caused the hydraulic resistance of water and waste streams to rise. Therefore the project implementation necessitated replacement of some pumps with more powerful ones.

The reduction of greenhouse gases (GHG) emissions due to the project is achieved by reduction of heat

¹ In accordance with the list of sectoral scopes adopted by the Joint Implementation Supervisory Committee.
http://ji.unfccc.int/Ref/Documents/List_Sectoral_Scopes.pdf



(steam) consumption for the Mill's process needs from the nearby Ust-Ilimsk combined heat and power plant (UI CHPP) with a proportional reduction of fossil fuel (coal) combustion thereat. UI CHPP is a part of OJSC "Irkutskenergo" and is the marginal source of energy for UI PPM.

The scale of the project makes it unique among the projects dealing with low-grade heat recovery in the pulp and paper industry of Russia. The project implementation faces technological and financial barriers which are overcome with the help of the joint implementation mechanism (JI). The possibility of procuring additional financing through sale of emission reduction units (ERUs) in the international market encouraged the company to launch the project.

The first step in the project implementation was signing by the First Deputy Director General of the order "On implementation of the BCD alkaline waste streams cooling project" No.252-a dated 02.12.2004. This order, inter alia, takes into account the ratification of the Kyoto Protocol by the Russian Federation. In view of the possibility of obtaining additional financing, the Head of the Environment and Production Control Department appointed a person responsible for coordination of work between "Ust-Ilimsk Timber Processing Complex" and "Environment Investment Center", with which the Mill had already cooperated within the framework of other GHG emission reduction projects.

The next step was signing a contract with "Alfa Laval". It should be noted that the contract with OJSC "Alfa Laval Potok" No.705-06/62 for the first supply of heat exchangers was entered into on February 25, 2005 – just a week after the Kyoto Protocol came into effect.

Development of the technical design [R5] was commissioned to LLC "Ust-Ilimsk Design and Production Engineering Office".

From October 2005 till February 2007 four narrow channels plate heat exchangers of M30 type manufactured by Alfa Laval were put into operation in the BCD for cooling of acid and alkaline bleaching waste streams. However, in the course of operation the narrow channels heat exchangers got clogged with tar and lignin contained in bleaching waste streams (especially in alkaline streams). This necessitated carrying out frequent and labour-intensive cleanouts of the heat exchangers. Therefore it was necessary to alter the project and replace the narrow channels heat exchangers with wide-gap channels heat exchangers of WideGap 350S type by the same manufacturer. By the end of 2008 wide-gap channels heat exchangers had been put into operation at both alkaline waste stream flows. The narrow channels exchangers installed at the acid waste stream flows are planned to be replaced in 2010. The schedule of equipment commissioning is given below in Section A.4.2

The installation of spiral liquor coolers and waste gas-vapour streams condensers for the second digester which replaced the heat exchangers were completed in the CWD over 2008. The installation of spiral heat exchangers for the first digester is planned to be finished in 2009.

As of today the total volume of investments into equipment procurement alone has amounted to over RUR 90 million. In addition, in 2010 it is planned to spend another RUR 20 million on procurement of wide-gap channels heat exchangers for acid waste streams.

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: Russian Federation (Host Party)	Legal entity A1: Open Joint Stock Company "Ilim Group"	No
Party B: EC	Legal entity B1: To be determined within 12 months upon approval of the project by the Russian Government	No

OJSC “Ilim Group”

OJSC “Ilim Group”² was incorporated on September 27, 2006 in Saint-Petersburg. In 2007 OJSC “Kotlas PPM”, OJSC “Pulp and Paperboard Mill”, OJSC “Bratskcomplexholding” and OJSC “Production Association “Ust-Ilimsk Timber Processing Complex”” joined the Group through single share issue.

The strategic partner of OJSC “Ilim Group” is International Paper, a pulp and paper company.

The company is managed by an international Board of Directors.

The company’s plant assets located in the Leningrad, Arkhangelsk and Irkutsk Regions are the largest enterprises of the Russian Timber Processing Complex and account for 65% of Russia’s overall market pulp production and for over 25% of cardboard production. The total annual production of pulp and paper by the company is over 2.5 million tonnes.

Ust-Ilimsk Branch

The Branch of OJSC “Ilim Group” in Ust-Ilimsk is the former OJSC “Production Association “Ust-Ilimsk Timber Processing Complex””. Construction of Ust-Ilimsk PMM began in 1973. The Mill’s capacity as of today is 630 thousand tonnes of market pulp per year.

The Mill produces sulfate bleached softwood pulp, unbleached hardwood pulp, unbleached pressed pulp, derivatives of wood chemical and biochemical processing.

The Branch accounts for around 30% of the market pulp production in Russia. The company exports up to 90% of the total produced bleached pulp to Europe and Asia.

Quality, environment and industrial safety management systems at Ust-Ilimsk Branch comply with the international standards of ISO 9001, ISO 14001 and OHSAS 18001.



Fig. A.3-1. “Ilim Group” Branch in Ust-Ilimsk

A.4. Technical description of the <u>project</u>:
--

A.4.1. Location of the <u>project</u>:

A.4.1.1. <u>Host Party(ies)</u>:

² See the official information on OJSC “Ilim Group” and its branches at the company’s web-site: www.ilimgroup.ru

The Russian Federation

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

The Irkutsk Region

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

The town of Ust-Ilimsk

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

The enterprise is situated in the town of Ust-Ilimsk. Ust-Ilimsk is a town in the north-west of the Irkutsk Region on the Angara River and is an administrative center of Ust-Ilimsk District of the Irkutsk Region. The distance from Ust-Ilimsk to Irkutsk by railroad is 1280 km; and 950 km by road. The population is 98 thousand people (2008). The Irkutsk Region is located in the south-east of the Siberian Federal District of the Russian Federation. The administrative center of the region is Irkutsk.

Geographical latitude: 58°00'. Geographical longitude: 102°40'. Time zone GMT: +8:00.



Fig. A.4-1. The Irkutsk Region and the town of Ust-Ilimsk on the map of Russia



Fig. A.4-2. The town of Ust-Ilimsk on the map of the Irkutsk Region

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

Bleached sulfate pulp is produced at OJSC “Ilim Group” Branch in the town of Ust-Ilimsk by continuous method at two production lines. The production is characterized by high consumption of heat and water for process needs. Cooking, bleaching and drying of pulp, black liquor evaporation, treatment of contaminated condensates, tall oil and turpentine rectification are the main consumers of heat and water.

General principles of pulp production

Pulp cooking is the key process of pulp and paper production. Sorted pulp chips are fed for cooking to digesters along with the so-called “white liquor”, a mixture of sodium hydroxide and sodium sulfide, which when heated causes wood lignin to degrade and unbleached pulp is produced. The chips are steamed and mixed with white liquor and then flow to the upper section of the digester. Cooking and diffusion washing of brown stock takes place when chips are moving downwards. From the lower section of the digester the pulp is fed for separation because it contains various impurities such as knurs and undercooked fiber. The separated liquid is called black liquor, it contains dissolved organic wood matter and mineral matter, such as different salts of sodium and sulfur. Black liquor is fed to the recovery system. The produced pulp is quite brown, therefore to achieve the required whiteness it is bleached.

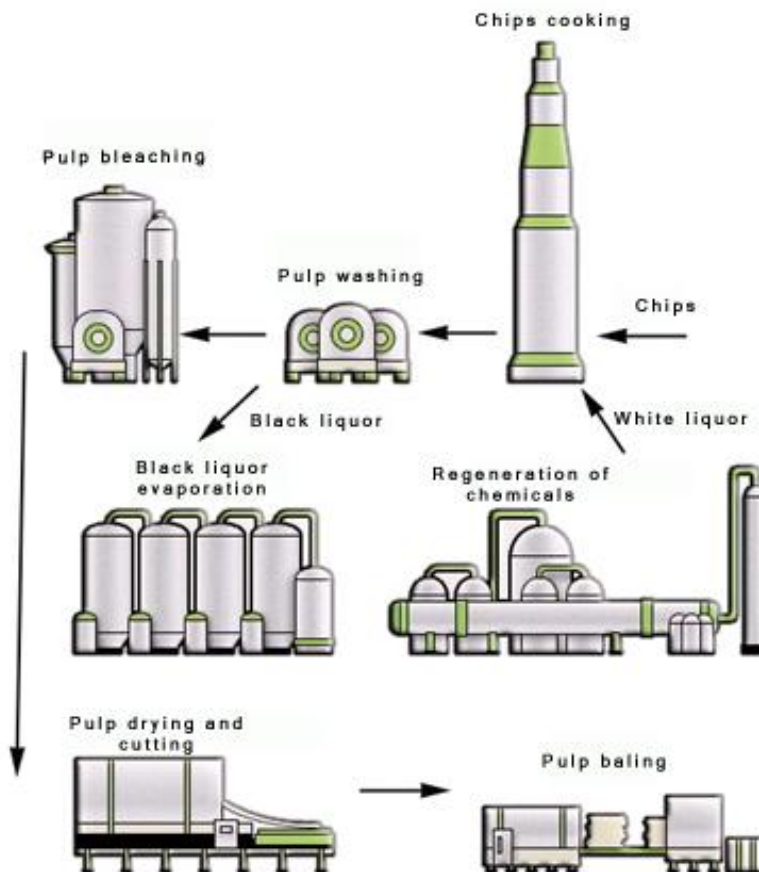


Fig. A.4-3. Key process stages

Unbleached pulp that has been sorted and washed is delivered to the storage towers from where it is further fed to the bleaching department. The pulp is bleached in stages using various bleaching agents until the required whiteness is achieved. The resulting bleached pulp is cleaned and is delivered for drying. The water is removed in the drying machine until the specified dryness value is achieved and then it is pressed out and dried with steam. Then the pulp web is cut into sheets, baled, pressed and



wrapped in large sheets of the same pulp and tied with wire. The bale packs are sent to the storage and further to the end-user.

This project covers the Bleaching-and-Cleaning (BCD), the Cooking-and-Washing (CWD) and the Drying Departments only.

Short description of the processes affected by the project

Bleaching-and-Cleaning Department

The baseline scenario (situation prior to the project implementation)

The pulp is bleached in continuous bleaching towers and the pulp stock is washed between the stages in Kamyr vacuum filters.

Hot cleaned condensate from the condensate stripping department (wood chemical production), hot water from the CWD and warm water from the evaporation department are collected in the warm water tank of the BCD. Water from the warm water tank of the BCD is heated in the heat exchangers by heating steam up to the required temperature and is used for spraying vacuum filters.

Acid and alkaline bleaching streams are fed via neutralization plant to the treatment plant. The temperature of effluents is around +60°C and prior to the project implementation the low-grade heat of these effluents had not been used. The maximum permissible temperature of waste streams entering the treatment plant is +40°C, for this reason they had been mixed with a large quantity of fresh water. The baseline scenario presupposes that this practice would be continued.

The project scenario

The project envisages installation of four plate heat exchangers manufactured by Alfa Laval at two flows of acid and alkaline bleaching waste streams. This ensures recovering low-grade heat of these waste streams and returning part of heat back to the technological process. In particular, the water temperature in the warm water tank of the BCD rises, thus reducing steam requirements for heating up the water to the temperature required for the process.

The cooling medium is warm water supplied at +40°C from the evaporation department. The water temperature is raised to +55°C in the plate heat exchangers and fed to the drying department, to the warm water tank in the BCD and also to the CWD to the black liquor coolers and condensers for waste gas-vapour streams from the digesters. Meanwhile the temperature of waste streams goes down to +50°C, thus proportionally reducing the consumption of fresh water mixed with the waste streams in order to reduce their temperature to the maximum permissible level of +40°C.

According to the initial project, narrow channels plate heat exchangers of M30 type manufactured by Alfa Laval were installed for waste streams cooling (those were mounted in 2005-2007). However because of the problems which the company was facing in the process of their operation (the channels of the heat exchangers got clogged quite fast with tar and lignin especially when alkaline streams were cooled), it was decided to replace those by wide-gap channels plate heat exchangers of WideGap 350S type manufactured by the same company. In 2008 the heat exchangers were replaced at two alkaline stream flows. The heat exchangers for acid flows are planned to be replaced in 2010.

It was originally intended that the filtered water supplied to UI CHPP would serve as cooling water in the heat exchangers of the 1st flow. However CHPP did not grant their permit for operation of heat exchangers under such conditions, and therefore it was decided to use the water from the evaporation department as cooling water.



Fig. A.4-4. Plate heat exchanger erected in the Bleaching-and-Cleaning Department

Cooking-and-Washing Department

The baseline scenario

In the CWD in the process of continuous pulp cooking black liquor is separated from the digesters and cooled, at first, in the expansion cyclones owing to intensive boiling and then in the black liquor coolers. Warm water at +40°C from the evaporation department is fed to the black liquor coolers and further the heated water is delivered to the warm water tank of the BCD.

The waste gas-vapour streams from the steaming vessel (the 1st flow) and from the chip bunker (the 2nd flow) are condensed in turpentine shell-and-tube condensers by fresh filtered water and by warm water supplied at +40°C from the evaporation department. Water heated owing to vapour condensation and condensate cooling is delivered to the warm water collection tank of the BCD. The turpentine condensate is supplied to the wood chemical production.

The clean condensate boiling vapour is condensed and cooled in the heat exchangers by warm water supplied at +40°C from the evaporation department. Heated water is fed to the warm water collection tank of the BCD. Clean condensate is fed for chemical water treatment.

Non-condensed malodorous gases after turpentine condensers are fed for additional condensing and then to the incineration unit for malodorous gases situated in the black liquor recovery boiler room. Fresh filtered water is used for vapour condensing. Due to vapour condensing and condensate cooling the water is heated and fed to the warm water collection tank of the BCD.

Under these conditions the average water temperature in the warm water collection tank of the BCD is of +55...+60 °C.

The project scenario

Due to installation of bleaching waste stream coolers in the BCD the warm water from the evaporation department is supplied at +40°C first to these heat exchangers where the water temperature is raised by 15°C and only then is it fed to the CWD (as well as to the BCD and to the drying department). Thus the temperature of warm water, which used for black liquor cooling and for condensing of vapour waste streams and boiling vapour, increases from +40°C to +55°C. With that the heat exchange surface of the old coolers for black liquor and the condensers for waste gas-vapour streams and boiling vapour could no longer ensure the required heat flow. Therefore it was decided to replace the old coolers and condensers

in the CWD with spiral Alfa Laval heat exchangers that have higher efficiency and are capable of ensuring the required heat flow at a higher water temperature.

So these measures are included in the framework of the project in view of the fact that some heat exchangers in the CWD had to be replaced after installing waste streams coolers in the BCD. Without the project, the complex replacement of the CWD heat exchangers would not have been required, the installed heat exchangers were repaired and replaced with similar equipment in accordance with the existing practice, in the course of routine maintenance.

After replacement of the heat exchangers in the CWD the water temperature in the warm water collection tank of the BCD has grown to +70...+75 °C.



Fig. A.4-5. Spiral heat exchanger installed in the Cooking-and-Washing Department

Drying department

The baseline scenario

The 1st and the 2nd flows consist of two drying machines and five baling and handling lines for transportation of pulp bales to the finished products storage area. In 2005 the frames of the pulp drying machines of the 1st and the 2nd flows were retrofitted and new Hi-Vac suction boxes were installed. The pulp drying machine of the 2nd flow was fitted with a steam box.

Large quantities of water and steam are used for pulp drying. Prior to the project implementation the workshop had used three kinds of water: filtered water, mechanically purified water and warm water from the evaporation department.

Warm water from the evaporation department is supplied at +40°C to:

- the heat recovery plant;
- ensure make up of the level in the collectors of register, suction and overflow return waters; and
- the heat exchangers of the steam-condensate system where it is heated by steam to the temperature of +50°C .

In order to improve pulp stock dehydration on the frame, the temperature in the headbox is maintained at +58...+60°C. For this purpose live steam is fed to the register water collector.

The project scenario

The project presupposes that the warm water from the evaporation department with the temperature of +40°C is pre-heated in the heat exchangers for acid and alkaline waste streams from the bleaching department to +55°C, which results in reduced consumption of live steam by the heat exchangers of the

steam-condensate system and in a lower steam demand used to maintain the temperature level in the headbox of the drying machine.

The diagrams of the main process flows covered by the project are shown in Fig. A.4-6 and Fig.A.4-7.

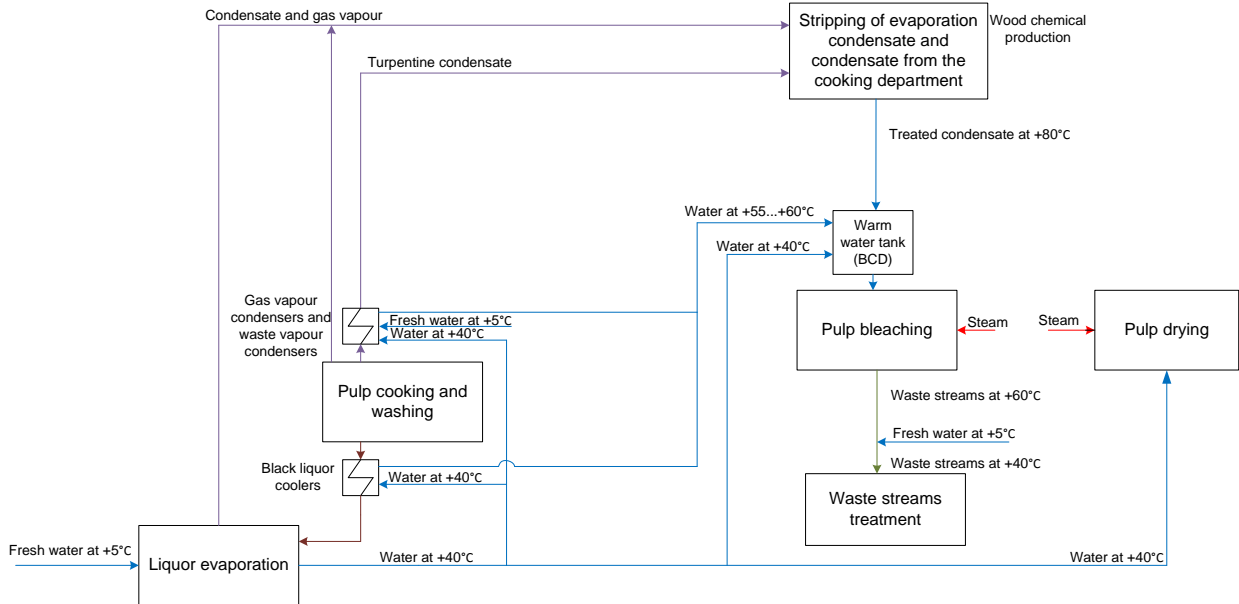


Fig. A.4-6. The diagram of the main process flows before the project implementation

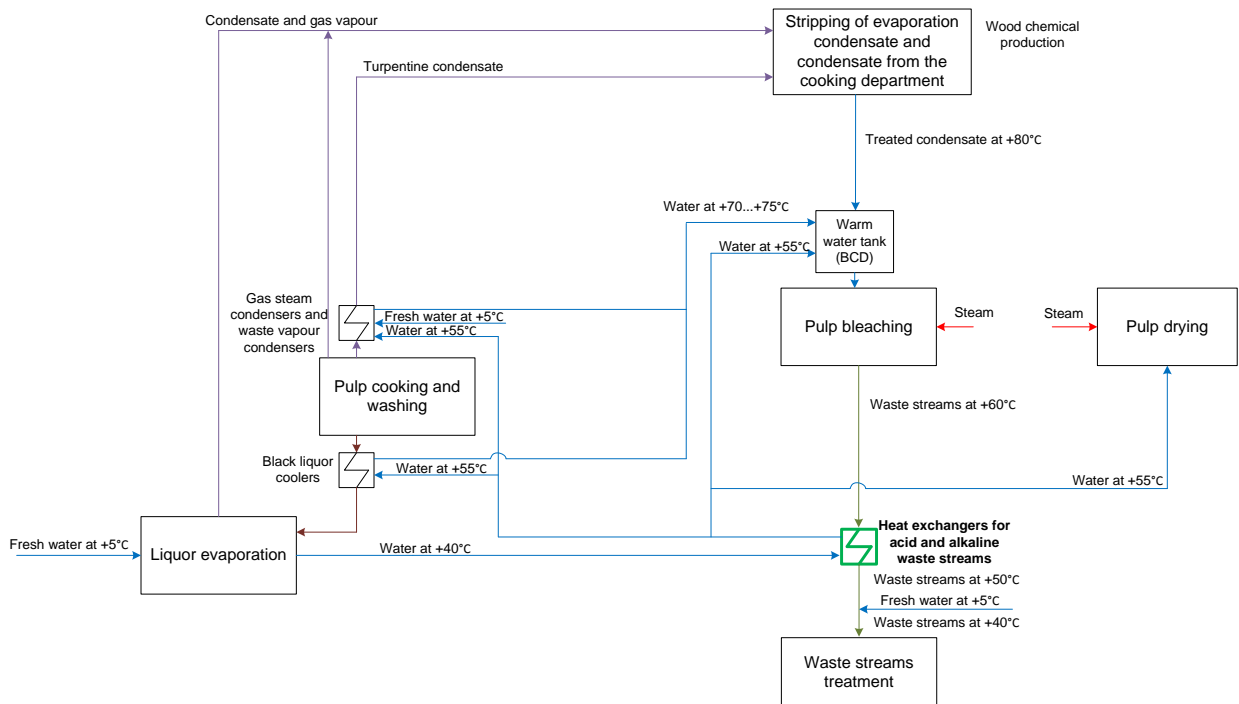


Fig. A.4-7. The diagram of the main process flows after the project implementation

**Equipment installed within the framework of the project****Bleaching-and-Cleaning Department**

Place of installation	Type of heat exchanger	Mark of heat exchanger	Number, nos.	Thermal capacity, kW	Commissioning date ³
Alkaline waste streams, the 1 st flow	Narrow channels, plate-type	M30	1	12060	15.07.2006, replaced with wide-gap channels exchanger
Alkaline waste streams, the 2 nd flow	Narrow channels, plate-type	M30	1	12060	22.02.2007, replaced with wide-gap channels exchanger
Acid waste streams, the 1 st flow	Narrow channels, plate-type	M30	1	12060	08.10.2005, Planned to be replaced with wide-gap channels exchanger in 2010
Acid waste streams, the 2 nd flow	Narrow channels, plate-type	M30	1	12060	22.02.2007, Planned to be replaced with wide-gap channels exchanger in 2010
Alkaline waste streams, the 1 st flow	Wide-gap channels, plate-type	WideGap 350S	1	13250	26.12. 2008
Alkaline waste streams, the 2 nd flow	Wide-gap channels, plate-type	WideGap 350S	1	13250	06.11.2008
Acid waste streams, the 1 st flow	Wide-gap channels, plate-type	WideGap 350S	1	13250	Planned to be installed in 2010
Acid waste streams, the 2 nd flow	Wide-gap channels, plate-type	WideGap 350S	1	13250	

Cooking-and-Washing Department

Place of installation	Type of heat exchanger	Mark of heat exchanger	Number, nos.	Thermal capacity, kW	Commissioning date
Cooling of black liquor from cooking boiler No.2	Spiral	1H-L-2T	1	12800	02.12.2008
Primary condenser of the first stage of cooking boiler No.2	Spiral	2V-C-1T	1	7514	29.05.2008

³ According to Certificates of Heat Exchangers Commissioning



Primary condenser of the second stage of cooking boiler No.2	Spiral	2V-C-1T	1	7514	29.05.2008
Primary condenser of the second stage of cooking boiler No.2	Spiral	2V-C-1T	1	3579	29.05.2008
Secondary condenser of the first stage of cooking boiler No.2	Spiral	ALSHE COND 14L	1	383.1	29.05.2008
Secondary condenser of the second stage of cooking boiler No.2	Spiral	ALSHE COND 14L	1	383.1	29.05.2008
Cooling of black liquor from cooking boiler No.1	Spiral	1H-L-2T	1	13420	Planned to be installed in 2009
Primary condenser of the first stage of cooking boiler No.1	Spiral	2V-C-1T	1	5670	Planned to be installed in 2009
Primary condenser of the second stage of cooking boiler No.1	Spiral	2V-C-1T	2	5822	Planned to be installed in 2009
Secondary condenser of the first stage of cooking boiler No.1	Spiral	2V-C-1T	1	164.9	Planned to be installed in 2009
Secondary condenser of the second stage of cooking boiler No.1	Spiral	2V-C-1T	1	193.4	Planned to be installed in 2009

Apart from the heat exchangers, the appropriate pipe fittings and stop valves, instrumentation and control system are installed; and pumps are replaced with more powerful units. The pumps which are no longer used in other departments are relocated here and therefore they are not procured within the framework of this project.

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

The GHG emission reductions from the project are due to reduction of steam consumption for the Mill's technological needs from the external marginal energy source – Ust-Ilimsk CHPP. This will result in



reduction of steam production at UI CHPP, and hence to reduction of fossil fuel (coal) consumption.

Fossil fuel (heavy fuel oil) consumption at the Mill's own technological heat and power plant (THPP) even before the project had been reduced to the minimum level, therefore emission reductions can be attributed only to external energy sources.

Leakages outside the project boundaries are significant and related to the reduction of heat-consumption-based electricity generation at UI CHPP, therefore the undergenerated electricity in general case has to be offset from the grid.

In the absence of the project the specified GHG emission reductions could not be achieved because without installation of high-performance Alfa Laval heat exchangers for utilization of bleaching waste streams heat the above mentioned effect could not be achieved.

It is unlikely that the project would have been implemented in the absence of the joint implementation mechanism, which is indeed a weighty additional stimulus. There are the following reasons to assume this:

- No major changes to the Russian environmental regulation are foreseen so far that would force the company to stop the existing practice of bleaching waste stream management;
- The technical condition of the old heat exchangers of the CWD allowed to maintain their operation under the previous mode for a number of years yet provided scheduled maintenance is carried out;
- No GHG emission limits are set for Russian enterprises, and such are not expected at least until 2012⁴;
- In the absence of the project it could have been possible to avoid fairly risky financial investments and risks involved in operation of new equipment unfamiliar for the Mill. See details in section B.2.

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

	Years
Length of the crediting period	5
Year	Estimate of annual emission reductions in tonnes of CO ₂ e
2008	118 072
2009	142 545
2010	143 295
2011	168 179
2012	169 180
Total estimated emission reductions over the crediting period (tonnes of CO₂ equivalent)	741 271
Annual average of estimated emission reductions over the crediting period (tonnes of CO ₂ equivalent)	148 254

A.5. Project approval by the Parties involved:

The letters of approval from the Parties will be received later.

⁴

<http://www.economy.gov.ru/wps/wcm/connect/economylib/mert/welcome/economy/kiorealize/doc1143621403750>

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

The PDD developer proposes his own approach to the baseline setting and GHG emission reductions calculation and does not agree it with any methodologies for the clean development mechanism (CDM), but he certainly makes his approach consistent with the requirements of *Decision 9/CMP.1, Appendix B [R1]*.

The baseline was chosen on the basis of critical analysis of several alternatives, taking into account the barrier analysis (See Section B.2).

The baseline scenario envisages that without the joint implementation mechanism and without selling GHG emission reductions “Ilim Group” Branch in Ust-Ilimsk would continue its operation and would not undertake any measures aimed at utilization of low-grate heat of bleaching waste streams. The temperature of waste streams is reduced before their discharge by mixing them with fresh water only. The shortfall of heat is covered in full by supplies from Ust-Ilimsk CHPP. The heat exchangers of the CWD wouldn't need to be replaced since they could ensure the required heat flow at a lower inlet temperature of water. The technical condition of these heat exchangers allowed to operate them in the previous mode for a number of years yet, provided that scheduled maintenance is carried out. This scenario is less risky and does not require significant investment.

The amount of GHG emission reductions generated by the project depends on the following main factors:

- The volumes of pulp production by the Mill;
- Heat utilization by the waste streams coolers of the BCD;
- Increase in electricity consumption by pump drives for circulation of heat-transfer liquids through the heat exchangers;
- Reduction of heat production by UI CHPP boilers as a result of the project;
- Reduction of coal consumption at UI CHPP as a result of the project;
- Reduction of heat-consumption-based electricity supply from UI CHPP as a result of the project;
- GHG emission factors.

Each of the above mentioned factors is considered in more detail further below.

The volumes of pulp production by the Mill

Pulp production data are not used for calculation of the utilized heat quantity and GHG emission reductions. However, the waste stream generation and, eventually, the quantity of GHG emission reductions depend on the pulp production volume, therefore it is reasonable to provide production data to show the Mill's development pattern.

Table B.1-1 below contains actual data on bleached pulp production in 2005-2008, as well as the planned production volumes in 2009-2012. As can be seen from the Table, the Mill is constantly increasing its production volumes and plans to increase those further till the year 2012. Thus, nothing here suggests that the quantity of bleaching waste streams will decrease in the short-term.

Table B.1-1. Bleached pulp production at UI PPM

Parameter	Unit	2005	2006	2007	2008	2009	2010	2011	2012
Bleached pulp	tonne	584 577	590 023	644 177	623 595	675 520	675 020	677 820	683 490

Heat utilization by the waste stream coolers of the BCD

Utilization of heat of alkaline and acid bleaching waste streams is envisaged only by the project. The project involves installation of four plate heat exchangers by Alfa Laval on the first and the second flows of acid waste streams, and also on the first and the second flows of alkaline waste streams.

The heat utilized in the heat exchanger for acid waste streams of the 1st flow during the year y, GJ:

$$HS_{ACID,y}^I = \frac{\rho_{water} \cdot c_{p,water} \cdot WV_{ACID}^I \cdot T_{ACID,y}^I \cdot (t_{2,ACID}^I - t_{1,ACID}^I)}{10^6} \quad (B.1-1)$$

The heat utilized in the heat exchanger for acid waste streams of the 2nd flow during the year y, GJ:

$$HS_{ACID,y}^{II} = \frac{\rho_{water} \cdot c_{p,water} \cdot WV_{ACID}^{II} \cdot T_{ACID,y}^{II} \cdot (t_{2,ACID}^{II} - t_{1,ACID}^{II})}{10^6} \quad (B.1-2)$$

The heat utilized in the heat exchanger for alkaline waste streams of the 1st flow during the year y, GJ:

$$HS_{ALK,y}^I = \frac{\rho_{water} \cdot c_{p,water} \cdot WV_{ALK}^I \cdot T_{ALK,y}^I \cdot (t_{2,ALK}^I - t_{1,ALK}^I)}{10^6} \quad (B.1-3)$$

The heat utilized in the heat exchanger for alkaline waste streams of the 2nd flow during the year y, GJ:

$$HS_{ALK,y}^{II} = \frac{\rho_{water} \cdot c_{p,water} \cdot WV_{ALK}^{II} \cdot T_{ALK,y}^{II} \cdot (t_{2,ALK}^{II} - t_{1,ALK}^{II})}{10^6} \quad (B.1-4)$$

The parameters used in these formulae are described in the tables below:

Data / Parameter:	ρ_{water}
Data unit:	kg/m ³
Description:	Water density
Time of determination/monitoring	Determined once at the stage of the PDD development
Source of data used:	E.Y. Sokolov “Cogeneration-Based District Heating and Heat Networks”, MEI, 2001 [R3]
Value of data applied (for ex ante calculations/determinations)	1000
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Set as default
QA/QC procedures (to be) applied	Assumed as per reference data
Any comment:	Assumed constant both in the estimations and in the monitoring for the entire period of 2008-2012

Data / Parameter:	$c_{p,water}$
Data unit:	$\frac{kJ}{kg \cdot ^\circ C}$
Description:	Specific isobaric heat capacity of water
Time of determination/monitoring	Determined once at the stage of the PDD development
Source of data used:	E.Y. Sokolov “Cogeneration-Based District Heating and Heat Networks”, MEI, 2001 [R3]



Value of data applied (for ex ante calculations/determinations)	4.187
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Set as default
QA/QC procedures (to be) applied	Assumed as per reference data
Any comment:	Assumed constant both in the estimations and in the monitoring for the entire period of 2008-2012

Data / Parameter:	$T_{ACID,y}^I, T_{ACID,y}^{II}, T_{ALK,y}^I, T_{ALK,y}^{II}$
Data unit:	Hour
Description:	Operating hours of the heat exchangers for acid and alkaline waste streams of the 1 st and the 2 nd flows during the year y
Time of determination/monitoring	Determined once at the stage of the PDD development
Source of data used:	The BCD's data on shutdowns of the heat exchangers for cleanouts
Value of data applied (for ex ante calculations/determinations)	8400. In the first year of operation the operating hours of the heat exchanger are calculated from the date of its installation (see the dates of commissioning in Section A.4.2)
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Heat exchangers are operated year-round with regular shutdowns for cleanouts. The cleanout of a narrow channels heat exchanger is carried out twice a month. Each cleanout takes 14 hours. If a wide-gap channels heat exchanger is installed the frequency of cleanouts reduces. For the conservative approach this changes were disregarded.
QA/QC procedures (to be) applied	Actual value determined on the basis of heat exchangers performance monitoring is assumed. Additional procedures are not required.
Any comment:	The assumed values are estimations and are necessary for preliminary calculations of GHG emission reductions only. It is not necessary to monitor these parameters.

Data / Parameter:	$WV_{ACID}^I, WV_{ACID}^{II}, WV_{ALK}^I, WV_{ALK}^{II}$
Data unit:	m ³ /h
Description:	Volumetric flow rate of cooling water passing through the heat exchangers for acid and alkaline waste streams of the first and the second flows
Time of determination/monitoring	Determined once at the stage of the PDD development. More accurate data will be obtained in the course of monitoring
Source of data used:	Application for the project "Cooling of Alkaline Waste Streams of the Bleaching Department", Ust-Ilimsk, 2007 [R6]
Value of data applied (for ex ante calculations/determinations)	500 for narrow channels heat exchanger, 700 for wide-gap channels heat exchanger
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Actual values based on the heat exchanger performance are assumed here



QA/QC procedures (to be) applied	Actual value determined on the basis of heat exchangers performance monitoring is assumed. Additional procedures are not required.
Any comment:	The assumed values are estimations and are necessary for preliminary calculations of GHG emission reductions only (with allowance for the dates of replacement of the narrow channels heat exchangers with wide-gap channels units, see the commissioning dates in Section A.4.2). In the course of monitoring these parameters shall be measured by flow meters.

Data / Parameter:	$t_{2,ACID}^I, t_{2,ACID}^{II}, t_{2,ALK}^I, t_{2,ALK}^{II}$
Data unit:	°C
Description:	Temperature of cooling water at the outlet from the heat exchangers for acid and alkaline waste streams of the first and the second flows.
Time of determination/monitoring	Determined once at the stage of the PDD development. More accurate data will be obtained in the course of monitoring
Source of data used:	Application for the project “Cooling of Alkaline Waste Streams of the Bleaching Department”, Ust-Ilimsk, 2007 [R6]
Value of data applied (for ex ante calculations/determinations)	55
Justification of the choice of data or description of measurement methods and procedures (to be) applied	A similar design value was assumed for all four heat exchangers in our estimations
QA/QC procedures (to be) applied	Actual value determined on the basis of heat exchangers performance monitoring is assumed. Additional procedures are not required.
Any comment:	The assumed value is estimation and is necessary for preliminary calculations of GHG emission reductions only. In the course of monitoring these parameters shall be measured by temperature gauges.

Data / Parameter:	$t_{1,ACID}^I, t_{1,ACID}^{II}, t_{1,ALK}^I, t_{1,ALK}^{II}$
Data unit:	°C
Description:	Temperature of cooling water at the inlet to the heat exchangers of acid and alkaline waste streams of the first and the second flows
Time of determination/monitoring	Determined once at the stage of the PDD development. More accurate data will be obtained in the course of the monitoring
Source of data used:	Application for the project “Cooling of alkaline waste streams of the bleaching department”, Ust-Ilimsk, 2007 [R6]
Value of data applied (for ex ante calculations/determinations)	40
Justification of the choice of data or description of measurement methods and procedures (to be) applied	A similar design value was assumed for all four heat exchangers in our estimations
QA/QC procedures (to be) applied	Actual value determined on the basis of heat exchangers performance monitoring is assumed. Additional procedures are not required.
Any comment:	The assumed value is estimation and is necessary for preliminary calculations of GHG emission reductions only. In the course of monitoring these parameters are measured by temperature gauges.

The total quantity of heat utilized by all heat exchangers for BCD waste streams is equivalent to the reduction of heat (steam) consumption from the outside for UI PPM’s process needs as a result of the project during the year y, GJ:

$$\Delta HC_y = HS_{ACID,y}^I + HS_{ACID,y}^{II} + HS_{ALK,y}^I + HS_{ALK,y}^{II} \tag{B.1-5}$$

The calculation results are given in Table B.1-2 below.

Table B.1-2. The heat utilized by the heat exchangers of the BCD

Parameter	Unit	2005	2006	2007	2008	2009	2010	2011	2012
Heat utilized by the heat exchanger for acid waste streams of the first flow	GJ	59 665	263 781	263 781	263 781	263 781	263 781	369 293	369 293
Heat utilized by the heat exchanger for acid waste streams of the second flow	GJ	-	-	229 238	263 781	263 781	263 781	369 293	369 293
Heat utilized by the heat exchanger for alkaline waste streams of the first flow	GJ	-	122 470	263 781	263 781	369 293	369 293	369 293	369 293
Heat utilized by the heat exchanger for alkaline waste streams of the second flow	GJ	-	-	229 238	263 781	369 293	369 293	369 293	369 293
TOTAL	GJ	59 665	386 251	986 039	1 055 124	1 266 149	1 266 149	1 477 174	1 477 174

Increase in electricity consumption by pump drives for circulation of heat-transfer liquids through the heat exchangers

The installation of the heat exchangers resulted in additional hydraulic resistance which causes higher head losses during pumping of waste streams and cooling water. The increase of power for circulation of heat-transfer liquids leads to higher electricity consumption. Besides, the pumps for water pumping needed to be replaced with more powerful units. The estimation of power consumption increase for pumping of heat-transfer liquids is given in Annex 2.1.

According to this estimation, GHG emissions have increased by 1 219 tCO₂, which is less than 1% of the total annual emission reductions of GHG and less than 2 000 tCO₂. Thus, according to the *Guidance on criteria for Baseline Setting and Monitoring, item 11 a) iii*), of the *Joint Implementation Supervisory Committee* [R9], this value can be neglected. Furthermore, it should be taken into consideration that fresh water consumption for diluting effluents before discharge, and hence electricity consumption for these purposes, on the contrary, have reduced as a result of the project.

Therefore this factor is excluded from further consideration and will not be monitored.

Reduction of heat production by UI CHPP boilers as a result of the project

The fossil fuel saving potential at the Mill’s own THPP is nearly used up. The only fossil fuel fired at the Mill’s own THPP is heavy fuel oil. Even before the project implementation heavy fuel oil consumption

by the steam boilers, which was necessary mainly for lighting up and flame stabilization, had not exceeded 3% of the total equivalent fuel consumption at the plant, which is a minimum level required for the process flow. The biofuel consumption at the THPP (black liquor, bark and wood waste, pitch and tall oil) primarily depends on the pulp production volumes and is by no manner of means related to the project.

The Mill's own THPP does not fully meet the heat demand of the enterprise. Therefore the shortfall of energy is supplied to the enterprise from Ust-Ilimsk CHPP, which is a part of OJSC "Irkutskenergo". This plant is the marginal energy source for UI PPM. Thus the total heat savings in the process cycle related to the project implementation should be charged against UI CHPP. The main fuel of the plant is coal.

The supplies of process steam from UI CHPP's turbines to the production site of UI PPM have reduced considerably as a result of the project. In order to determine the reduction of coal consumption at UI CHPP it is necessary to find the variation of live steam flow to the turbines.

The turbine hall of UI CHPP has:

- One turbine unit of PT-60-130/13 type (turbine with production and heating steam extractions);
- Two turbine units of R-50-130/13 type (back-pressure turbines);
- Two turbine units of T-100/120-130 type (turbines with heating steam extraction);
- One turbine unit of T-185/220-130 type (turbine with heating steam extraction).

The project does not affect the heating steam extraction from the turbines. Under a stable demand of process steam the back-pressure turbines usually operate in the base mode, and heat and electricity loads are regulated by turbines with less rigid operation modes, in this case by PT-60-130/13 turbine. Most likely, it is this turbine to which the reduction of process steam supply from UI CHPP as a result of the project should be attributed.

On the basis of energy characteristics of PT-60-130/13 turbine presented in analytical form⁵, an equation was derived which describes the variation of heat (live steam) flow to the turbine depending on the variation of production steam extraction:

$$\Delta Q_0 = 1.31 \cdot \Delta Q_p, \quad (\text{B.1-6})$$

where ΔQ_0 is the variation of heat (live steam) flow to the turbine, GJ;

ΔQ_p is the variation of heat supply from production steam extraction, GJ;

1.310 is the factor that shows the relation between the variation of heat flow to the turbine and the variation of heat supply from production steam extraction.

Taking into account the losses in the Mill's steam pipeline, the heat flow factor and the heat consumption for auxiliary needs of UI CHPP, the equation (B.1-6) is rearranged in the following form:

$$\Delta HG_{UI\ CHPP,y} = \frac{1.31 \cdot \Delta HC_y}{(1 - \varepsilon_{sl}) \cdot (1 - \varepsilon_{heat}^{aux}) \cdot k_{HF}}, \quad (\text{B.1-7})$$

where $\Delta HG_{UI\ CHPP,y}$ is the reduction of heat (live steam) production by UI CHPP's boilers as a result of the project during the year y, GJ.

The description of the parameters used in the formula (B.1-7) is given in the table below:

Data / Parameter:	ε_{heat}^{aux}
Data unit:	-

⁵ B.V.Sazanov, V.I.Sitas. Thermal Energy Systems of Industrial Enterprises. M.: Energoatomizdat, 1990 [R2].



Description:	The relative heat consumption for auxiliary needs of UI CHPP
Time of <u>determination/monitoring</u>	Determined once at the stage of the PDD development
Source of data used:	E.Y. Sokolov "Cogeneration-Based District Heating and Heat Networks", MEI, 2001 [R3]
Value of data applied (for ex ante calculations/determinations)	0.05
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The recommended average value
QA/QC procedures (to be) applied	Assumed as per reference data
Any comment:	Assumed constant both in the estimations and for monitoring for the entire period of 2008-2012

Data / Parameter:	ε_{sl}
Data unit:	-
Description:	The relative heat losses in the steam pipeline from UI CHPP to UI PPM
Time of <u>determination/monitoring</u>	Determined once at the stage of the PDD development
Source of data used:	E.Y. Sokolov "Cogeneration-Based District Heating and Heat Networks", MEI, 2001 [R3]
Value of data applied (for ex ante calculations/determinations)	0.05
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The recommended average value
QA/QC procedures (to be) applied	Assumed as per reference data
Any comment:	Assumed constant both in the estimations and for monitoring for the entire period of 2008-2012

Data / Parameter:	k_{HF}
Data unit:	-
Description:	The heat flow factor at UI CHPP
Time of <u>determination/monitoring</u>	Determined once at the stage of the PDD development
Source of data used:	V.Y.Ryzhkin. Thermal Power Stations.- M.: Energoatomizdat, 1987 [R4]
Value of data applied (for ex ante calculations/determinations)	0.98
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The recommended value at an average load of a steam boiler
QA/QC procedures (to be) applied	Assumed as per reference data
Any comment:	Assumed constant both in the estimations and for monitoring for the entire period of 2008-2012

The calculation results are given in Table B.1-3.

Table B.1-3. The reduction of heat production by UI CHPP’s boilers as a result of the project

Parameter	Unit	2005	2006	2007	2008	2009	2010	2011	2012
The reduction of heat production	GJ	88 372	572 094	1 460 467	1 562 793	1 875 352	1 875 352	2 187 910	2 187 910

Reduction of coal consumption at UI CHPP as a result of the project

The reduction of coal consumption at UI CHPP as a result of the project during the year y is determined as follows, GJ:

$$\Delta FC_{coal, UI CHPP, y} = \frac{\Delta HG_{UI CHPP, y}}{\eta_{boiler, UI CHPP}} \tag{B.1-8}$$

The description of the parameter used in the formula (B.1-8) is given in the table below:

Data / Parameter:	$\eta_{boiler, UI CHPP}$
Data unit:	-
Description:	The efficiency of the steam boilers of UI CHPP
Time of determination/monitoring	Determined once at the stage of the PDD development
Source of data used:	Reference Book on Heat Engineering, Volume 2, Energy, Moscow, 1976 [R10]
Value of data applied (for ex ante calculations/determinations)	0.917
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The recommended value at nominal load of BKZ-420-140 coal-fired steam boilers. This is conservative, since the annual average efficiency of the boilers is knowingly lower than the nominal level.
QA/QC procedures (to be) applied	Assumed as per reference data
Any comment:	Assumed constant both in the estimations and for monitoring for the entire period of 2008-2012

The calculation results are given in Table B.1-4.

Table B.1-4. The reduction of coal consumption at UI CHPP as a result of the project

Parameter	Unit	2005	2006	2007	2008	2009	2010	2011	2012
Reduction of coal consumption	GJ	96 371	623 876	1 592 658	1 704 246	2 045 095	2 045 095	2 385 944	2 385 944

Reduction of heat-consumption-based electricity supply from UI CHPP as a result of the project

The heat savings due to the project with proportional reduction of steam flow to the UI CHPP’s turbines lead to such an undesirable effect as reduction of heat-consumption-based electricity generation at this CHPP. Undergeneration of electricity, in general case, has to be offset by additional fuel consumption at the power plants in the grid (including UI CHPP), which determines the project leakages.

It has been demonstrated above that the variation of process steam supply from UI CHPP as a result of the project should be, most likely, attributed to the turbine PT-60-130/13. The energy characteristics of

this turbine⁶ were used as a basis to derive another equation that describes the variation of heat-consumption-based electricity generation depending on the variation of production steam extraction:

$$\Delta N_t = \frac{0.305 \cdot \Delta Q_p}{3.6}, \quad (\text{B.1-9})$$

where ΔN_t is the variation of heat-consumption-based electricity generation, MWh;

0.305 is the factor that shows the relation between the variation of heat-consumption-based electricity generation and the variation of production steam extraction.

3.6 is the conversion factor, GJ to MWh.

Taking into account the losses in the steam pipeline and the electricity consumption for auxiliary needs of UI CHPP, the equation (B.1-9) is rearranged in the following form:

$$\Delta ES_{UI\ CHPP,y} = \frac{0.305 \cdot \Delta HC_y \cdot (1 - \varepsilon_{el}^{aux})}{3.6 \cdot (1 - \varepsilon_{sl})}, \quad (\text{B.1-10})$$

where $\Delta ES_{UI\ CHPP,y}$ is the reduction of heat-consumption-based electricity supply from UI CHPP as a result of the project during the year y , MWh.

The description of the parameters used in the formula (B.1-10) is given in the table below:

Data / Parameter:	ε_{el}^{aux}
Data unit:	-
Description:	The relative electricity consumption for auxiliary needs of UI CHPP
Time of determination/monitoring	Determined once at the stage of the PDD development
Source of data used:	V.Y.Ryzhkin. Thermal Power Stations. - M.: Energoatomizdat, 1987 [R4]
Value of data applied (for ex ante calculations/determinations)	0.05
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The recommended average value
QA/QC procedures (to be) applied	Assumed as per reference data
Any comment:	Assumed constant both in the estimations and for monitoring for the entire period of 2008-2012

The calculation results are given in Table B.1-5 below.

Table B.1-5. The reduction of heat-consumption-based electricity supply from UI CHPP as a result of the project

Parameter	Unit	2005	2006	2007	2008	2009	2010	2011	2012
Reduction of electricity supply	MWh	5 055	32 724	83 539	89 392	107 271	107 271	125 149	125 149

⁶ B.V.Sazanov, V.I.Sitas. Thermal Energy Systems of Industrial Enterprises. M.: Energoatomizdat, 1990 [R2].

**GHG emission factors**

The GHG emissions are calculated in Section E. The following emission factors are used for calculation:

Data / Parameter:	$EF_{CO_2,coal}$
Data unit:	kg CO ₂ /GJ
Description:	The CO ₂ emission factor for coal combustion
Time of determination/monitoring	Determined once at the stage of the PDD development
Source of data used:	Reference Book "Energy Fuel of the USSR", M. Energoatomizdat, 1991 [R11]
Value of data applied (for ex ante calculations/determinations)	98.92
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The lowest of the two factors for the two coal grades combusted at UI CHPP was chosen, which is conservative. The details are given in Annex 2.2.
QA/QC procedures (to be) applied	This value was calculated using reference data
Any comment:	Assumed constant both in the estimations and for monitoring for the entire period of 2008-2012

Data / Parameter:	$EF_{CO_2,grid}^y$
Data unit:	t CO ₂ /MWh
Description:	The CO ₂ emission factor for electricity consumed from the grid during the year y
Time of determination/monitoring	Determined once at the stage of the PDD development
Source of data used:	Operational Guidelines for Project Design Documents of Joint Implementation Projects. Vol.1. General Guidelines/ Version 2.3. Ministry of Economic Affairs of the Netherlands. May 2004 [R7]
Value of data applied (for ex ante calculations/determinations)	$EF_{CO_2,grid}^{2008} = 0.565$ tCO ₂ /MWh, $EF_{CO_2,grid}^{2009} = 0.557$ tCO ₂ /MWh, $EF_{CO_2,grid}^{2010} = 0.550$ tCO ₂ /MWh, $EF_{CO_2,grid}^{2011} = 0.542$ tCO ₂ /MWh, $EF_{CO_2,grid}^{2012} = 0.534$ tCO ₂ /MWh
Justification of the choice of data or description of measurement methods and procedures (to be) applied	The assumed values are recommended for Russia for estimation of GHG emission reductions related to electricity consumption from the grid. Grounds for applicability of assumed emission factors are given in Annex 2.3.
QA/QC procedures (to be) applied	Assumed as per reference data
Any comment:	Necessary for leakage estimation. The specified values are used in estimation calculations and in monitoring over 2008-2012

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 of the project is demonstrated alongside with determination of the most likely baseline scenario in several steps. Firstly, possible alternatives of the project are identified and described; those alternatives which are in conflict of the country's regulations are excluded. The remaining alternatives

undergo a barrier analysis. In the barrier analysis the alternatives are considered from the point of view of technological and financial barriers: those alternatives which overcome the technological barriers are further considered from the financial point of view. The only remaining alternative is considered as the most likely baseline scenario. The common practice analysis is undertaken at the final stage of the additionality demonstration.

Step 1. Identification of potential alternatives

The following project alternatives were identified for heat recovery from the bleaching waste streams and for ensuring the required heat supplies to the pulp production.

Alternative 1: Continuation of the current situation

This alternative presupposes that OJSC “Ilim Group” Branch in the town of Ust-Ilimsk continues its business as usual without undertaking any measures providing for utilisation of low-grade heat of the bleaching waste streams. The temperature of the waste streams before their discharge is reduced by mixing in some fresh water. The shortfall of heat is supplied in full from UI CHPP. The heat exchangers of the CWD would not require replacement since they could ensure the required heat flow at a lower inlet temperature of water. The technical condition of these heat exchangers would allow operating them at the previous level for a long time yet, provided that planned repairs and maintenance is carried out.

Alternative 2: The project activity without JI mechanism

It presupposes implementation of all measures envisaged by the project but without the JI mechanism. The central project measure is installation of coolers for bleaching waste streams from the BCD – four plate heat exchangers by Alfa Laval with the total thermal capacity of 50 MW, designed for cooling of acid and alkaline waste streams at the two bleached pulp production lines. This brings about an additional water heating stage due to which some heat of the bleaching waste streams is returned to the pulp production cycle thereby reducing the demand for heating steam and for steam supplies from UI CHPP. The consumption of fresh water for dilution of waste streams before discharge reduces considerably.

Furthermore, several heat exchangers designed for black liquor cooling and for condensing of waste gas-vapour streams from the digesters are replaced in the CWD with spiral heat exchangers manufactured by Alfa Laval which ensure the required heat flow at a higher inlet temperature of water.

Alternative 3: Installation of heat exchangers only in the BCD without replacement of heat exchangers in the CWD

What make this alternative different from the previous one is that the heat exchangers in the CWD are not replaced. Not replacing the heat exchangers in the CWD (when waste stream coolers are installed in the BCD) affects cooling of black liquor and condensation of vapour waste streams from the digesters.

Neither of the identified alternatives conflicts with the legislation of the Russian Federation.

The conclusion: neither of the above alternatives is excluded at this step and all of them undergo the barrier analysis.

Step 2. The barrier analysis

Technological barriers

Let us identify the alternatives which cannot be implemented because of significant barriers.

Alternative 1

There are no barriers to continuation of the established practice of bleaching waste streams management, which does not provide for recovery of low-grade heat. Acid and alkaline bleaching waste streams at +60°C are cooled down to the normative level of +40°C by mixing them with fresh water before being fed to the treatment facility. There is no deficit of fresh water. Such technological scheme of bleaching



waste streams management was implemented in accordance with the construction project for the whole enterprise. Ust-Ilimsk CHPP is capable and ready to supply heat to the enterprise even in larger quantities than prior to the project.

Thus this alternative does not require any modifications of the process flow scheme, it is the simplest one and does not face any technological barriers.

Alternative 2

The enterprise had not had any experience in mounting or operating such state-of-the-art and high-performance equipment as plate and spiral heat exchangers manufactured by Alfa Laval. There was a risk that the new heat exchangers will not operate efficiently in real conditions of operation considering the high contamination level of the heat-transfer liquids, and that this equipment will require frequent maintenance and special attention of the personnel. Unfortunately these worries proved true almost immediately after commissioning of the first heat exchangers.

Originally narrow channels plate heat exchangers were installed for cooling of acid and alkaline waste streams. These heat exchangers got clogged with tar and lignin contained in the bleaching waste streams (especially in alkaline waste streams). This necessitated frequent and labour-consuming cleanouts of the heat exchangers. The cleanout of each narrow channels heat exchanger had to be performed twice per month manually by means of their complete disassembly. The cleanout of each unit takes between 12 and 14 hours. During this time waste streams are not cooled and the process water is not heated. At the same time the stability of operation of the heat exchangers in the CWD is impaired which affects adversely the pulp production process on the whole.

In connection with that it was decided to replace these almost new narrow channels heat exchangers with wide-gap channels units. The heat exchangers for alkaline waste streams were replaced in 2008, whereas the heat exchangers for acid waste streams are planned to be replaced in 2010. This fact increases the cost of the project which is high even without that.

Thus this alternative faces significant technological barriers, which however can be, in principle, overcome if there are sufficient financial resources available.

Alternative 3

The installation of the heat exchangers in the BCD causes an increase in the temperature of water used for cooling of black liquor and vapour waste streams from the digesters of the CWD. Under such conditions the heat exchange surface area of the existing heat exchangers of the CWD becomes inadequate, which leads to unstable operation of the equipment and to disturbances in the process conditions. These circumstances are unacceptable for continuous pulp production process. Therefore once the heat exchangers are installed in the BCD it becomes necessary to replace the heat exchanging equipment in the CWD.

Thus, this alternative faces significant technological barriers and is excluded from further consideration.

The conclusion: *The remaining alternatives 1 and 2 will be considered in the analysis of financial barriers.*

Financial barriers

Alternative 1

This alternative does not entail any investments and it is a financially risk-free scenario. The enterprise has been using this process flow scheme from the moment of its construction. The design documentation for the Mill does not mention any heat exchangers for waste streams and their installation was not required.

Therefore this alternative does not face any financial barriers.



Alternative 2

The implementation of this alternative entails sizeable financial investments. The required investments into the project amount to around RUR 110 million. Of which 47% of these investments were spent on replacement of the heat exchangers in the CWD, which in the absence of the project activity would have continued to operate properly for a long time yet, and 36% are spent on replacement of Alfa Laval narrow channels heat exchangers that had been installed within the framework of the project but had fallen short in real life. Moreover, maintenance of the new heat exchangers entails additional operating costs which in fact may turn out to be higher than projected (See the above description of the situation with the narrow channels plate heat exchangers).

Instead of being invested in low-grade waste heat recovery, which leads neither to increase of the product output nor to improvement of its quality, these financial resources could have been spent on modernization and expansion of the fixed production assets of OJSC “Ilim Group” Branch in Ust-Ilimsk, which could have yielded more profit to its owners.

Therefore this alternative encounters serious financial barriers and is not likely to be feasible.

***The conclusion:** Only Alternative 1 that presupposes “business as usual” scenario does not face any barriers and therefore it is the most likely baseline scenario. Alternative 2 is not likely to be feasible because of some serious barriers.*

Using JI mechanism to overcome the barriers hindering the project activity

An additional weighty stimulus is needed to overcome the barriers and to offset the risks that are faced by the project. Such stimulus for the company’s management was the possibility of getting back some of the financial resources invested in the project by selling emission reduction units in the international market. It was these carbon revenues that acted as a stimulus towards the project implementation. It is worth mentioning that the contract with OJSC “Alfa Laval Potok” for supply of the first heat exchangers was entered into on the 25th of February 2005 – just over a week after the Kyoto Protocol entered into force. Without reliance on the future carbon revenues it is unlikely that the project would have been implemented.

***The conclusion:** The JI mechanism helps to overcome the barriers faced by the project by means of carbon revenues that allow to offset the project costs.*

Step 3. Common Practice Analysis

The PDD developer does not know any instances of implementation of such a large-scale project involving low-grade waste heat utilization at any Russian pulp and paper mill. According to Alfa Laval’s data⁷, the heat exchangers installed on the flows of acid and alkaline bleaching waste streams are unique in their size and thermal capacity in the pulp and paper industry of Russia and CIS countries alike. Moreover, installation of the BCD heat exchangers necessitated replacement of the expensive CWD heat exchangers, which if operated in customary mode and regularly repaired, could have served at least until 2012. Such a large-scale replacement of heat exchangers has not been undertaken at any pulp and paper mill.

***The conclusion:** This project is not common practice.*

Step 4. The final conclusion

To our opinion, the above reasoning is sufficient to consider continuation of the current situation as the most likely baseline scenario and to recognize that the GHG emission reductions generated by the project are additional to those that might have otherwise occurred.

⁷ Letter from Head of the Pulp and Paper Industry Section of “Alfa-Laval Potok”

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

Table B.3-1 shows which sources and gases are included in the project boundaries and which are excluded from them. Fig. B.3-1 shows the main components and boundaries of the baseline and the project scenarios.

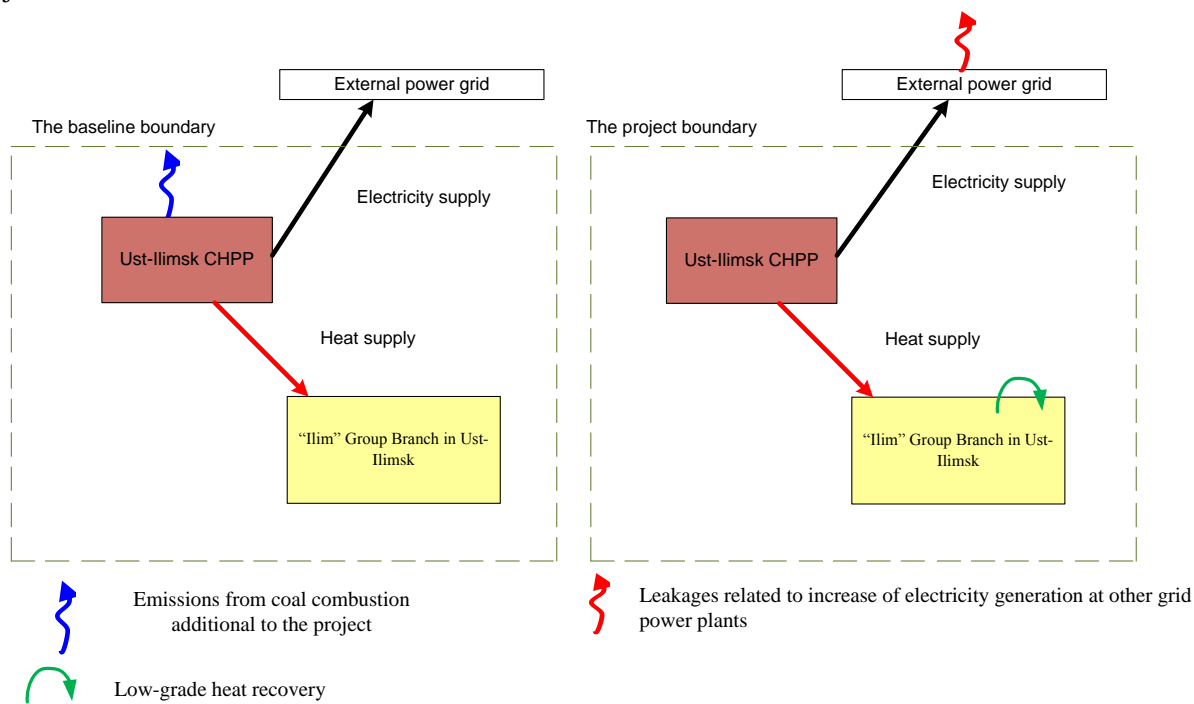


Fig. B.3-1. The main components and boundaries of the baseline and the project scenarios

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

	Source	Gas	Incl./Excl.	Justification / Explanation
Baseline	Ust-Ilimsk CHPP, combustion of larger quantities of coal compared with the project	CO ₂	Incl.	The main source of emissions
		CH ₄	Excl.	Negligibly small. Conservative
		N ₂ O	Excl.	Negligibly small. Conservative
Project	There are no emissions			
Leakages*	Power plants in the grid, combustion of fuel to compensate for the reduction of electricity supply to the grid	CO ₂	Incl.	Significant emissions that cannot be neglected
		CH ₄	Excl.	Negligibly small
		N ₂ O	Excl.	Negligibly small

* Fugitive leakages of GHG from coal production and transportation are neglected. This is conservative.



B.4. Further baseline information, including the date of baseline setting and the name(s) of the person(s)/entity(ies) setting the baseline:

The date of baseline setting: 09/04/2009

The baseline was developed by: LLC “CCGS” (LLC “CCGS” is not the project participant listed in Annex 1 of this PDD)

The contact person: Egor Ershov

E-mail: e.ershov@ccgs.ru



SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

25/02/2005 (the date of contract with OJSC “Alfa Laval Potok” No.705-06/62 for supply of the first heat exchangers for acid waste streams)

C.2. Expected operational lifetime of the project:

10 years/120 months

C.3. Length of the crediting period:

5 years/60 months (from the 1st of January 2008 till the 31st of December 2012)

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

The monitoring plan was developed following our own approach in accordance with the project specifics and requirements of *Decision 9/CMP.1, Appendix B [R1]* without using any approved CDM methodologies.

All data required for estimation of GHG emission reductions are collected in compliance with the highest sectoral standards and best practice of energy accounting.

All data required for monitoring shall be archived at the Mill in paper and electronic form for at least two years upon the end of the crediting period or the last issue of ERUs.

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 CO₂ 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	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.2.)								

D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of CO₂ 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. $WV_{ACID,i,y}^I$	The volume of cooling water passing through the heat exchanger for acid waste streams of the 1 st flow	Bleaching and Cleaning Department	m ³	m	Continuously	100%	Electronic and paper	Flow meter readings
2. $t_{1,i,y}^I$	The temperature of cooling water at the inlet of the heat exchangers for acid and alkaline waste streams of the 1 st flow	Bleaching and Cleaning Department	°C	m	Continuously	100%	Electronic and paper	Readings of thermal converter



3. $t_{2,ACID,i,y}^I$	The temperature of cooling water at the outlet from the heat exchanger for acid waste streams of the 1 st flow	Bleaching and Cleaning Department	°C	m	Continuously	100%	Electronic and paper	Readings of thermal converter
4. $WV_{ALK,i,y}^I$	The volume of cooling water passing through the heat exchanger for alkaline waste streams of the 1 st flow	Bleaching and Cleaning Department	m ³	m	Continuously	100%	Electronic and paper	Flow meter readings
5. $t_{2,ALK,i,y}^I$	The temperature of cooling water at the outlet from the heat exchanger for alkaline waste streams of the 1 st flow	Bleaching and Cleaning Department	°C	m	Continuously	100%	Electronic and paper	Readings of thermal converter
6. $WV_{bl,i,y}^{II}$	The volume of cooling water passing through the heat exchangers for acid and alkaline waste streams of the 2 nd flow and fed to the BCD	Bleaching and Cleaning Department	m ³	m	Continuously	100%	Electronic and paper	Flow meter readings



7. $WV_{dr,i,y}^{II}$	The volume of cooling water passing through the heat exchangers for acid and alkaline waste streams of the 2 nd flow and fed to the Drying Department	Bleaching and Cleaning Department	m ³	m	Continuously	100%	Electronic and paper	Flow meter readings
8. $WV_{c,i,y}^{II}$	The volume of cooling water passing through the heat exchangers for acid and alkaline waste streams of the 2 nd flow and fed to the CWD	Bleaching and Cleaning Department	m ³	m	Continuously	100%	Electronic and paper	Flow meter readings
9. $t_{1,i,y}^{II}$	The temperature of cooling water at the inlet to the heat exchangers for acid and alkaline waste streams of the 2 nd flow	Bleaching and Cleaning Department	°C	m	Continuously	100%	Electronic and paper	Readings of thermal converter
10. $t_{2,i,y}^{II}$	The temperature of cooling water at the outlet from the heat exchangers for acid and alkaline waste streams of the 2 nd flow	Bleaching and Cleaning Department	°C	m	Continuously	100%	Electronic and paper	Readings of thermal converter

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

The GHG emission reduction due to the project during the year y , tCO₂e:

$$ER_y = ER_{UI\ CHPP,y} - LE_y, \tag{D.1-1}$$

where $ER_{UI\ CHPP,y}$ is the reduction of CO₂ emissions from UI CHPP as a result of the project during the year y , tCO₂;

$$ER_{UI\ CHPP,y} = \Delta FC_{coal,UI\ CHPP,y} \cdot EF_{CO_2,coal} \cdot 10^{-3}, \tag{D.1-2}$$

where $EF_{CO_2,coal}$ is the CO₂ emission factor for coal combustion, kg CO₂/GJ. $EF_{CO_2,coal} = 98.92$ kg CO₂/GJ. See Annex 2.2;

$\Delta FC_{coal,UI\ CHPP,y}$ is the reduction of coal combustion at UI CHPP as a result of the project during the year y , GJ.

$$\Delta FC_{coal,UI\ CHPP,y} = \frac{1.31 \cdot \Delta HC_y}{\eta_{boiler,UI\ CHPP} \cdot (1 - \varepsilon_{heat}^{aux}) \cdot (1 - \varepsilon_{sl}) \cdot k_{HF}}, \tag{D.1-3}$$

where $\eta_{boiler,UI\ CHPP}$ is the efficiency of steam boilers at UI CHPP. Assumed constant and equal to $\eta_{boiler,UI\ CHPP} = 0.917$. See Section B.1;

ε_{heat}^{aux} is the relative heat consumption for auxiliary needs of UI CHPP. Assumed constant and equal to $\varepsilon_{UI\ CHPP}^{aux} = 0.05$. See Section B.1;

ε_{sl} is the relative heat losses in the steam line from UI CHPP to UI PPM. Assumed constant and equal to $\varepsilon_{sl} = 0.05$. See Section B.1;

k_{HF} is the heat flow factor at UI CHPP. Assumed constant and equal to $k_{HF} = 0.98$. See Section B.1;

1.31 is the factor that shows the relation between the variation of heat flow to the turbine and the variation of production steam extraction from the turbines. See Section B.1;

ΔHC_y is the reduction of heat (steam) consumption for UI PPM's process needs from the outside as a result of the project during the year y , GJ.

$$\Delta HC_y = HS_{ACID,y}^I + HS_{ALK,y}^I + HS_{ACID,y}^{II} + HS_{ALK,y}^{II}, \tag{D.1-4}$$

where $HS_{ACID,y}^I$ is the heat recovered by the heat exchanger for acid waste streams of the 1st flow, GJ;

$$HS_{ACID,y}^I = \sum_{i=1}^n \frac{\rho_{water} \cdot c_{p,water} \cdot WV_{ACID,i,y}^I \cdot (t_{2,ACID,i,y}^I - t_{1,i,y}^I)}{10^6}, \tag{D.1-5}$$

where i is the index that shows that calculations use hourly data;



n is the operating hours of the heat exchanger in the year y ;

$\sum_{i=1}^n$ is the sum of all values of the given parameter over the year y (determined every hour and then summed up);

ρ_{water} is the water density, kg/m^3 . Assumed constant and equal to $\rho_{water} = 1000 \text{ kg/m}^3$;

$c_{p,water}$ is the specific isobaric heat capacity of water, $\frac{\text{kJ}}{\text{kg}\cdot\text{°C}}$. Assumed constant and equal to $c_{p,water} = 4.187 \frac{\text{kJ}}{\text{kg}\cdot\text{°C}}$;

$WV_{ACID,i,y}^I$ is the volume of cooling water passing from the heat exchanger for acid waste streams of the 1st flow during the i -hour of its operation from the beginning of the year y , m^3 ;

$t_{2,ACID,i,y}^I$ is the average temperature of the cooling water at the outlet from the heat exchanger for acid waste streams of the 1st flow during the i -hour of its operation from the beginning of the year y , °C ;

$t_{1,i,y}^I$ is the average temperature of the cooling water at the inlet to the heat exchangers for acid and alkaline waste streams of the 1st flow during the i -hour of its operation from the beginning of the year y , °C .

$HS_{ALK,y}^I$ is the heat recovered by the heat exchanger for alkaline waste streams of the 1st flow, GJ;

$$HS_{ALK,y}^I = \sum_{i=1}^n \frac{\rho_{water} \cdot c_{p,water} \cdot WV_{ALK,i,y}^I \cdot (t_{2,ALK,i,y}^I - t_{1,i,y}^I)}{10^6}, \quad (\text{D.1-6})$$

where $WV_{ALK,i,y}^I$ is the volume of cooling water passing through the heat exchanger for alkaline waste streams of the 1st flow during the i -hour of its operation from the beginning of the year y , m^3 ;

$t_{2,ALK,i,y}^I$ is the average temperature of cooling water at the outlet from the heat exchanger for alkaline waste streams of the 1st flow during the i -hour of its operation from the beginning of the year y , °C .

$HS_{ACID,y}^{II} + HS_{ALK,y}^{II}$ is the heat recovered by the heat exchangers for acid and alkaline waste streams of the 2nd flow, GJ.

$$HS_{ACID,y}^{II} + HS_{ALK,y}^{II} = \sum_{i=1}^n \frac{\rho_{water} \cdot c_{p,water} \cdot WV_{i,y}^{II} \cdot (t_{2,i,y}^{II} - t_{1,i,y}^{II})}{10^6}, \quad (\text{D.1-7})$$



where $WV_{i,y}^{II}$ is the volume of cooling water passing through the heat exchangers for acid and alkaline waste streams of the 2nd flow during the i -hour of operation of heat exchangers from the beginning of the year y , m³;

$$WV_{i,y}^{II} = WV_{bl,i,y}^{II} + WV_{dr,i,y}^{II} + WV_{c,i,y}^{II}, \tag{D.1-8}$$

where $WV_{bl,i,y}^{II}$ is the volume of cooling water passing through the heat exchangers for acid and alkaline waste streams of the 2nd flow and fed to the BCD during the i -hour of operation of the heat exchangers from the beginning of the year y , m³;

$WV_{dr,i,y}^{II}$ is the volume of cooling water passing through the heat exchangers for acid and alkaline waste streams of the 2nd flow and fed to the drying department during the i -hour of operation of the heat exchangers from the beginning of the year y , m³;

$WV_{c,i,y}^{II}$ is the volume of cooling water passing through the heat exchangers for acid and alkaline waste streams of the 2nd flow and fed to the CWD during the i -hour of operation of the heat exchangers from the beginning of the year y , m³.

$t_{2,i,y}^{II}$ is the average temperature of cooling water at the outlet from the heat exchangers for acid and alkaline waste streams of the 2nd flow during the i -hour of their operation from the beginning of the year y , °C;

$t_{1,i,y}^{II}$ is the average temperature of cooling water at the inlet to the heat exchangers for acid and alkaline waste streams of the 2nd flow during the i -hour of their operation from the beginning of the year y , °C.

LE_y is the leakages during the year y , tCO₂e, See section D.1.3.2.

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

The leakages are estimated using the formulae below. Collection of additional data for estimation of leakages is not needed.

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 CO₂ equivalent):**

The leakages during the year y , tCO₂e:

$$LE_y = LE_{ES,y}, \quad (D.1-9)$$

where $LE_{ES,y}$ is the leakages from combustion of fossil fuel by the grid power plants to compensate for the reduction of electricity supply to the grid as a result of the project during the year y , tCO₂.

$$LE_{ES,y} = \Delta ES_{UI\ CHPP,y} \cdot EF_{CO_2,grid}^y, \quad (D.1-10)$$

where $EF_{CO_2,grid}^y$ is the CO₂ emission factor for electricity consumed from the grid during the year y , tCO₂/MWh. According to “Operational Guidelines for Project Design Documents of Joint Implementation Projects”⁸ this factor for Russia is specified depending on the year under consideration as follows: $EF_{CO_2,grid}^{2008} = 0.565$ tCO₂/MWh, $EF_{CO_2,grid}^{2009} = 0.557$ tCO₂/MWh, $EF_{CO_2,grid}^{2010} = 0.550$ tCO₂/MWh, $EF_{CO_2,grid}^{2011} = 0.542$ tCO₂/MWh, $EF_{CO_2,grid}^{2012} = 0.534$ tCO₂/MWh;

$\Delta ES_{UI\ CHPP,y}$ is the reduction of heat-consumption-based electricity supply from UI CHPP as a result of the project during the year y , MWh.

$$\Delta ES_{UI\ CHPP,y} = \frac{0.305 \cdot \Delta HC_y \cdot (1 - \varepsilon_{el}^{aux})}{3.6 \cdot (1 - \varepsilon_{sl})}, \quad (D.1-11)$$

where 0.305 is the factor that shows the relation between the variation of heat-consumption-based electricity generation and the variation of production steam extraction from the turbine, See Section B.1.

ε_{el}^{aux} is the relative electricity consumption for auxiliary needs of UI CHPP. Assumed constant and equal to $\varepsilon_{el}^{aux} = 0.05$. See section B.1.

D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source etc.; emissions/emission reductions in units of CO₂ equivalent):

See section D.1.2.2.

⁸ Operational Guidelines for Project Design Documents of Joint Implementation Projects. Vol.1. General Guidelines./ Version 2.3. Ministry of Economic Affairs of the Netherlands. May 2004 [R7].

**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 Environment and Production Control Department is in charge of industrial environmental monitoring at the Mill. It is accountable to the Health, Safety and Environment Directorate. The Directorate consists of:

- Safety and Production Control Department;
- Department of Industrial Environmental Monitoring;
- Gas Rescue Plant;
- Radiation Safety Service;
- Sanitary Industrial Laboratory;
- Civil Defense and Emergency Headquarters.

The programme of industrial environmental monitoring that is currently implemented by the Mill will not undergo any major changes after the project implementation and will be fulfilled according to the established scheme and schedule.

Similar to the way it is now, the monitoring will be performed by the respective department of the Mill, including sanitary-industrial laboratory. The Department employs qualified specialists. The sanitary industrial laboratory is adequately equipped. Its ability to take measurements in all sectors, which fall under their responsibility, is confirmed by Calibration Certificates.

The industrial environmental monitoring covers the following:

- Analytical control of compliance with the prescribed pollutant emission standards in accordance with the laboratory control charts;
- Monitoring of the impact of waste disposal sites on underground and surface waters, atmospheric air and soil;
- Control of pollutants content in the atmospheric air on the border of the sanitary protection zone, etc.

The data obtained by the analytical laboratory are processed and summarized in monthly and annual reports, which contain all required detailed data

The enterprise has the following reporting obligations as per official annual statistic forms:

- 2-tp (air) Data on Atmospheric Air containing information on the quantities of trapped and destroyed air pollutants, detailed emissions of specific pollutants, number of emission sources, emission reduction actions and emissions from separate groups of pollutant sources;
- 2-tp (water) Data on Water Use, containing information on water consumption from natural sources, discharges of effluents and their pollutant content, capacity of wastewater treatment facilities, etc.;



- 2-tp (wastes) Data on generation, utilization, destruction, transportation and disposal of production and consumption residues, containing an annual balance of wastes flows by their types and hazard classes.

In compliance with the Russian legislation, every year the enterprise has to develop and implement environment protection measures.

Quality, environment and industrial safety management systems at Ust-Ilimsk Branch comply with the international standards of ISO 9001, ISO 14001 and OHSAS 18001. The enterprise manufactures products certified for compliance with the requirements of the Forest Stewardship Council (FSC).

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.
Table D.1.2.1. ID 1	Low	The volumetric flow rate of cooling water passing through the heat exchanger for acid waste streams of the 1 st flow is measured with EGJ (dP) 110 flow meter, serial number 634881. Measurement range 800 m ³ /h. Accuracy class 0.5. Calibration frequency: once every three years. The instrument is calibrated by the Service Repair Workshop LLC "Avtomatica". Output signal from the flow meter is sent to the automated operating dispatch control system (ADCS).
Table D.1.2.1. ID 2	Low	Temperature converter TSP9201 is used for measurement of cooling water temperature at the inlet to the heat exchangers for acid and alkaline waste streams of the 1 st flow. Serial number 052. Operating range of temperature measurement: -50... +500 °C. Calibration interval – 3 years. The signals from the temperature converter are sent to the ADCS.
Table D.1.2.1. ID 3	Low	Temperature converter TSP9201 is used for measurement of cooling water temperature at the outlet from the heat exchanger for acid waste streams of the 1 st flow. Serial number 522. Operating range of temperature measurement: -50... +500 °C. Calibration interval – 3 years. The signals from the temperature converter are sent to the ADCS.
Table D.1.2.1. ID 4	Low	The volumetric flow rate of cooling water passing through the heat exchanger for alkaline waste streams of the 1 st flow is measured with a flow meter EGJ (dP) 110, serial number 634886. Measurement range: 800 m ³ /h. Accuracy class 0.5. Calibration frequency: once every three years. The instrument is calibrated by the Service Repair Workshop LLC "Avtomatica". Output signal from the flow meter is sent to the ADCS.
Table D.1.2.1. ID 5	Low	Temperature converter TSP9201 is used for measurement of cooling water temperature at the outlet from the heat exchanger for alkaline waste streams of the 1 st flow. Serial number 053. Operating range of temperature measurement: -50... +500 °C. Calibration interval – 3 years. The signals from the temperature converter are sent to the ADCS.



Table D.1.2.1. ID 6	Low	The volumetric flow rate of cooling water passing through the heat exchangers for acid and alkaline waste streams of the 2 nd flow and fed to the BCD is measured with a flow meter UNE 11, serial number KC129. Measurement range: 1000 m ³ /h. Accuracy class 1.0. Calibration frequency: once every two years. The instrument is calibrated by the Service Repair Workshop LLC “Avtomatica”. Output signal from the flow meter is sent to the ADCS.
Table D.1.2.1. ID 7	Low	The volumetric flow rate of cooling water passing through the heat exchangers for acid and alkaline waste streams of the 2 nd flow and fed to the drying department is measured with a flow meter EJA (dP), serial number 11380. Measurement range: 1000 m ³ /h. Accuracy class 1.0. Calibration frequency: once every three years. The instrument is calibrated by the Service Repair Workshop LLC “Avtomatica”. Output signal from the flow meter is sent to the ADCS.
Table D.1.2.1. ID 8	Low	The volumetric flow rate of cooling water passing through the heat exchangers for acid and alkaline waste streams of the 2 nd flow and fed to the CWD is measured with a flow meter EJA (dP), serial number 05422. Measurement range: 1400 m ³ /h. Accuracy class 1.0. Calibration frequency: once every three years. The instrument is calibrated by the service repair workshop LLC “Avtomatica”. Output signal from the flow meter is sent to the ADCS.
Table D.1.2.1. ID 9	Low	Temperature converter TSP9201 is used for measurement of cooling water temperature at the inlet to the heat exchangers for acid and alkaline waste streams of the 2 nd flow. Serial number 326. Operating range of temperature measurement: -50... +500 °C. Calibration interval – 3 years. The signals from the temperature converter are sent to the ADCS.
Table D.1.2.1. ID 10	Low	Temperature converter TSP9201 is used for measurement of cooling water temperature at the outlet from the heat exchangers for acid and alkaline waste streams of the 2 nd flow. Serial number 329. Operating range of temperature measurement: -50... +500 °C. Calibration interval – 3 years. The signals from the temperature converter are sent to the ADCS.

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

The data required for calculation of GHG emission reductions shall be collected and recorded in accordance with the scheme of monitoring points as shown in Fig.D.3-1.

The readings of the instruments used for monitoring of GHG emission reductions are recorded in the ADCS and are shown on the monitors of all computers with the required software installed. The data are printed on paper and are stored in the computer memory for three years, whereupon the data is transferred to the electronic archive of the Mill. The data shall be kept in the Mill’s archives in electronic and paper form for at least two years after the end of the crediting period or after the last issue of ERUs.

The management of OJSC “Ilim Group” Branch in Ust-Ilimsk is responsible for:



- normal operation of the equipment;
- timely calibration and proper maintenance of instrumentation;
- collection of all data required for calculation of GHG emission reductions under the project;
- arranging and holding training sessions for the Mill's personnel regarding collection of data required for the GHG emissions monitoring under the project.

All personnel of the BCD and CWD have undergone training and certification which covered the scope of the operation manual for the plate heat exchangers manufactured by Alfa Laval. An uncertified employee is not allowed to carry out maintenance or repair of the heat exchanging equipment.

The head of the BCD periodically holds examination to appraise the knowledge of the Instructions. Those employees who successfully passed the exam put their signatures in a special log and are allowed to operate the heat exchangers. The permit to operate the heat exchangers was issued by the Federal Environmental, Technological and Nuclear Inspection (Rostekhnadzor of Russia).

The quarterly data for GHG emission reduction monitoring will be furnished by the Deputy Chief Power Engineer of OJSC "Ilim Group" Branch in Ust-Ilimsk to the Project Implementation Department of LLC "CCGS".

CCGS specialists shall calculate GHG emission reductions using the provided data and shall draw up a monitoring report at the end of each reporting year. In case any doubt as to the accuracy of the input data arises, those are checked and revised by the specialists of OJSC "Ilim Group" Branch in Ust-Ilimsk. The preliminary version of the monitoring report is submitted to the management of OJSC "Ilim Group" Branch in Ust-Ilimsk for review. In case any mistakes are identified, CCGS specialists shall correct the report accordingly. The final version of the report shall be submitted for verification to the accredited independent body.

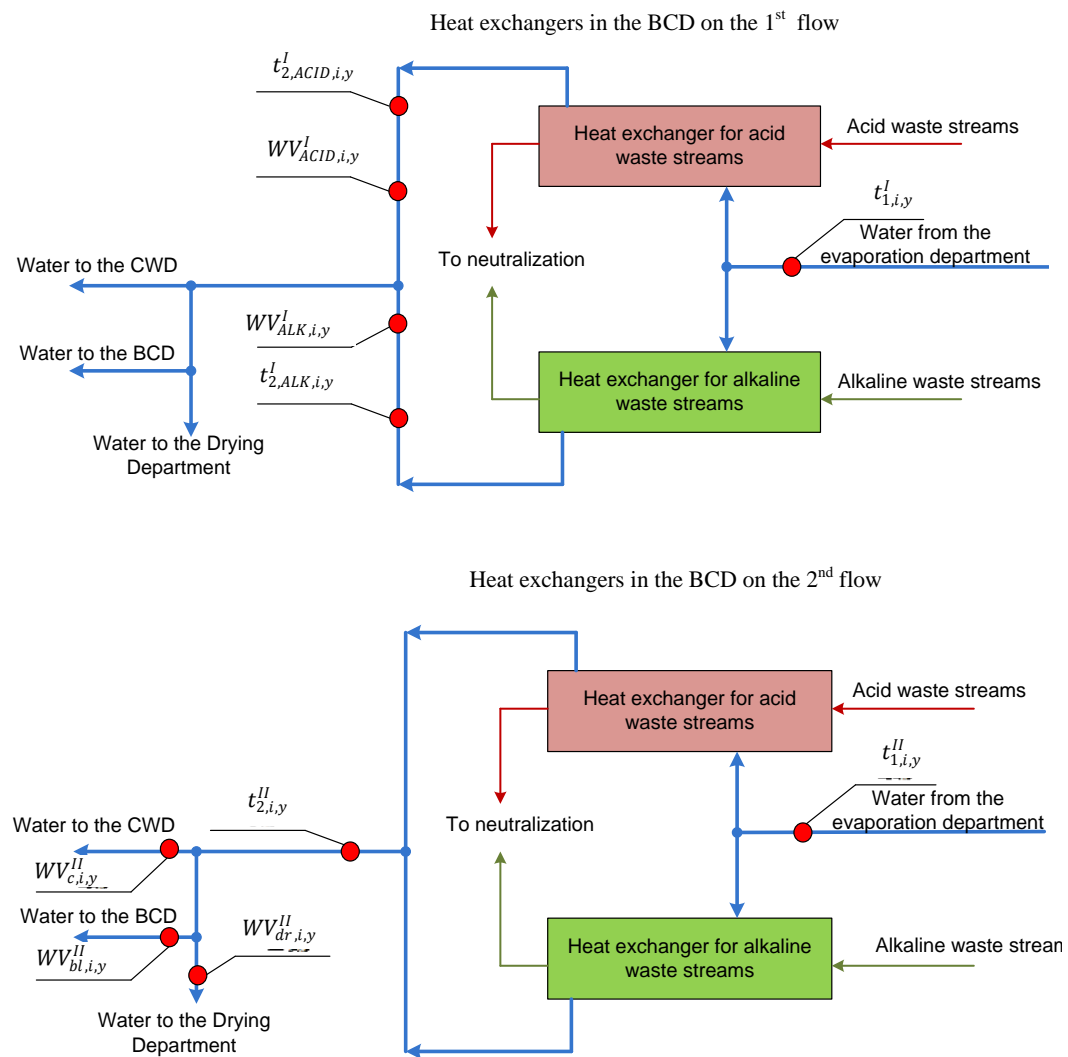


Fig. D.3-1. Location of the monitoring points



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

The monitoring plan was developed by LLC “CCGS” (LLC “CCGS” is not the project participant listed in Annex 1 of the PDD).

Contact person: Egor Ershov

E-mail: e.ershov@ccgs.ru

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

There are no project emissions of GHG, therefore:

$$PE_y = 0 \quad (\text{E.1-1})$$

E.2. Estimated leakage:

The leakages during the year y , tCO₂e:

$$LE_y = LE_{ES,y}, \quad (\text{E.1-2})$$

where $LE_{ES,y}$ is the leakages from combustion of fossil fuel by power plants to offset the reduction of electricity supply to the power grid as a result of the project during the year y , tCO₂.

$$LE_{ES,y} = \Delta ES_{UI\ CHPP,y} \cdot EF_{CO_2,grid}^y, \quad (\text{E.1-3})$$

where $EF_{CO_2,grid}^y$ is the CO₂ emission factor for electricity consumed from the grid during the year y , tCO₂/MWh. According to “Operational Guidelines for Project Design Documents of Joint Implementation Projects”⁹ this factor for Russia is specified depending on the year under consideration as follows: $EF_{CO_2,grid}^{2008} = 0.565$ tCO₂/MWh, $EF_{CO_2,grid}^{2009} = 0.557$ tCO₂/MWh, $EF_{CO_2,grid}^{2010} = 0.550$ tCO₂/MWh, $EF_{CO_2,grid}^{2011} = 0.542$ tCO₂/MWh, $EF_{CO_2,grid}^{2012} = 0.534$ tCO₂/MWh;

$\Delta ES_{UI\ CHPP,y}$ is the reduction of heat-consumption-based electricity supply from UI CHPP as a result of the project during the year y , MWh. See Section B.1, Table B.1-5.

Table E.2-1. The leakages from fuel combustion by grid power plants to offset reduction of electricity supply to the grid

Year	Estimated project leakages, tCO ₂ e
2008	50 507
2009	59 750
2010	58 999
2011	67 831
2012	66 830
Total for the period 2008-2012	303 916

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

Table E.3-1. The sum of the project GHG emissions and leakages

Year	Estimated project emissions and leakages, tCO ₂ e
2008	50 507
2009	59 750
2010	58 999
2011	67 831
2012	66 830
Total for the period 2008-2012	303 916

⁹ Operational Guidelines for Project Design Documents of Joint Implementation Projects. Vol.1. General Guidelines./ Version 2.3. Ministry of Economic Affairs of the Netherlands. May 2004 [R7].

E.4. Estimated baseline emissions:

The baseline emissions of GHG during the year y , tCO₂e:

$$BE_y = BE_{UI\ CHPP,y}, \quad (E.4-1)$$

where $BE_{UI\ CHPP,y}$ is the baseline emissions of CO₂ from combustion of larger quantities of coal at UI CHPP in comparison with the project scenario during the year y , tCO₂.

$$BE_{UI\ CHPP,y} = \Delta FC_{coal,UI\ CHPP,y} \cdot EF_{CO_2,coal} \cdot 10^{-3}, \quad (E.4-2)$$

where $\Delta FC_{coal,UI\ CHPP,y}$ is the reduction of coal consumption at UI CHPP as a result of the project during the year y , GJ. See Section B.1, Table B.1-4;

$EF_{CO_2,coal}$ is the CO₂ emission factor for coal combustion, kg CO₂/GJ. See Section B.1 and Annex 2.2, $EF_{CO_2,coal} = 98.92$ kg CO₂/GJ.

According to 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2, Energy [R8] emissions of CH₄ and N₂O from combustion of fossil fuels are considered to be negligibly small.

Table E.4-1. Baseline GHG emissions

Year	Estimated baseline emissions of GHG, t CO ₂ e
2008	168 579
2009	202 294
2010	202 294
2011	236 010
2012	236 010
Total for the period 2008-2012	1 045 188

E.5. Difference between E.4. and E.3. representing the emission reductions of the project:
Table E.5-1. Estimated reductions of GHG emissions

Year	Estimated reduction of GHG emissions from the project, tCO ₂ e
2008	118 072
2009	142 545
2010	143 295
2011	168 179
2012	169 180
Total for the period 2008-2012	741 271

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

Year	Estimated project emissions (tCO ₂ e)	Estimated leakages (tCO ₂ e)	Estimated baseline emissions (tCO ₂ e)	Estimated emission reductions (tCO ₂ e)
2008	0	50 507	168 579	118 072
2009	0	59 750	202 294	142 545
2010	0	58 999	202 294	143 295
2011	0	67 831	236 010	168 179
2012	0	66 830	236 010	169 180
Total (tCO₂e)	0	303 916	1 045 188	741 271

**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 does not lead to any changes in the environmental impacts of the Mill's departments. According to the Terms of Reference for the design of heat exchangers for acid and alkaline waste streams of the 1st flow and heat exchangers for acid and alkaline waste streams of the 2nd flow, there are no requirements to the development of any environmental measures, such as Maximum Permissible Emissions (MPE), Maximum Permissible Concentrations (MPC) or Environmental Impact Assessment (EIA).

The Environment Protection Section of the Executive Summary for the technical design document "Cooling of alkaline and acid bleaching waste streams" [R5], developed by LLC "Ust-Ilimsk Design and Production Engineering Office", contains the following information:

BCD Waste Water Management

Waste water from the Bleaching-and-Cleaning Department is subdivided into the following groups according to their contamination level:

- fiber-free waste water;
- fiber-containing waste water;
- acid waste water; and
- alkaline waste water.

Fiber-free waste water from the equipment glands cooling, from the gas neutralization plant, from washing of the chemicals tank and from overflows of return water and alkaline leachates is collected in an underground reservoir and then delivered to the neutralization plant.

Fibre-containing waste water from floor washing and equipment flushing is collected in an underground reservoir and then delivered to the fiber capture plant.

Excess acid return water (acid waste streams) from the tanks containing leachate from the chlorination stages, chlorine dioxide of the 1st and the 2nd stages is collected in a tank and then fed to the heat exchangers for acid waste streams of the 1st and the 2nd flows for heat recovery and cooling. The cooled acid waste streams are fed to the cooling station. Before installation of the heat exchangers these waste streams had not been cooled.

Excess alkaline water (alkaline waste streams) from the tanks containing leachate from the alkali extraction stages, hypochloride bleaching is collected in a tank and then fed to the heat exchangers of the 1st and the 2nd flows for heat recovery and cooling. The cooled alkaline waste streams are fed to the cooling station. Before installation of the heat exchangers these waste streams had not been cooled.

The quantity, rate of recurrence and content of pollutants in the waste streams from the BCD meet the requirements of the Process Procedure for Pulp Bleaching and Sorting Process. The quality of the industrial waste streams is subject to laboratory control.

The consumption of fresh water for diluting the bleaching waste streams before feeding them for neutralisation has reduced as a result of the project.

The system for collection and neutralisation of gas emissions from the pulp production

A gas scrubbing unit is used to capture gas emissions containing harmful substances: chlorine, chlorine dioxide and sulphur dioxide.

Gas mixtures are collected with the help of a branched system of air ducts.

Neutralised gases are emitted into the atmosphere via two gas flues at 70 m high.

The gas scrubbing unit consists of two paired cascade scrubbers of impact-inertia action. One scrubber has 9 in-built pipes and the second one has 6 pipes. The scrubbers are sprayed with fresh water with



caustic soda added as required. The gas hits at a high velocity against the water surface inside the non-corrosion pipes, which causes the water to disperse and then it is carried away by the reverting gas flow. The water captures admixtures from the gas and flows to the scrubber tank and then it is discharged to the production sewerage system. In addition, water is removed from the cleaned gas in a droplet separator after which gas is released into the atmosphere. Gas-vapour free from chlorine and chlorine dioxide is collected by a different gas recovery system, which covers vacuum filters and return water tanks. Gas-vapour in small amounts is released into the atmosphere without purification through exhaust ventilation via 10 stacks, 47m high each.

Gas emissions into the atmosphere meet the process requirements. The gas emissions from the Mill are subject to laboratory control.

The project has no impact whatsoever upon the Mill's gas emissions management system.

Estimation of pollutant emission reductions at Ust-Ilimsk CHPP

The project helps to reduce coal combustion at Ust-Ilimsk CHPP. It results in lower emissions of both greenhouse gases and pollutants produced from coal combustion.

Table F.1-2 shows calculation data on the variation of pollutant emissions as a result of the project implementation. The calculations were made in accordance with RD 34.02.305-98 "The Methodology for Calculation of Gross Pollutant Emissions from TPP Boilers" [R12], issued by VTI.

As a result of the project the coal consumption at Ust-Ilimsk CHPP reduces by an average of 115 thousand tonnes. The emissions of sulfur dioxide reduce by 1071 t/year, carbon oxide – by 441 t/year, nitrogen oxides (calculated as nitrogen dioxide) – by 590 t/year, and suspended particles – by 904 t/year. The overall reduction of gross pollutant emissions to the atmosphere amounts to 3008 t/year.

Furthermore, the disposal of coal ash to the ash disposal site reduces as well.

Table F.1-1. Variation of pollutant emissions at UI CHPP, t/year

Pollutant emissions	Value
Suspended particles	-904
Sulfur dioxide (SO ₂)	-1071
Nitrogen oxides calculated as nitrogen dioxide (NO ₂)	-590
Carbon oxide (CO)	-441
Total emissions	-3006

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 project does not have any significant impact upon the environment. Moreover the project leads to reduction of fossil fuel (coal) combustion, and hence to reduction of pollutants and greenhouse gases emissions into the atmosphere. The state expert review of EIA is not required.

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

No public hearings were held, because it is not required for this type of projects. However the project activity was widely discussed in the plant's newspaper "Vestnik Ulimskogo LPK": No.85 dated November 2, 2005; No.615 dated December 10, 2008; and No.617 dated December 17, 2008. Only positive feedback was received from the employees of the PPM.

No remarks or negative comments have been received.



REFERENCES

- [R1] Decision 9/CMP.1. Guidelines for the implementation of Article 6 of the Kyoto Protocol. FCCC/KP/CMP/2005/8/Add.2. March 30, 2006.
- [R2] B.V.Sazanov, V.I.Sitas. Thermal energy systems of industrial enterprises. M.: Energoatomizdat, 1990.
- [R3] E.Y.Sokolov. "Cogeneration-Based District Heating and Heat Networks", MEI, 2001.
- [R4] V.Y.Ryzhkin. Thermal power plants. – M.: Energoatomizdat, 1987.
- [R5] "Cooling of Alkaline and Acid Bleaching Waste Streams", Executive Summary to the technical design. LLC "Ust-Ilimsk Design and Production Engineering Office". Ust-Ilimsk, 2006.
- [R6] Application for the project "Cooling of Alkaline Waste Streams of the Bleaching Department". Ust-Ilimsk, 2007.
- [R7] Operational Guidelines for Project Design Documents of Joint Implementation Projects. Vol.1. General Guidelines./ Version 2.3. Ministry of Economic Affairs of the Netherlands. May 2004.
- [R8] 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2, Energy.
- [R9] Guidance on criteria for Baseline Setting and Monitoring. Joint Implementation Supervisory Committee
- [R10] Reference Book on Heat Engineering. Volume 2. Energy, Moscow, 1976.
- [R11] Energy Fuel of the USSR, M. Energoatomizdat, 1991.
- [R12] RD 34.02.305-98 "The Methodology for Calculation of Gross Pollutant Emissions from TPP Boilers.". VTI. 1998.
- [R13] V.M.Cherkassky, Pumps, Fans, Compressors. Moscow, Energoatomizdat, 1984.
- [R14] Induction Motors of 4A series: Reference Book. Moscow, Energoizdat, 1982.

Annex 1**CONTACT INFORMATION ON PROJECT PARTICIPANTS**

Organisation:	Open Joint Stock Company "Ilim Group"
Street/P.O.Box:	Marat
Building:	17
City:	Saint-Petersburg
State/Region:	
Postal code:	191025
Country:	Russia
Phone:	+7 (812) 718 60 50
Fax:	+7 (812) 718 60 06
E-mail:	office@ilimgroup.ru
URL:	www.ilimgroup.ru
Represented by:	
Title:	Director for Labour Protection and Environment
Salutation:	Mr.
Last name:	Andreev
Middle name:	
First name:	Andrey
Department:	
Phone (direct):	
Fax (direct):	
Mobile:	+7 921 993 00 40
Personal e-mail:	andrey.andreev@ilimgroup.ru

Annex 2

BASELINE INFORMATION

Annex 2.1 Estimation of GHG emissions related to consumption of electricity for pumping heat-transfer liquids through the heat exchangers for waste streams

There are four heat exchangers for acid and alkaline streams of the 1st and the 2nd flows. Two heat-transfer liquids (waste streams and water) are to be pumped through each heat exchanger; this altogether makes eight flows of heat-transfer liquids.

Electricity consumption for water pumping through the heat exchanger for the acid waste streams of the 1st flow during the year *y* is determined as follows, MWh:

$$EC_{ACID,water,pump,y}^I = \Delta N_{el,pump} \cdot T_{ACID,y}^I \cdot 10^{-3}, \quad (A.2-1)$$

where $T_{ACID,y}^I$ is the operating hours of the heat exchanger for acid waste streams of the 1st flow during the year *y*, hour;

$\Delta N_{el,pump}$ is the increase of the consumed electric power of the pump, kW.

$$\Delta N_{el,pump} = \frac{\Delta N_{pump}}{\eta_{pump} \cdot \eta_{mot}}, \quad (A.2-2)$$

where η_{pump} is the efficiency of the pump, $\eta_{pump} = 0.83^{10}$;

η_{mot} is the efficiency of the electric motor of the pump for high-power engines $\eta_{mot} = 0.92^{11}$.

ΔN_{pump} is the increase of the net output of the pump, kW.

$$\Delta N_{pump} = \frac{\Delta p_{water,pump}^I \cdot WatV_{ACID}^I}{3600}, \quad (A.2-3)$$

where $\Delta p_{water,pump}^I$ is the rated head losses in the heat exchanger for acid waste streams of the 1st flow, kPa (See Table A.3);

$WatV_{ACID}^I$ is the rated volumetric flow of cooling water passing though the heat exchanger for acid waste streams of the 1st flow, m³/h (See Table A.1).

Table A.1. Nameplate characteristics of the heat exchangers

Heat exchanger	Heat transfer liquid	Head losses, kPa	Volumetric flow, m ³ /h
Heat exchanger for acid waste streams of the 1 st flow	Water	50	700
	Waste streams	99	1000
Heat exchanger for acid waste streams of the 2 nd flow	Water	50	700
	Waste streams	99	1000
Heat exchanger for alkaline waste streams of the 1 st flow	Water	129	700
	Waste streams	107	1200
Heat exchanger for	Water	129	700

¹⁰ V.M.Cherkassky, Pumps, Fans, Compressors. Moscow, Energoatomizdat, 1984 [R13].

¹¹ Induction Motors of 4A series: Reference Book. Moscow, Energoizdat, 1982 [R14].

alkaline waste streams of the 2 nd flow	Waste streams	107	1200
--	---------------	-----	------

The emissions of GHG related to electricity consumption for pumping water through the heat exchangers for acid waste streams of the 1st flow during the year y, t CO₂e:

$$E_{pumps,y} = EC_{ACID,water,pump,y}^I \cdot EF_{CO_2,grid}^y \quad (A.2-4)$$

where $EF_{CO_2,grid}^y$ is the CO₂ emission factor for electricity consumed from the grid, tCO₂/MWh.

According to the Operational Guidelines for Project Design Documents of Joint Implementation Projects¹² the largest value of this factor for Russia is assumed herein, which corresponds to the year 2008: $EF_{CO_2,grid}^y = 0.565$ tCO₂/MWh.

Calculations for other flows are similar, the results are shown in Table A.2 below.

Table A.2. Calculation of the increase of GHG emissions as a result of the increase of electricity consumption by pump drives

Heat exchanger	Heat transfer liquid	Operating hours, h	Pump efficiency	Electric motor efficiency	Electric capacity, kW	Annual consumption of electricity, MWh	Annual emission of GHG, t CO ₂
Heat exchanger for acid waste streams of the 1 st flow	Water	8400	0.83	0.92	12.73	108	61
	Waste streams	8400	0.83	0.92	36.01	303	171
Heat exchanger for acid waste streams of the 2 nd flow	Water	8400	0.83	0.92	12.73	107	60
	Waste streams	8400	0.83	0.92	36.01	303	171
Heat exchanger for alkaline waste streams of the 1 st flow	Water	8400	0.83	0.92	32.85	276	156
	Waste streams	8400	0.83	0.92	46.71	392	222
Heat exchanger for alkaline waste streams of the 2 nd flow	Water	8400	0.83	0.92	32.85	276	156
	Waste streams	8400	0.83	0.92	46.71	392	222
Total					257	2157	1219

¹² Operational Guidelines for Project Design Documents of Joint Implementation Projects. Vol.1. General Guidelines/ Version 2.3. Ministry of Economic Affairs of the Netherlands. May 2004 [R7].

Annex 2.2. Selection of the emission factor for coal combustion at Ust-Ilimsk CHPP

Ust-Ilimsk CHPP is firing two grades of coal¹³, their characteristics¹⁴ are shown in the table below.

Table A.3. Characteristics of fuel combusted at Ust-Ilimsk CHPP

Parameter	Designation	Unit	Irsha-Borodinsky coal (Kansko-Achinsky coal field)	Zheronsky coal (Tungusky coal field)
Net calorific value on as-received basis	NCV_{Coal}	kcal/kg	3 650	4 430
		MJ/kg	15.28	18.55
Ash content on dry basis	A^d	%	11	24
Moisture content on as-received basis	W_t^r	%	33	18
Carbon content on dry ash-free basis	C^{daf}	%	71.5	80.3

GHG emission factors for fuel combustion, in general case, account for emissions of CO₂, CH₄ and N₂O. However the contribution of CH₄ and N₂O to the total amount of GHG emissions from fuel combustion is negligibly small¹⁵ (considering their Global Warming Potentials), therefore they are neglected in our calculations.

The $EF_{CO_2,coal}$ factor shall be determined on the basis of the data available. The CO₂ emission factors directly depend on the carbon content of a fuel and can be calculated as follows, kg/GJ:

$$EF_{CO_2,coal} = \frac{44}{12} \cdot K_C \quad (A.2-5)$$

where K_C is the factor of carbon content per energy unit of fuel on as-received basis, kg C/GJ;

$$K_C = 10 \cdot \frac{C^r}{NCV_{Coal}}, \quad (A.2-6)$$

where NCV_{Coal} is the net calorific value of fuel on as-received basis, MJ/kg.

C^r is the carbon content of fuel on as-received basis, %,

$$C^r = C^{daf} \cdot \frac{100 - A^r - W_t^r}{100} \quad (A.2-7)$$

where W_t^r is the moisture content of fuel on as-received basis, %;

C^{daf} is the carbon content of fuel on dry ash-free basis, %;

A^r is the ash content of fuel on as-received basis, %;

¹³ <http://www.irkutskenergo.ru/qa/968.2.html>

¹⁴ According to the Reference Book *Energy Fuel of the USSR, M. Energoatomizdat, 1991* [R11].

¹⁵ 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2, Energy [R8].



$$A^r = A^d \cdot \frac{100 - W_t^r}{100} \quad (\text{A.2-8})$$

where A^d is the ash content of fuel on dry basis, %.

The calculation results are given in the table below.

Table A.4. Emission factors for coal grades combusted at Ust-Ilimsk CHPP

Emission factor	Unit	Irsha-Borodinsky coal (Kansko-Achinsky coal field)	Zheronsky coal (Tungusky coal field)
$EF_{CO_2,coal}$	kgCO ₂ /GJ	102.31	98.92

Since the exact ratio of these coal grades is not known for each year of the crediting period, we conservatively assumed the minimum emission factor of 98.92 kg CO₂/GJ for the entire period of 2008-2012.



Annex 2.3. Applicability of CO₂ emission factors for grid electricity recommended by “Operational Guidelines for Project Design Documents of Joint Implementation Projects” [R7] for calculation of the project leakages

To justify the appropriateness of the emission factors for grid electricity applied in the PDD we are basing on the annual reports of Irkutskenergo for the years 2007¹⁶ and 2008¹⁷, which say, inter alia:

“2007 was the first year of operation of the unified model of wholesale and retail markets for electricity and power approved by the Regulations of the Russian Government No. 529 and No.530 (respectively) dated August 31, 2006...”

*Under the existing conditions OJSC “Irkutskenergo” was selling its total volume of power generation and was **purchasing in the market the total volume of its own consumption**”.*

“Since 2008 OJSC “Irkutskenergo” for the first time started to sell its total volume of electricity and capacity generation to the wholesale market in view of assigning the status of “provider of last resort” to LLC “Irkutsk Energy Sale Company”, which in its turn acquired the right to purchase electricity and power in the wholesale market...”

*“Since 01.01.2008 OJSC “Irkutskenergo” assigned the functions of the “provider of last resort” to LLC “Irkutsk Energy Sale Company”. The consolidated budgeted balance of production and supply of electricity and power within the framework of the Unified Energy System of Russia for 2009 **approves the factor of electricity purchase by the sale company from the Wholesale Market for Electricity and Power ...**”*

In other words the responsibility for energy supply now rests with LLC “Irkutsk Energy Sale Company” which has been entitled to purchase electricity and power in the wholesale market. The purpose of the reform was to liberalize the electricity market: the one who has the cheapest energy will have more buyers. Therefore, making up for the “falling out capacities” is no longer the task of Irkutskenergo but of Irkutsk Energy Sale Company, which may act as it wishes in different ways. For example, it can use the electricity and power purchased from Irkutskenergo to meet the demand within the Irkutsk region itself and only then sell the surplus to the outside the region. This would be logical. Since costs of electricity transportation over the territory of Irkutsk Energy Sale Company’s region are knowingly lower than delivery of electricity to the Urals (from the Urals) or to the Center (from the Center). Proceeding from this it would be reasonable to assume that the falling out capacities are covered by electricity generation outside the Irkutsk region, because reduction of electricity generation in Irkutskenergo results in reduction of electricity export outside of the Irkutsk region.

Give it in other words, we *do not assert* that undergeneration of power by Irkutskenergo caused by the project is covered by power flows from outside of the region. But we assume with a sufficient degree of assurance that these falling-out capacities are covered by redistribution of power generated by Irkutskenergo and that therefore electricity supply to outside of the region reduces. And this means that we have the right to attribute leakages resulting from the project implementation to the entire UES of Russia on the whole and not to apply specific emission factors for Irkutskenergo. Irkutskenergo will generate just as much energy as is permitted by its capacities and wholesale prices. That’s what the market is for! Where exactly the electricity is generated – either at HPP or at TPP in this case is irrelevant, there is a single purchase price for electricity in the market. Thus the use of recommended [R7] GHG emission factors for grid electricity is justified.

Appropriateness and conservatism of using these emission factors are also confirmed by the estimation of the weighted average GHG emission factor for electricity generation by Irkutskenergo.

¹⁶ <http://www.irkutskenergo.ru/gi/2524>

¹⁷ <http://www.irkutskenergo.ru/gi/4018>



According to the data presented in Irkutskenero's annual report for 2008, electricity generation at HPP amounted to 44.149 million MW*h (73.3%), and at TPP – 16.061 million MW*h (26.7%).

GHG emission factor for hydropower is zero.

Let us assume that all TPPs of Irkutskenergo are coal-fired (98 kg CO₂e/GJ or, if all fuel consumption is attributed to electricity generation - 353 kg CO₂e/MW*h. With allowance for electricity generation efficiency, which is conservatively assumed at 30%, the emission factor is 1177 kg CO₂e/MW*h).

Then the weighted average emission factor will amount to:

$$EF = \frac{0.733 \times 0 + 0.267 \times 1177}{1} = 314 \text{ kg CO}_2\text{e/MW}^*\text{h.}$$

However following the conservative approach, the estimation of GHG emission reductions in the PDD uses GHG emission factors for grid electricity assumed at the recommended level [R7].



Annex 3

MONITORING PLAN

Information on instruments used for GHG emission reduction monitoring

Location	Measured parameters	Mark and type of the instrument	Serial number	Measurement range	Unit	Error, accuracy class	Calibration interval (month)	Last check (calibration) date	Origination responsible for check (calibration)
Heat exchanger for acid waste streams of the 1 st flow, position 51.117A	Parameters of cooling water at the outlet from the heat exchanger for acid waste streams of the 1 st flow	1. Temperature gauge: TSP 9201	522	-50...+500	Degrees of C	A	3 years	11.03.2008	Service Repair Workshop LLC "Avtomatika"
		2. Flow meter: EJA(dP)110	634881	800 m ³ /h-5000 kgf/m ²	m ³ /h	0.5	3 years	04.06.2009	Service Repair Workshop LLC "Avtomatika"
	Parameters of cooling water at the inlet to the heat exchangers for acid and alkaline waste streams	3. Temperature gauge: TSP 9201	052	-50...+500	Degrees of C	A	3 years	19.01.2008	Service Repair Workshop LLC "Avtomatika"
Heat exchanger for alkaline waste streams of the	Parameters of cooling water at the outlet from the heat exchanger	4. Temperature gauge: TSP 9201	053	-50...+500	Degrees of C	A	3 years	19.01.2008	Service Repair Workshop LLC "Avtomatika"



1 st flow, position 51.117B	for alkaline waste streams of the 1 st flow	5. Flow meter: EJA(dP)110	634886	800 m3/h-5000 kgf/m2	m3/h	0.5	3 years	04.06.2009	Service Repair Workshop LLC "Avtomatika"
Heat exchanger for acid waste streams of the 2 nd flow, position 52.117A	Parameters of cooling water after the heat exchangers for acid and alkaline waste streams of the 2 nd flow (total)	6. Temperature gauge: TSP 9201	329	-50...+500	Degrees of C	A	3 years	11.03.2009	Service Repair Workshop LLC "Avtomatika"
Heat exchanger for alkaline waste streams of the 2 nd flow, position 52.117B	Parameters of cooling water fed to the heat exchangers for acid and alkaline waste streams (total)	7. Temperature gauge: TSP 9201	326	-50...+500	Degrees of C	A	3 years	11.03.2009	Service Repair Workshop LLC "Avtomatika"
	Parameters of cooling water after the heat exchangers of the 2 nd flow fed to reservoir No.209 (FI 1004), to the drying department (FI 1007), to the CWD (FI 1006)	8.Flow meters (streams fed to the BCD, CWD, drying department)	UNE No. KC 129	1000 m3/h, 1.6 kgf/cm2	m3/h	1.0	2 years	17.02.2009	Service Repair Workshop LLC "Avtomatika"
			EJA No. 05422	1400 m3/h, 1.0 kgf/cm2	m3/h	1.0	3 years	13.04.2009	Service Repair Workshop LLC "Avtomatika"
EJA No.113 80	1000 m3/h, 5000 kgf/m2	m3/h	1.0	3 years	13.04.2009	Service Repair Workshop LLC "Avtomatika"			