MONITORING REPORT
Version 1.1
27.05.2011

EVAPORATION SYSTEM MODERNIZATION AT OJSC "ILIM GROUP" BRANCH IN KORYAZHMA

Monitoring period: 1.01.2010 – 31.12.2010 (first and last days included)

CONTENTS

SECTION A. General description of the project activity

A.1. Title of the project activity and sectoral scope

Title: Evaporation System Modernization at OJSC "Ilim Group" Branch in Koryazhma

Sectoral scope: Manufacturing industries (4)

A.2. Monitoring period

Monitoring period: 1.01.2010 – 31.12.2010 (first and last days included)

A.3. Brief description of the project activity

The project is aimed at modernization of the Mill's evaporation system, which is intended to reduce power consumption of the pulp production process, stabilize operation of the process equipment, mitigate negative environmental impacts and reduce greenhouse gases (GHG) emissions.

This project envisages construction of a new high-technology evaporator plant manufactured by "Andritz" with the evaporating capacity of 600 tonnes per hour and decommissioning of the two old "Ramen" evaporator plants with the design capacity of 140 tonnes per hour, each.

GHG emission reductions in the monitoring period (1.01.2010 – 31.12.2010) amounted to **158 437** tCO_2e.

A.4. Location of the project activity

The project was implemented on the site of OJSC "Ilim Group" Branch in Koryazhma, Arkhangelsk Region, Russia. The Mill is located on the bank of the Vychegda River within the city limits and covers the territory of 995.8 ha. The enterprise is connected to the Russian transport network by railway and motor roads. The distance from Koryazhma to Kotlas along the railway is 32 km, and to Arkhangelsk - 830 km.

Latitude: 61°18'. Longitude: 47°10'. Time zone GMT: +3:00

The Arkhangelsk Region is located in the north of the European part of Russia and is a constituent of the North-Western Federal District of the Russian Federation. The administrative center of the region is the city of Arkhangelsk.

Fig. A.4.1. The Arkhangelsk Region and the town of Koryazhma on the map of Russia

Fig. A.4.2. The town of Koryazhma on the map of the Arkhangelsk Region

A.5. Technical description of the project

The new evaporator plant is a single-line six-stage plant consisting of seven evaporating units operating as per a six-stage scheme and on the principle of falling film formed across heat exchange surfaces manufactured from "lamellar" packages (Fig. A.5.1). There is no barometric condenser. Highly contaminated condensates are treated in a stripping column.

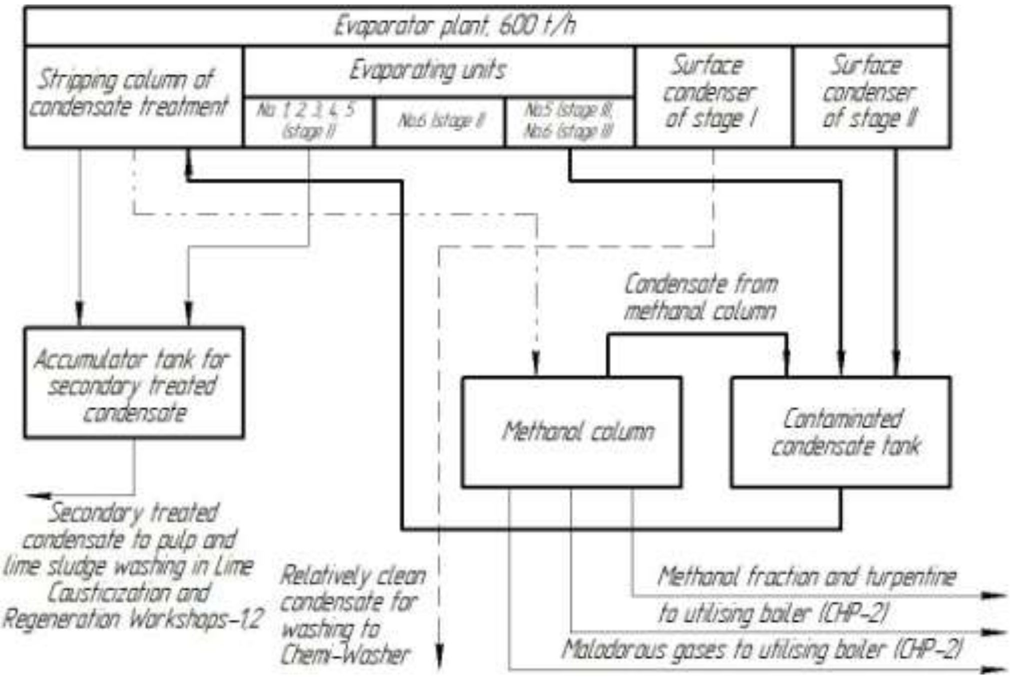

Fig. A.5.1. Scheme of collection, treatment and utilization of condensates from the new evaporator plant

Design concentration of dry residue after the evaporator plant is 53%, further evaporation to 65% is achieved in the existing "Ahlstrom" concentrators. Evaporating capacity of the evaporator plant is 600 t/h and it can be freely regulated within the range of 20÷100%. Quick start and shutdown of the units is ensured by presence of small quantities of liquor in the units.

A.6. Methodology applied to the project activity

A.6.1. Baseline methodology

The developer proposed his own approach [R1] 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* [R2].

A.6.2. Monitoring methodology

The monitoring plan was developed following our own approach [R1] in accordance with the project specifics and requirements of *Decision 9/CMP.1, Appendix B* [R2] without using any approved CDM methodologies.

A.7. Name of responsible person(s)/entity(ies)

CCGS LLC:

- Vladimir Dyachkov, Director of Project Implementation Department
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- Evgeniy Zhuravskiy, Specialist of Project Implementation Department
  e-mail: e.zhuravskiy@ccgs.ru

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

B.1.1. Key starting dates of the project activity

Activity	Date
Signing of contract for procurement of main equipment (start of the project activity)	January 2005
Commencement of construction and assembly works	March 2005
Commissioning of equipment (start of GHG emission reductions)	December 2007

B.1.2. The information regarding the actual operation of the project activity during the monitoring period

1. According to the project red liquor was supposed to be evaporated in a new Andritz evaporator plant, however in 2010 red liquor was evaporated in the old "UkrNIIHimMash" evaporator plant.

   Since the commissioning date (December 2007) till January 10, 2009 Andritz evaporation plant had been evaporating all black liquor fed from cardboard and paper production (CPP), some black liquor from hardwood sulfate bleached pulp production (SBPP) and all red liquor fed from neutral sulfite semi-chemical pulp production (NSSP). This scheme was envisaged by the project.

   However the experience of co-evaporation of black and red liquors showed that such mode leads to clogging up of distribution grates and, as a consequence, to clogging up of heating surfaces (lamellas) of the evaporator units and to increase of fresh steam consumption. The plant had to be shut down in order to clean up the evaporator units. Attempts were made to solve the problem by using various evaporation modes and chemicals. Ultimately the Mill's specialists came to a conclusion that co-evaporation of black and red liquors at the new evaporator plant is difficult.

   From January 11, 2009 red liquor has been supplied to "UkrNIIHimMash" evaporator plant, just like it was before project.

2. On October 14, 2010 the flow meter installed on the relatively clean condensate (condensate B) line broke down. It was not possible to repair or replace the broken measuring device with the equipment in operation. The device was restored on December 24, 2010.

3. In late 2009 an automated system for monitoring of heat savings due to use of warm water and condensates was set up. This allowed in 2010 to automatically calculate heat savings on an hourly basis.

B.2. Deviations or revisions to the registered monitoring plan

1. Since all through the year 2010 red liquor was fed for combustion in liquor recovery boilers via the old "UkrNIIHimMash" evaporator plant, which is similar to the baseline scenario, the project and the baseline scenarios for red liquor coincided and the effect from its evaporation in the new evaporation unit (lower heat consumption for water evaporation and higher dry matter content in liquors) was not realized.

   This deviation was taken into account in the calculation model by means of equating the red liquor flow via Andritz evaporator plant to zero, except for calculation of efficiency of liquor recovery boilers, where instead of red liquor flow via Andritz plant we used red liquor flow via UkrNIIHimMash plant.

2. The approach provided for in the emergency monitoring procedures (See Section C.10) was applied to determine the flow rate while the relatively clean condensate flow meter was out of order.

   Monthly volumes of relatively clean condensate produced at the new “Andritz” evaporator plant and then used in production process were calculated for the entire monitoring period from October 2010 till December 2010 using liquor evaporation data. The calculations used monthly-minimum values of evaporated water quantity which are recorded every week. This, in its turn, resulted in a minimum value of condensate production, and therefore also in a minimum GHG emission reduction effect from using condensate (the method for calculation of relatively clean condensate is described in more details in Section F.2).

   This approach was used for emission reduction monitoring in 2008-2009, within the framework of which comparison was made of calculated and actual volumes of relatively clean condensate supplied to the production. It was established that the calculated values are lower than the actual values by 6.7 – 15.9 %. Therefore it is fair to say that the method proposed for determining relatively clean condensate volumes is adequate and conservative.

SECTION C. Description of the monitoring system

C.1. Organizational scheme of the monitoring

Organizational scheme of the monitoring is shown in Fig. C.1.1.

The Head of Labour Safety and Environmental Protection Department is in charge of the JI project implementation on the part of the Central Office (Order No.GD-120 of 06.07.2010).

Original request for primary GHG emission reductions monitoring data is made by the Director of the Project Implementation Department of CCGS LLC to the Central Office of “Ilim Group” in St.-Petersburg, namely to the Head of Labour Protection and Industrial Safety Department, who in his turn gives instructions to a certain enterprise to collect the requested data. Each enterprise that is implementing projects within the framework of the Kyoto Protocol has specific persons (a working group) that responsible for collection, control and transfer of monitoring data. The responsibility of these persons is specified in corresponding orders. At “Ilim” Group Branch in Koryazhma the responsibility of such persons are set forth in Orders No.FU/512-A of 04.12.2007, No.FK/1381 of 03.12.2009 and No.GD-16 of 01.02.2011.

Collection of all primary data is carried out in accordance with the Mill’s existing practice of fuel, energy and feedstock monitoring. The monitoring does not require to make any changes in the company’s existing monitoring and data collection system. All necessary data are determined and registered in any case.

Primary data are furnished to the Head of the Technical Development Department from three subdivisions: Energy Technological Heat and Power Station (ETHPS), Planning and Economic Department of Production Line "Energetika" and Budgetary Department. The Head of the Technical Development Department submits the primary data package to the Central Office, namely to the Head of Labour Protection and Industrial Safety Department, who in his turn transfers it to the Director of the Project Implementation Department of CCGS LLC. All information is transferred by e-mail.

On the basis of the received data the Department of Project Implementation of CCGS LLC prepares a GHG emission reduction monitoring report and submits it for additional cross-check to the Project Development Department of CCGS LLC. As soon as all comments made by the Project Development Department are incorporated or resolved the monitoring report is submitted for verification to the enterprise where the project is implemented. At CCGS LLC the procedure for verification of the monitoring reports are laid down in “The provisions for quality control procedure in relation to preparation of project design documents and monitoring reports for greenhouse gas emission reduction projects”.

After the report is verified and amended as necessary, the Director of the Project Implementation Department of CCGS LLC informs the Head of Labour Protection and Industrial Safety Department of “Ilim” Group’s Central Office in St.-Petersburg about preliminary monitoring results and, if there are no comments on his part, the General Director of CCGS LLC takes the final decision to submit the monitoring report for verification to an independent expert organization.

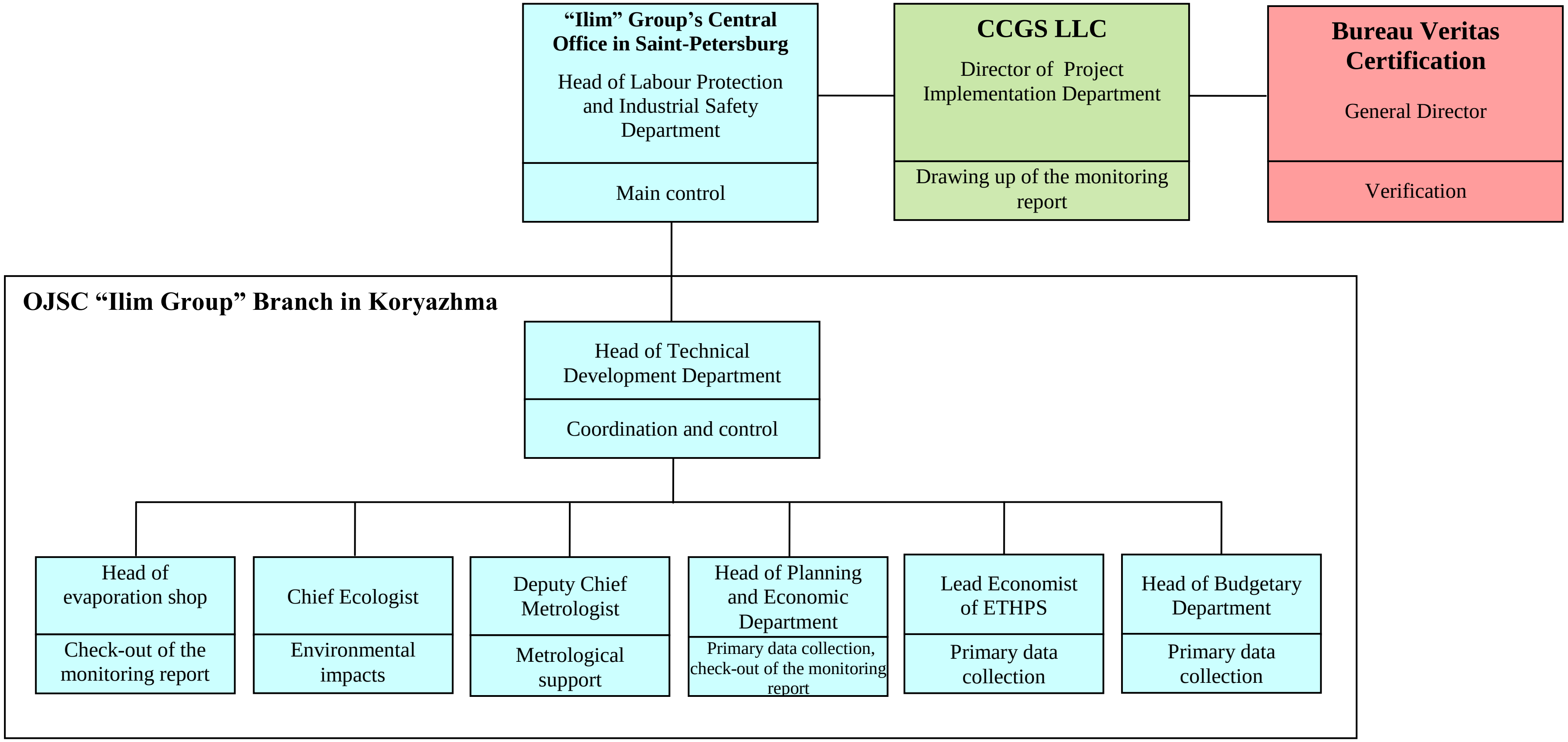


Fig. C.1.1. Organizational scheme of the monitoring

C.2. Roles and responsibilities of personnel

The management of CCGS LLC is responsible for:

- drawing up of the monitoring report (Director of Project Implementation Department);
- interaction with the independent expert organization concerning verification of GHG emissions reductions (Director of Project Implementation Department);
- arranging and holding training sessions for the Mill's personnel regarding collection of data required for the GHG emissions monitoring under the project (Director of Project Implementation Department).

The management of "Ilim" Group's Central Office in Saint-Petersburg is responsible for project implementation (Head of Labour Protection and Industrial Safety Department, Order NoGD-120 of 06.07.2010).

The management of OJSC "Ilim Group" Branch in Koryazhma is responsible for (Order No.GD-16 of 01.02.2011):

- coordination of monitoring, organizational issues, interaction with the Central Office (Head of Technical Development Department);
- collection, verification, storage and transfer of primary data (Lead Economist of ETHPS, Head of Planning and Economic Department of Production Line "Energetika", Chief of Budgetary Department);
- timely calibration and proper maintenance of instrumentation (Deputy Chief Metrologist);
- influence estimation on environment (Chief Ecologist);
- check-out of the monitoring report (Head of evaporation shop, Head of Planning and Economic Department of Production Line "Energetika").

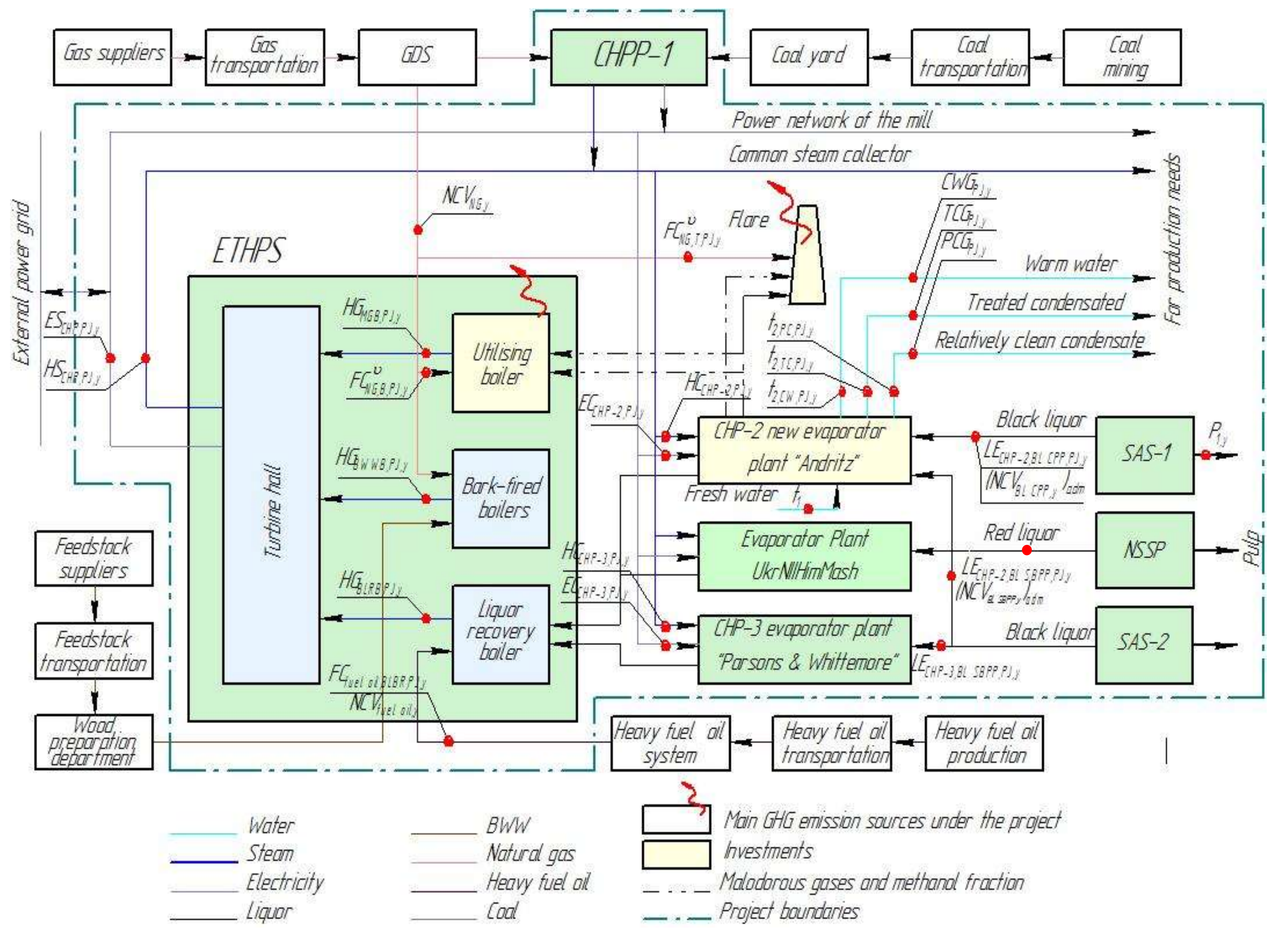
The roles and responsibilities of technicians and engineers of OJSC "Ilim Group" Branch in Koryazhma related to collection, check-out and transfer of GHG emission reduction monitoring data are shown in Table C.2.1.

Table C.2.1. Personal responsibilities of primary data collection and storage

Primary data	Document where the data are recorded	Person responsible for monitoring of the data
Consumption of heavy fuel oil by LRBs	“ETHPS Performance”	Lead Economist of ETHPS
Net calorific value of red liquor adjusted to absolutely dry matter		
Net calorific value of BL CPP adjusted to absolutely dry matter		
Net calorific value of BL SBPP adjusted to absolutely dry matter		
Net calorific value of heavy fuel oil		
Net calorific value of natural gas		
Heat production by the utilizing boiler firing malodorous gases and methanol fraction (used to determine the overall heat production at ETHPS)		
Overall heat quantity produced by liquor recovery boilers (used to determine the overall heat production at ETHPS)		
Overall heat quantity produced by BWW-fired boilers (used to determine the overall heat production at ETHPS)		
Quantity of red liquor fed to the evaporator plant		
Quantity of BL CPP fed to the evaporator plant of CHP-2		
Quantity of BL SBPP fed to the evaporator plant of CHP-2		
Quantity of BL SBPP fed to the evaporator plant of CHP-3		
Electricity supply from ETHPS		
Inlet and outlet dryness of liquors	“Liquor evaporation data”	Lead Economist of ETHPS
Volumetric consumption of natural gas by utilizing boiler	“Evaporator Plant Performance Parameters”	Lead Economist of ETHPS
Volumetric consumption of natural gas by flare		
Volume of reused warm water		
Volume of treated condensate fed for reuse (condensate A)		
Volume of relatively clean condensate fed for reuse (condensate B)		
Water temperature at the inlet to the new evaporator plant		
Warm water flow temperature at the outlet from the new evaporator plant		
Temperature of relatively clean condensate stream at the outlet from the new evaporator plant (condensate B)		
Temperature of treated condensate stream at the outlet from the new evaporator plant (condensate A)		
Electricity consumption at the evaporator plant of CHP-2	“Monthly Electricity Balance”	Head of Planning and Economic Department of Production Line " Energetika "
Electricity consumption at the evaporator plant of CHP -3		
Heat consumption at the evaporator plant of CHP-3	“Monthly Heat Balance”	Head of Planning and Economic Department of Production Line "Energetika"
Heat consumption at the evaporator plant of CHP-2		
Heat supply from ETHPS		

Volume of pulp produced in the cooking department of SAS-1	"Production Output"	Head of Budgetary Department

C.3. Location of the monitoring points



HG	Heat generation
HS	Heat supply
HC	Heat consumption
ES	Electricity supply
EC	Electricity consumption
FC	Fuel consumption
LE	Liquor consumption
NCV	Net calorific value
t	Temperature
P	Pulp cooking volume
CWG	Warm water expenditure
TCG	Treated condensate consumption
PCG	Relatively clean condensate consumption

C.4. Procedures for management of monitoring and measuring devices

The Plant Standard “Management of monitoring and measuring devices” [R11] is in effect at the Mill and specifies the following:

- procedures for procurement of measuring devices;
- stock record procedure;
- operation;
- repair;
- identification;
- operational procedure in case of identification of non-compliance of the measuring devices;
- persons responsible for measuring devices operation and monitoring of compliance with the Plant Standard.

The Plant Standard was developed in accordance with the requirements of:

- ISO 9001:2008 “Quality Management Systems. Requirements” (item 7.6);
- ISO 14001:2004 “Environmental Management Systems. Requirements and Guidance (item 4.5.1);
- OHSAS 18001:2007 “Occupational Safety and Health Management Systems. Specification” (item. 4.5.1).

The enterprise’s compliance with the three above mentioned standards has been officially certified.

According to procedures of these standards, if any non-compliance of the measuring processes with the standards specified in design documentation is identified, the situation is analyzed, alternative monitoring and measuring procedures are developed for the period of non-compliance as well as corrective actions are taken that allow to remedy any identified non-compliance.

The measuring devices used for monitoring are in compliance with the Russian law on measurement uniformity assurance (Federal Law No.102-FZ "On assurance of measurement uniformity" of 26.06.2008) and are subject to regular metrological evaluation of their serviceability (calibration).

Calibration of all measuring devices is carried out in accordance with the schedule developed by the Department of the Chief Metrologist. The Chief Metrologist is responsible for timely calibration of measuring devices.

The measuring instruments have been calibrated during scheduled shutdowns of the equipment. If necessary, the removed measuring instrument is replaced with a gaged back-up instrument. Operation of the equipment without measuring instruments is not allowed.

C.5. Data on metering devices

The measuring devices are provided in accordance with the official rules "Electricity Metering Rules", "Heat Metering Rules" etc. The devices have to undergo regular inspection and supervision under the Federal Law No.102-FZ "On assurance of measurement uniformity" of 26.06.2008. Table C.5.1. shows metrological performance of the measuring devices used for monitoring.

Table C.5.1. Data on metering devices for GHG emission reduction monitoring

Metered parameter	Mark and type of meter	Serial number	Set number	Measurement range	Unit	Error, accuracy class	Calibration interval (month)	Last calibration data	Organisation which performs calibration
Volume of pulp produced in SAS-1 cooking workshop after blowdown:	1.Flow meter: AXF200G,200	S5HA03069839	D-341	0-360	m^3/h	1.0	60	23.10.2009	OJSC "Ilim Group" Branch in Koryazhma
	2.Concentration meter: MEK-2300	256337/1/3	D-504	2-5	%	1.0	Adjusted on a weekly basis as per laboratory analysis		OJSC "Ilim Group" Branch in Koryazhma
Volumetric consumption of natural gas by utilizing boiler	3.Natural gas flow meter: PROWIRL 72,25 PROWIRL F,25	8103AF02000	Ch-322	0-400	m^3/h	1.0	60	20.06.2007	OJSC "Ilim Group" Branch in Koryazhma
Volumetric consumption of natural gas by flare	4.Natural gas flow meter: PROWIRL F,40	8103B002000	Ch-320	0-650	m^3/h	1.0	60	20.06.2007	OJSC "Ilim Group" Branch in Koryazhma
Calorific value of natural gas	5.Calorimetric bomb: V-08-MA	1857	TEC	15000	J/kg	0.10%	12	16.12.2010	Arkhangelsk Centre for Standardisation and Metrology (ACSM)
	6.Weights: VLKT-500	136	TEC	0-500	g	Class 4	12	22.07.2010	Arkhangelsk Centre for Standardization and Metrology
	7.Set of weights: G-2-210	288	T-002	1-100	g	Class 2	12	17.02.2010	
Calorific value of liquor	8.Calorimetric bomb: V-08-M	1085	TEC	15000	J/kg	0.10%	12	16.12.2010	Arkhangelsk Centre for Standardization and Metrology
	9.Weights: VLKT-500	110	TEC	0-500	g	Class 4	12	22.07.2010	OJSC "Ilim Group" Branch in Koryazhma
	10.Set of weights: G-2-210	392	T-003	1-100	g	Class 2	12	17.02.2010	Arkhangelsk Centre for Standardization and Metrology
Heat consumption for CHP-3 evaporator plant	11.Flow meter: HD4SD27SHO	u/n	T-365	0-63	t/h	0.5	12	14.01.2011	OJSC "Ilim Group" Branch in Koryazhma
	12.Temperature meter: Sh4500, THK	2034746	T-152	0-300	^0C	1.5	24	09.02.2010	OJSC "Ilim Group" Branch in Koryazhma

Metered parameter	Mark and type of meter	Serial number	Set number	Measurement range	Unit	Error, accuracy class	Calibration interval (month)	Last calibration data	Organisation which performs calibration
	13.Pressure meter: HT6S122SHO	44659434	T-256	0-60	bar	0.5	12	03.04.2010	OJSC “Ilim Group” Branch in Koryazhma
Heat consumption for CHP-3 concentrators	14.Flow meter: Metran 150	875211	T-396	0.47; 0-40	kgf/cm^2; t/h	0.5	12	03.08.2010	OJSC “Ilim Group” Branch in Koryazhma
	15.Temperature meter: 90.220-F02Pt100	00397095	T-162	0-200	^0C	0.3 grade of C	12	13.01.2010	Arkhangelsk Centre for Standardization and Metrology
	16.Pressure meter: PRESS-EL	3447	T-202	0-13	bar	0.5	12	29.10.2010	OJSC “Ilim Group” Branch in Koryazhma
Heat consumption for CHP-2 evaporator plant	17.Flow meter: Deltabar PMD-75	81007E0109D	Ch-300	0-0.075	bar	0.5	12	22.09.2010	OJSC “Ilim Group” Branch in Koryazhma
	18.Temperature meter: TMT-182	810069	Ch-100	0-250	^0C	Class C	24	29.06.2010	OJSC “Ilim Group” Branch in Koryazhma
	19.Pressure meter: Metran 150	875209	Ch-201	0-5	bar	0.5	12	07.06.2010	OJSC “Ilim Group” Branch in Koryazhma
Heat consumption for CHP-2 concentrators	20.Pressure meter: PRESS-EL	112282	S-228	0-10	bar	0,5	12	12.08.2010	OJSC “Ilim Group” Branch in Koryazhma
	21.Flow meter: DIFF EL	250668	S-343	0-588.4	mbar	0.5	12	29.10.2010	OJSC “Ilim Group” Branch in Koryazhma
	22.Flow meter: DIFF EL	250667	S-381	0-588,4	mbar	0,5	12	28.12.2010	OJSC “Ilim Group” Branch in Koryazhma
	23.Temperature meter: S-550	u/n	S-100	0-200	^0C	Class C	60	23.06.2008	OJSC “Ilim Group” Branch in Koryazhma
	24.Temperature meter: S-550	u/n	S-102	0-200	^0C	Class C	60	23.06.2008	OJSC “Ilim Group” Branch in Koryazhma
Heat production by utilizing boiler	25.Flow meter: Deltabar S, PMD75 type	81009A0109D	Ch-316	0.230; 0-2.8	bar; kg/s	0.5	12	11.08.2010	OJSC “Ilim Group” Branch in Koryazhma
	26.Temperature meter: TR88-AA4B1D2R3000	810061	Ch-143	0-220	^0C	Class C	60	26.06.2008	OJSC “Ilim Group” Branch in Koryazhma
	27.Pressure meter: Cerabar S, PMP71 type	81008F0109C	Ch-222	0-20	bar	0.5	12	10.08.2010	OJSC “Ilim Group” Branch in Koryazhma
Quantity of red liquor fed to evaporator plant	28.Flow meter: OPTI FLUX4000F,150	A0732427	Ch-333	0-250	m^3/h	1.0	60	28.10.2008	OJSC “Ilim Group” Branch in Koryazhma
	29.Temperature meter:	556	____	0-150	^0C	1 grade of C	48	23.01.2010	OJSC “Ilim Group” Branch in Koryazhma
	30.Density meter:	BY LABORATORY METHOD							OJSC “Ilim Group” Branch in

Metered parameter	**Mark and type of meter**	**Serial number**	**Set number**	**Measurement range**	**Unit**	**Error, accuracy class**	**Calibration interval (month)**	**Last calibration data**	**Organisation which performs calibration**
									Koryazhma
Quantity of black liquor from CPP fed to CHP-2 evaporator plant	31.Flow meter: 50XM12,50; SM,50	2X1003/A6; 2X1003/C6	D-913	0-20	m^3/h	1.0	60	04.09.2008	OJSC "Ilim Group" Branch in Koryazhma
	32.Temperature meter:	555	____	0-150	^0C	1 grade of C	48	23.01.2010	OJSC "Ilim Group" Branch in Koryazhma
	33.Density meter:	BY LABORATORY METHOD							OJSC "Ilim Group" Branch in Koryazhma
Quantity of black liquor from SBPP fed to CHP-2 evaporator plant	34.Flow meter: IFS400F,250; IFC080,250	150A0732429; 93401408	B-391	0 – 450	m^3/h	1,0	60	31.08.2009	OJSC "Ilim Group" Branch in Koryazhma
	35.Temperature meter: 13TD73	7528	B-112	0-100	^0C	1.5	12	14.04.2010	OJSC "Ilim Group" Branch in Koryazhma
	36.Density meter:	BY LABORATORY METHOD							OJSC "Ilim Group" Branch in Koryazhma
Quantity of black liquor from SBPP fed to CHP-3 evaporator plant	37.Flow meter: DMPK100	07932	T-370	6300; 0-500	kgf/m^2; t/m^3	1.5	12	07.06.2010	OJSC "Ilim Group" Branch in Koryazhma
	38.Temperature meter:	125	____	0-150	^0C	1 grade of C	48	23.01.2010	OJSC "Ilim Group" Branch in Koryazhma
	39.Density meter: DIFF AIR	7997	T-017	0-300; 1-1,1	kgf/m^2; t/m^3	1.0	12	03.08.2010	OJSC "Ilim Group" Branch in Koryazhma
Volume of warm water after condenser of CHP-2 evaporator plant fed for production needs	40.Flow meter: OPTI FLUX5000F,600	A0693092	Ch-328	0-5000	m^3/h	1.0	60	15.10.2007	OJSC "Ilim Group" Branch in Koryazhma
Temperature of warm water after the condenser of CHP-2 evaporator plant fed for production needs	41.Temperature meter: TMT-182	88008F14154	Ch -151	0-120	^0C	Class C	24	24.08.2009	OJSC "Ilim Group" Branch in Koryazhma
Volume of condensate after CHP-2 evaporator plant, fed for production needs from condensate accumulation tank	42.Flow meter: Deltabar S PMD75 type	81007F0109D	Ch-301	0-42	l/s	0.5	12	27.01.2011	OJSC "Ilim Group" Branch in Koryazhma
Condensate temperature after evaporator plant of CHP-2 that is fed for process needs from condensate surge tank (Condensate A)	43.Temperature sensor 1XPt100/dl	00449900	D-127	0-200	^0C	Class B	60	26.10.2009	OJSC "Ilim Group" Branch in Koryazhma
Flow rate of relatively clean condensate B	44.Flow meter AXF200G	S5RF02652	D-334	0-180	m^3/h	1,0	60	13.12.10	OJSC "Ilim Group" Branch in Koryazhma
Temperature of relatively clean condensate B	45.Temperature sensor 1XPt100/dl	00449012	D-126	0-200	^0C	Class B	60	26.10.2009	OJSC "Ilim Group" Branch in Koryazhma

Metered parameter	Mark and type of meter	Serial number	Set number	Measurement range	Unit	Error, accuracy class	Calibration interval (month)	Last calibration data	Organisation which performs calibration
Electricity consumption by CHP-2 evaporator plant	46.Electricity meter: ELCTIEA	1138305	—	10000	kWh	0.5	96	2nd quarter of 2006	OJSC “Ilim Group” Branch in Koryazhma
Electricity consumption by CHP-3 evaporator plant	47.Electricity meter: ELCTIEA	1138304	—	10000	kWh	0.5	96	2nd quarter of 2006	OJSC “Ilim Group” Branch in Koryazhma

Table C.5.2. Justifications of replacements of measuring devices

Metered parameter	Mark and serial number of device		Comments
	PDD	MR	
Volume of pulp produced in SAS-1 cooking workshop after blowdown	Flow meter: AXFA11G,80 No. S5F501993617	Flow meter: AXF200G,200 No S5HA03069839	The correction of information for the device. The flow meter set remained the same, mark and serial number in PDD were given for the amplifier (component part). In MR mark and serial number are on the flow meter set (in accordance to enterprise passport for this measuring set).
Calorific value of natural gas	Weights: VLKT-2 No.102	Weights: VLKT-500 No.136	A weighing instrument with the same accuracy class is used; reason of replacement - renewal of the measuring devices park
	Set of weights: G Г-2-210 No. 87	Set of weights: G-2-210 No. 288	A set of weights with the same accuracy class is used; reason of replacement - renewal of the instrumentation park
Calorific value of liquor	Weights: VLKT-500 No.185	Weights: VLKT-500 No.110	A weighing instrument with the same accuracy class is used; reason of replacement - renewal of the measuring devices park
	Set of weights: G-2-210 No.109	Set of weights: G-2-210 No.392	A set of weights with the same accuracy class is used; reason of replacement - renewal of the instrumentation park
Heat consumption for CHP-3 concentrators	Flow meter: DIFF-EL No.5829	Flow meter: Metran 150 No.875211	Replaced with a device with the same accuracy class; request No. 464 dated 03.08.2010
	Temperature meter: TEMP-AIR No.6930	Temperature meter: 90.220-F02Pt100 No.00397095	Replaced with a device with the same accuracy class; request No.7 dated 13.01.2011
Heat consumption for CHP-2 evaporator plant	Pressure meter: PMP-71 8100790109C	Pressure meter: Metran 150 875209	Replaced with a device with the same accuracy class (breakdown); request No.341 dated 07.06.2010
Heat consumption for CHP-2 concentrators	Temperature meter: Pt 100 u/n	Temperature meter: S-550 u/n	Replaced with a device with the same accuracy class; request No.780 dated 28.12.2010

	Pressure meter: PRESS EL No. 110664	Pressure meter: PRESS EL No. 112282	Replaced with a device with the same accuracy class; request No.780 dated 28.12.2010
Quantity of red liquor fed to evaporator plant	Flow meter: OPTI FLUX 4000F,150 No. 81008F0115	Flow meter: OPTI FLUX 4000F,150 No.A0732427	The correction of information for the device. The flow meter set remained the same, serial number in PDD was given for the amplifier (component part of set). In MR the serial number is on the flow meter set (in accordance to enterprise passport for this measuring set).
Volume of warm water after condenser of CHP-2 evaporator plant fed for production needs	Flow meter: OPTI FLUX5000F, 600 No. A0661894	Flow meter: OPTI FLUX5000F, 600 No.A0693092	The correction of information for the device. The flow meter set remained the same, serial number in PDD was given for the amplifier (component part of set). In MR the serial number is on the flow meter set (in accordance to enterprise passport for this measuring set).
Temperature of warm water after the condenser of CHP-2 evaporator plant fed for production needs	Temperature meter: TR15 1xPT100/A/4 No. 88008F14154	Temperature meter: TMT-182 No. 88008F14154	The correction of information for the device. The Temperature meter remained the same, the mark in PDD was given for the converter (component part of set). In MR the mark of device is on the set (in accordance to enterprise passport for this measuring set).

C.6. Procedures for collection of primary data

Primary data	Procedure for registration, monitoring, record and storage of primary data (including everyday monitoring)
Pulp cooking volume	1. The volume of pulp produced in the pulp cooking workshop SAS-1 is continuously measured by flow meters and concentration sensor installed after the digesters. In addition, pulp cooking volumes are cross checked by two methods: The first method is by measuring the rotation speed of the special dosing tray with known holding capacity which is used to feed chips to the digesters. Then the volume of cooked pulp is determined using pulp production standards approved at the enterprise. The second method is based on weighing of each type of finished marketable products and determining the quantity of pulp consumed for manufacturing of these products using special consumption coefficients approved at the enterprise. These coefficients are approved individually for each paper and cardboard making machine. 2. Data from the instruments are sent to APCS and recorded in the Mill’s automated dispatch control system (ADCS), printed in hard copy at the Mill’s commercial department and stored in the computer memory for not less than one year, then the computer data are handed over to the Mill’s archives. 3. The data are recorded by an operator on a daily basis in daily reports on pulp cooking workshop performance, and also handed over to the commercial department of the enterprise. Daily reports are then summarized in monthly and annual reports. 4. Pulp cooking data will be stored in the Mill’s archives in electronic and paper form for at least 2 years after the end of the crediting period or the last issue of ERUs.

Natural gas consumption in the utilizing boiler and in the flare	1. The consumed quantity of natural gas is continuously measured by flow meters. 2. Flow meter readings are recorded in the APCS and are shown on the displays of all computers with the required software installed. The data are printed in hard copy and stored in the computer memory for at least one year, and then sent to the Mill's electronic archive. 3. The data are recorded by CHP-2 operators on a daily basis in daily reports, which are then summarized in monthly and annual reports. 4. Natural gas consumption data will be stored in the Mill's archive in electronic and paper form for at least 2 years after the end of the crediting period or the last issue of ERUs.
Consumption of heavy fuel oil	1. The consumed quantity of heavy fuel oil is continuously measured by flow meters. 2. Flow meter readings are recorded in the APCS and are shown on the displays of all computers with the required software installed. The data are printed in hard copy and are stored in the computer memory for at least one year, and then sent to the Mill's electronic archive. 3. The data are recorded by operators on a daily basis in daily reports, which are then summarized in monthly and annual reports. 4. Heavy fuel oil consumption data will be stored in the Mill's archive in electronic and paper form for at least 2 years after the end of the crediting period or the last issue of ERUs.
Calorific value of heavy fuel oil	1. The calorific value of heavy fuel oil is determined by the fuel supplier, and the fuel certificate is provided by the fuel supplier for each batch of heavy fuel oil supplied to the Mill. 2. The calorific value data are recorded in the logs and then transferred to the APCS where they are stored for at least one year, and then the data are sent to the Mill's electronic archive. The data are shown on the displays of all computers with the required software installed. 3. Calorific values data will be stored in the Mill's archive in electronic and paper form for at least 2 years after the end of the crediting period or the last issue of ERUs.
Calorific values of natural gas and liquors	1. Calorific values of natural gas and liquors are determined experimentally on a weekly basis in the production laboratory of OJSC "Ilim Group" Branch in Koryazhma. 2. The test results are recorded by laboratory assistants in the logs and then transferred to the APCS where they are stored for at least one year, and then the data are sent to the Mill's electronic archive. The data are shown on the displays of all computers with the required software installed. 3. Calorific values data will be stored in the Mill's archive in electronic and paper form for at least 2 years after the end of the crediting period or the last issue of ERUs.
Inlet and outlet dryness of liquors	1. Inlet and outlet dryness of liquors are determined experimentally on a weekly basis in the production laboratory of OJSC "Ilim Group" Branch in Koryazhma. 2. The test results are recorded by laboratory assistants in the logs and fixed in the computer of the lead economist of ETHPS. 3. Inlet and outlet dryness of liquors data will be stored in the Mill's archive in electronic and paper form for at least 2 years after the end of the crediting period or the last issue of ERUs.

Liquor supply to evaporator plants	1. For measurement of the quantity of liquors fed to evaporator plants, flow meters and concentration meters are used. The parameters are measured continuously. 2. The meter readings are recorded in the APCS and are shown on the displays of all computers with the required software installed. The data are printed in hard copy and are stored in the computer memory for at least one year, and then sent to the Mill’s electronic archive. 3. The data are recorded by operators on a daily basis in daily reports, which are then summarized in monthly and annual reports. 4. Data on the quantity of liquors supplied to evaporator plants will be stored in the Mill’s archive in electronic and paper form for at least 2 years after the end of the crediting period or the last issue of ERUs.
Production, supply and consumption of heat	1. For monitoring of heat production, supply and consumption sensors and transmitters are used, which continuously measure flow rate, temperature and pressure of steam. 2. The meter readings are recorded in the APCS and are shown on the displays of all computers with the required software installed. The data are printed in hard copy and are stored in the computer memory for at least one year, and then sent to the Mill’s electronic archive. 3. The data are recorded by operators on a daily basis in daily reports, which are then summarized in monthly and annual reports. 4. Data will be stored in the Mill’s archive in electronic and paper form for at least 2 years after the end of the crediting period or the last issue of ERUs.
Quantity of warm water and condensate streams fed for reuse	1. Flow meters are used for monitoring of the quantity of warm water and condensate streams supplied for production needs. The parameters are measured continuously. 2. The meter readings are recorded in the APCS and are shown on the displays of all computers with the required software installed. The data are printed in hard copy and are stored in the computer memory for at least one year, and then sent to the Mill’s electronic archive. 3. The data are recorded by operators on a daily basis in daily reports, which are then summarized in monthly and annual reports. 4. Data on the quantity of reused warm water and condensate will be stored in the Mill’s archive in electronic and paper form for at least 2 years after the end of the crediting period or the last issue of ERUs.
Temperatures of warm water and condensates	1. Temperature sensors are used for monitoring of warm water and condensates temperatures. The parameters are measured continuously. 2. The meter readings are recorded in the APCS and are shown on the displays of all computers with the required software installed. The data are printed in hard copy and are stored in the computer memory for at least one year, and then sent to the Mill’s electronic archive. 3. The data are recorded by operators on a daily basis in daily reports, which are then summarized in monthly and annual reports. 4. Data on the warm water and condensates temperatures will be stored in the Mill’s archive in electronic and paper form for at least 2 years after the end of the crediting period or the last issue of ERUs.
Electricity consumption metering	1. Electricity consumption at the evaporator plants and the electricity supply from ETHPS are continuously measured by electricity meters. 2. The meter readings are recorded in the APCS and are shown on the displays of all computers with the required software installed. The data

	are printed in hard copy and are stored in the computer memory for at least one year, and then sent to the Mill's electronic archive. 3. The data are recorded by operators on a daily basis in daily reports, which are then summarized in monthly and annual reports. 4. Data on electricity consumption by evaporator plants and electricity supply from ETHPS will be stored in the Mill's archive in electronic and paper form for at least 2 years after the end of the crediting period or the last issue of ERUs.

C.7. Data storage

All monitoring data will be stored in the Mill's archive in electronic and paper form for at least 2 years after the end of the crediting period or the last issue of ERUs.

C.8. Involvement of Third Parties

The Arkhangelsk Centre for Standardization and Metrology is the Third Party involved.

C.9. Quality control and quality assurance procedures undertaken for monitoring

C.9.1. 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)*	QC/QA procedures for primary data
Table E.1. ID 1,2	Low	Flow meters are used to measure consumption of natural gas in the flare and in the utilizing boiler. Measurement error is 1.0 %. Calibration interval: 5 years. Output signals from the flow meters transmitters enters the Automated Process Control System (APCS).

Data *(Indicate table and ID number)*	Uncertainty level of data *(high/medium/low)*	QC/QA procedures for primary data
Table E.2. ID 4	Low	The volume of pulp produced in SAS-1 cooking workshop is measures with the help of the following: 1. Flow meter. Measurement error 1.0 %. Calibration interval: five years. 2. Concentration meter. Measurement error 1.0 %. The concentration meter is adjusted on a weekly basis according to the laboratory analysis. The instruments are installed after the digesters of SAS-1. Data from the instruments are sent to the APCS. In addition, pulp cooking volumes are cross checked by two methods: The first method is by measuring the rotation speed of the special dosing tray with known holding capacity which is used to feed chips to the digesters. Then using the pulp yield standards approved at the enterprise the volume of cooked pulp is determined. The second method is based on weighing of each type of finished marketable product and determining the quantity of pulp consumed for manufacturing of these products using special consumption coefficients approved at the enterprise. These coefficients are approved individually for each paper and cardboard making machine.
Table E.2. ID 5	Low	Flow meters are used for measuring heavy fuel oil consumption. Measurement error is 1.0 %. Calibration interval: five years. Output signals from the flow meters transmitters are sent to the APCS.
Table E.1. ID 3 Table E.2. ID 6-8	Low	The calorific values of natural gas and liquors are measured in the Mill’s production laboratory on a weekly basis. Instruments for measurement of calorific value of liquors and natural gas are: 1. Calorimetric bomb. Measurement error is 0.10%. Calibration interval: 1 year. 2. Weights. Accuracy class: 4. Calibration interval: 1 year. 3. Set of weights. Accuracy class: 2. Calibration interval: 1 year.
Table E.2. ID 9	Low	Calorific value of heavy fuel oil. Data of the fuel suppliers’ certified laboratories are used. At the year-end weighted average value is determined.
Table E.2. ID 10-15	Low	For metering of output, supply and consumption of heat the following is used: 1. Steam flow meters. Measurement error 0.5 %. Calibration interval: 1 year; 2. Temperature meter. Accuracy class C. Calibration interval: five years; 3. Pressure meter. Measurement error 0.5 %. Calibration interval: 1 year. Signals from the instruments are sent to the APCS.

Data *(Indicate table and ID number)*	Uncertainty level of data *(high/medium/low)*	QC/QA procedures for primary data
Table E.2. ID 16-19	Low	Liquor consumption is measured by the following: 1. Flow meters. Measurement error 1.0%. Calibration interval: five years. 2. Temperature meter. Measurement error 1 ^oC. Calibration interval: four years. 3. Density meter. Liquor density is measured by laboratory method on a daily basis. Mass flow rate of liquors is calculated in tonnes of a.d.m. based on the volume flow rate, temperature and density.
Table E.2. ID 20-22	Low	Consumption of warm water and condensate streams are measured by electromagnetic flow meters. Measurement error 1.0%. Calibration interval: five years. Output signals from flow meters are sent to the APCS.
Table E.2. ID 23-26	Low	Temperature converters are used for measurement of warm water and condensate streams after CHP-2 evaporator plant. Accuracy class B, C. Calibration interval: five years. Output signals from the converters are sent to the APCS.
Table E.3. ID 27-29	Low	Electricity consumption at evaporator plants and electricity supply from ETHPS are measured by electricity meters. Measurement error 0.5 %. Calibration interval: eight years.

C.9.2. Internal check-out

Ivan Chukhlomin, the Head of Labour Safety and Environmental Protection Department, is in charge of the JI project implementation on the part of the Central Office (Order NoGD-120 of 06.07.2010). The project implementation process is checked and reviewed at the level of the Central Office and Branch Offices two times per year. The checks and reviews are to be based on the data and recommendations provided by CCGS LLC. The first review is to be carried out in May-June based on the results of emission reductions verification, the second review is to be held in October based on the data obtained in the course of training and preliminary estimation of emission reductions in January-September. Based on the results of such checks and reviews recommendations are developed as to how to improve the monitoring plan and to maximize emission reductions.

The responsibility for internal check-out of primary data for monitoring lies with the following persons:

- The Head of Planning and Economics Department Production Line "Energetika" Maxim Balakshin (consumption of energy resources, technical data);
- The Lead Economist of ETHPS Ekaterina Artamonova (consumption of fuel and energy resources, technical data);
- The Head of the Budgeting Department Natalia Belyh (pulping volumes and production output levels);
- The Chief Ecologist Nikolay Ryabov (environmental impact of the project).

The internal check-out of GHG emission reduction calculation at “Ilim Group” Branch in Koryazhma was carried out by the Head of evaporation shop, Michael Vorontsov and Head of Planning and Economic Department of Production Line "Energetika" Maxim Balakshin. Act of internal audit was made on results of check-out of the monitoring report (Act No.3 of 18.03.2011).

The responsibility of these persons is specified in Order GD-16 of 01.02.2011. Actions of the members of this working group are described in detail in the Monitoring Guidelines.

At least once every year the company carries out an internal check of observance of monitoring procedures. In 2010 such internal check was carried out on May, 19-20. Act of internal audit was made on the check results (Act No.1 of 24.05.2010).

C.9.3. Cross-check

Primary data are verified by cross checking different sources where these data are recorded.

The monitoring reports are verified by specialists of both “Ilim Group” Branch in Koryazhma and CCGS LLC.

At CCGS LLC the check of the monitoring report is carried out by the Director of the Project Implementation Department, or, on his instructions, by other specialist of the Project Implementation Department who was not directly involved in preparation of this project monitoring report.

Additional cross check is carried out by the Director of the Project Development Department of CCGS LLC, or, on his instructions, by other specialist of the Project Development Department.

At CCGS LLC the procedure for verification of the monitoring reports are laid down in “The provisions for quality control procedure in relation to preparation of project design documents and monitoring reports for greenhouse gas emission reduction projects at CCGS LLC”.

C.9.4. Trainings

All personnel of the evaporation plant have undergone certification in accordance with the requirements of Rostechnadzor.

Furthermore, in connection with the commissioning of the evaporator plant, the personnel underwent training within the framework of the contract with the equipment supplier, "ANDRITZ OY", in accordance with the personnel’s job content.

At least once per year CCGS LLC together with the management of OJSC “Ilim Group” shall arrange and hold training sessions for the Mill’s personnel regarding collection of data required for the GHG emissions monitoring under the project.

The Monitoring Guidelines which describe in detail actions of each member of the working group have been approved and are in effect within the company.

Check-out of the equipment required for primary monitoring data collection and personnel training were carried out on October 12-25, 2010 (Act No.2 of 27.10.2010).

C.10. Emergency monitoring procedures

In case of any emergency situations at the company which affect the project monitoring system (breakdown of equipment, failure of measuring devices) specialists of OJSC “Ilim Group” Branch in Koryazhma and CCGS LLC shall analyze the situation and elaborate alternative monitoring and measurement schemes for the duration of such circumstances as well as corrective actions covering the monitoring equipment and/or plan.

C.11. Industrial environmental control

The company is certified for compliance with the international standard ISO 14001 “Environmental Management” and carries out its operations in accordance with this standard.

The enterprise manufactures products certified for compliance with the requirements of the Forest Stewardship Council (FSC).

The Environmental Service, accountable to the Deputy Technical Manager for Environmental Protection, is responsible for industrial environmental monitoring at the enterprise. The Service consists of:

- Environmental Protection Department (EPD), comprising a production laboratory;
- Biological Treatment Facility for Industrial Effluents (BTFIE), comprising a production laboratory.

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 pollution content in the atmospheric air on the border of the sanitary protection zone, etc.

The data retrieved by the analytical laboratory are processed and summarized in monthly and annual reports, which contain all required detailed data, including data by sections and streams covered by this project.

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, the enterprise annually develops and implements environmental protection measures.

SECTION D. Influence estimation on environment

The Mill is located in the industrial zone of Koryazhma, 1 km from the residential area. The modernized production is a part of the functioning pulp and paper mill and has no sanitary protection zone of its own.

Under the project the old run-down equipment was replaced by the new modern equipment purchased from “Andritz” (Finland), which provides for more complete and efficient evaporation of liquors.

Commissioning of the new evaporator plant makes it possible to completely avoid emissions of harmful substances in the process of liquor evaporation. Stabilization of operation of other evaporator plants by redistribution of liquor streams and load reduction help to minimize overall emissions from all evaporator plants operated by the Mill.

The environmental monitoring shows that in 2010 the pollutant emissions reduced against the pre-investment level (Table D.1 - D.3).

Reduction of pollutant emissions from the evaporator plants amounted to 417 tonnes in 2010.

Table D.1. Pollutant emissions from all evaporator plants in 2010, t

Name	Before project implementation	Actual in 2010	Increase(+)/Reduction(-)
Hydrogen sulfide	2.9	2.4	-0.5
Methanol	220.7	0.0	-220.7
Methyl disulphide	40.9	0.0	-40.9
Dimethyl sulfide	59.1	0.0	-59.1
Methylmercaptan	2.3	1.8	-0.5
Turpentine	95.7	0.0	-95.7
Total:	**421.6**	**4.2**	**-417.4**

Table D.2. Overall pollutant emissions from the Mill in 2010, t

Name	Before project implementation	Actual in 2010	Increase(+)/Reduction(-)
Sulfur dioxide (SO_2)	3 820.76	849.85	-2 970.91
Nitrogen oxide (NO_2)	3 966.29	3 285.40	-680.89
Carbon oxide (CO)	6 475.41	2 127.13	-4 348.28
Hydrogen sulfide	1 052.98	44.31	-1 008.67
Methanol	487.32	116.13	-371.19
Methyl disulphide	246.65	110.10	-136.56
Dimethyl sulfide	217.83	38.23	-179.60
Methylmercaptan	127.75	15.03	-112.72
Turpentine	242.75	30.60	-212.15
Total:	**16 637.74**	**6 616.77**	**-10 020.97**

Table D.3. The amount of pollutants contained in the Mill’s overall effluents at the input and output of the Mill’s wastewater treatment facilities for 2010, t

Ingredient	Before project implementation		Actual in 2010		Increase(+)/Reduction(-)	
	Input	Output	Input	Output	Input	Output
BOD 20	67 496.04	10 594.67	20 350.4	937.92	-47 145.60	-9 656.75
COD	214 063.70	88 455.56	57 774.30	10 503.45	-156 289.40	-77 952.11
Lignin sulfonates	50 217.73	37 241.98	7 852.65	1 481.19	-42 365.08	-35 760.79
Suspended solids	37 237.73	11 028.75	16 225.86	1 872.24	-21 011.87	-9 156.51
Methanol	8 766.82	1 519.29	1 929.22	84.89	-6 837.60	-1 434.40
Phenol	158.95	3.73	163.23	0.91	4.28	-2.83
Total:	**377 940.97**	**148 843.98**	**104 295.70**	**14 880.60**	**-273 645.27**	**-133 963.39**

SECTION E. Data and parameters

E.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived

ID number	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)	Numerical value
1. $FC^{v}_{NG,B,y}$	Volumetric consumption of natural gas by the utilizing boiler	ETHPS	Thousand m^3	m	Continuously	100 %	Electronic and paper	2 547
2. $FC^{v}_{NG,T,y}$	Volumetric consumption of natural gas by the flare	ETHPS	Thousand m^3	m	Continuously	100 %	Electronic and paper	1 288
3. $NCV_{NG,y}$	Weighted average net calorific value of natural gas	ETHPS, Production laboratory	GJ/ thousand m^3	m	Once per week	100 %	Electronic and paper	33.51

E.2. Data to be collected in order to monitor emissions from the baseline, and how these data will be archived

ID number	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)	Numerical value
4. $P_{1,y}$	Volume of pulp produced in the pulp cooking workshop SAS-1	Budgetary Department, SAS-1 cooking workshop	t a.d.p.	m	Continuously	100 %	Electronic and paper	373 860
5. $FC_{fuel\ oil,BLRB,y}$	Heavy fuel oil consumption by liquor recovery boilers under the project	ETHPS	t	m	Continuously	100 %	Electronic and paper	2 047

ID number	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)	Numerical value
6. $\left(NCV_{RL,PJ,y}\right)_{adm}$	Weighted average net calorific value of red liquor referred to absolutely dry mass under the project	ETHPS, Production laboratory	GJ/t a.d.m.	m	Once per week	100 %	Electronic and paper	11.56
7. $\left(NCV_{BL\ CPP,y}\right)_{adm}$	Weighted average net calorific value of BL CPP referred to absolutely dry mass	ETHPS, Production laboratory	GJ/t a.d.m.	m	Once per week	100 %	Electronic and paper	11.87
8. $\left(NCV_{BL\ SBPP,y}\right)_{adm}$	Weighted average net calorific value of BL SBPP referred to absolutely dry mass	ETHPS, Production laboratory	GJ/t a.d.m.	m	Once per week	100 %	Electronic and paper	10.87
9. $NCV_{fuel\ oil,y}$	Weighted average net calorific value of heavy fuel oil	Fuel certificate	GJ/t a.d.m.	m	For each supplied batch of heavy fuel oil	100 %	Electronic and paper	40.61
10. $HC_{CHP-3,PJ,y}$	Heat consumption at the evaporator plant of CHP-3 under the project	Planning and Economic Department of Production Line " Energetika	GJ	m, c	Continuously	100 %	Electronic and paper	1 376 162
11. $HC_{CHP-2,PJ,y}$	Heat consumption at the evaporator plant of CHP-2 under the project	Planning and Economic Department of Production Line " Energetika	GJ	m, c	Continuously	100 %	Electronic and paper	2 715 919
12. $HG_{MGB,y}$	Heat production by the utilizing boiler	ETHPS	GJ	m, c	Continuously	100 %	Electronic and paper	140 270
13. $HG_{BLRB,PJ,y}$	Total heat produced by liquor recovery boilers under the project	ETHPS	GJ	m, c	Continuously	100 %	Electronic and paper	9 528 157

ID number	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)	Numerical value
14. $HG_{BWWB,PJ,y}$	Total heat produced by BWW-fired boilers under the project	ETHPS	GJ	m, c	Continuously	100 %	Electronic and paper	3 593 083
15. $HS_{CHP,PJ,y}$	Heat supply from ETHPS under the project	Planning and Economic Department of Production Line " Energetika	GJ	m, c	Continuously	100 %	Electronic and paper	10 369 895
16. $LE_{UkrNIIHimMASH,RL,PJ,y}$	Quantity of red liquor fed to the evaporator plant of UkrNIIHimMash	ETHPS	t a.d.m.	m	Continuously	100 %	Electronic and paper	68 429
17. $LE_{CHP-2,BL\ CPP,PJ,y}$	Quantity of BL CPP fed to the evaporator plant of CHP-2 under the project	ETHPS	t a.d.m.	m	Continuously	100 %	Electronic and paper	486 019
18. $LE_{CHP-2,BL\ SBPP,PJ,y}$	Quantity of BL SBPP fed to the evaporator plant of CHP-2 under the project	ETHPS	t a.d.m.	m	Continuously	100 %	Electronic and paper	183 106
19. $LE_{CHP-3,BL\ SBPP,PJ,y}$	Quantity of BL SBPP fed to the evaporator plant of CHP-3 under the project	ETHPS	t a.d.m.	m	Continuously	100 %	Electronic and paper	366 125
20. $CWG_{PJ,i,y}$	Volume of warm water returned for reuse under the project	ETHPS	m^3	m	Continuously	100 %	Electronic and paper	26 115 751*
21. $PCG_{PJ,i,y}$	Volume of relatively clean condensate returned for reuse under the project	ETHPS	m^3	m, c	Continuously	100 %	Electronic and paper	1 194 714*
22. $TCG_{PJ,i,y}$	Volume of treated condensate returned for reuse under the project	ETHPS	m^3	m	Continuously	100 %	Electronic and paper	1 178 815*

ID number	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)	Numerical value
23. $t_{1,i,y}$	Water temperature at the inlet to the new evaporator plant	ETHPS	^{o}C	m	Continuously	100 %	Electronic and paper	19.06*
24. $t_{2,CW,PJ,i,y}$	Temperature of warm water stream at the outlet from the new evaporator plant	ETHPS	^{o}C	m	Continuously	100 %	Electronic and paper	40.49*
25. $t_{2,PC,PJ,i,y}$	Temperature of relatively clean condensate stream at the outlet from the new evaporator plant	ETHPS	^{o}C	m	Continuously	100 %	Electronic and paper	55.93*
26. $t_{2,TC,PJ,i,y}$	Temperature of treated condensate stream at the outlet from the new evaporator plant	ETHPS	^{o}C	m	Continuously	100 %	Electronic and paper	75.25*

* The Table shows total annual volumes and average annual temperatures, however hourly data were used for automatic calculation of heat savings due to use of warm water and condensates. The calculation results are given in Annex 4.

E.3. Data to be collected in order to monitor the leakage, and how these data will be archived:

ID number	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)	Numerical value
27. $EC_{CHP-2,PJ,y}$	Electricity consumption by evaporator plant of CHP-2 under the project	Planning and Economic Department of Production Line " Energetika	MWh	m	Continuously	100 %	Electronic and paper	20 881
28. $EC_{CHP-3,PJ,y}$	Electricity consumption by evaporator plant of CHP-3 under the project	Planning and Economic Department of Production Line " Energetika	MWh	m	Continuously	100 %	Electronic and paper	10 186
29. $ES_{CHP,PJ,y}$	Electricity supply from ETHPS under the project	ETHPS	MWh	m	Continuously	100 %	Electronic and paper	205 557

SECTION F. Emission reductions calculation

F.1. Project emissions calculation

The project GHG emissions during the year y, t CO_2e:

$PE_y = PE_{NG,y}$,

where $PE_{NG,y}$ is the project emissions of CO_2 from natural gas combustion in the utilizing boiler and in the flare during the year y, t CO_2e:

$PE_{NG,y} = FC_{NG,B+T,y} \times EF_{CO2,NG}$,

where $EF_{CO2,NG}$ is the emission factor for natural gas, t CO_2/GJ. According to IPCC [R3], and with an allowance for the oxidized carbon fraction of 0.995, this factor is assumed constant and equal to $EF_{CO2,NG}$ =0.0561×0.995=0.05582 t CO_2/GJ;

$FC_{NG,B+T,y}$ is the natural gas consumption by the utilizing boiler and the flare during the year y, GJ.

$FC_{NG,B+T,y} = FC_{NG,B,y} + FC_{NG,T,y}$,

where $FC_{NG,B,y}$ is the natural gas consumption by the utilizing boiler during the year y, GJ;

$FC_{NG,T,y}$ is the natural gas consumption by the flare during the year y, GJ.

$FC_{NG,B,y} = FC^{v}_{NG,B,y} \times NCV_{NG,y}$,

where $FC^{v}_{NG,B,y}$ is the volumetric consumption of natural gas by the utilizing boiler during the year y, thousand m^3;

$NCV_{NG,y}$ is the weighted average net calorific value of natural gas during the year y, GJ/ thousand m^3.

$FC_{NG,T,y} = FC^{v}_{NG,T,y} \times NCV_{NG,y}$,

where $FC^{v}_{NG,T,y}$ is the volumetric consumption of natural gas by the flare under the project during the year y, thousand m^3.

F.2. Baseline emissions calculation

The baseline GHG emissions during the year *y*, t CO_2e:

$$BE_y = BE_{NG,y},$$

where $BE_{NG,y}$ is the baseline emissions of CO_2 from natural gas combustion during the year *y*, t CO_2.

$$BE_{NG,y} = \Delta FC_{NG,CHPP-1,y} \times EF_{CO2,NG},$$

where $\Delta FC_{NG,CHPP-1,y}$ is the reduction of natural gas consumption at CHPP-1 due to the project during the year *y*, GJ.

$$\Delta FC_{NG,CHPP-1,y} = \frac{\Delta HG_{CHPP-1,y}}{\eta_{B,CHPP-1}},$$

where $\eta_{B,CHPP-1}$ is the efficiency of gas-fired boilers of CHPP-1. This efficiency is assumed constant over years and equal to $\eta_{B,CHPP-1}$ = 0.93 [R6, page 14];

$\Delta HG_{CHPP-1,y}$ is the reduction of heat production by CHPP-1 boilers due to the project during the year *y*, GJ.

$$\Delta HG_{CHPP-1,y} = \frac{1.2485 \times \Delta HC_{PJ,y}}{(1-\omega_{HN}) \times (1-q_{CHPP-1}) \times \omega_{TF}},$$

where ω_{HN} is the relative losses in the Mill's steam network. This value is assumed constant over years and equal to ω_{HN} = 0.02 [R6, page 22];

ω_{TF} is the heat flow factor. This value is assumed constant over years and equal to ω_{TF} = 0.98 [R7, page 135, fig. 10.2].

q_{CHPP-1} is the relative heat consumption for auxiliary needs of CHPP-1. This value is assumed constant over years and equal to q_{CHPP-1} = 0.02 [R8, table 4].

1.2485 is the factor which describes the relation between variation of fresh steam flow to turbines and variation of heat supply from production steam extraction of turbines (See Annex 1);

$\Delta HC_{PJ,y}$ is the total heat savings in the pulp production cycle due to the project during the year *y*, GJ.

$$\Delta HC_{PJ,y} = \Delta HC_{CHP,PJ,y} + \Delta HS_{CHP,PJ,y} + \Delta HC_{W,PJ,y} + \Delta HS_{MGB,y},$$

where $\Delta HC_{CHP,PJ,y}$ is the savings of heat consumed for liquor evaporation due to the project during the year *y*, GJ;

$\Delta HS_{CHP,PJ,y}$ is the additional heat supply from ETHPS due to increased heat production by liquor recovery boilers during the year *y*, GJ;

$\Delta HC_{W,PJ,y}$ is the total heat savings due to reuse of warm water and condensates from the new evaporator plant during the year *y*, GJ;

$\Delta HS_{MGB,y}$ is the additional heat supply due to operation of the utilizing boiler during the year *y*, GJ.

$$\Delta HC_{CHP,PJ,y} = HC_{CHP,BL,y} - HC_{CHP,PJ,y},$$

where $HC_{CHP,PJ,y}$ is the total project heat consumption for liquor evaporation during the year *y*, GJ;

$HC_{CHP,BL,y}$ is the total baseline heat consumption for liquor evaporation during the year *y*, GJ.

$$HC_{CHP,PJ,y} = HC_{CHP-3,PJ,y} + HC_{CHP-2,PJ,y},$$

where $HC_{CHP-3,PJ,y}$ is the heat consumption by evaporator plant of CHP-3 under the project during the year *y*, GJ;

$HC_{CHP-2,PJ,y}$ is the heat consumption by evaporator plant of CHP-2 under the project during the year *y*, GJ.

$$HC_{CHP,BL,y} = HC_{CHP-2,BL,y} + HC_{CHP-3,BL,y} + HC_{UkrNIIHimMash,BL,y},$$

where $HC_{CHP-2,BL,y}$ is the heat consumption by evaporator plants of CHP-2 under the baseline during the year *y*, GJ;

$HC_{CHP-3,BL,y}$ is the heat consumption by evaporator plant of CHP-3 under the baseline during the year *y*, GJ;

$HC_{UkrNIIHimMash,BL,y}$ is the heat consumption by evaporator plant “UkrNIIHimMash” under the baseline during the year *y*, GJ.

$$HC_{CHP-2,BL,y} = \beta_{HC,CHP-2,BL} \times LE_{CHP-2,BL,y},$$

where $\beta_{HC,CHP-2,BL}$ is the specific heat consumption by evaporator plant of CHP-2 under the baseline, GJ/t a.d.m. It is assumed constant over years and equal to $\beta_{HC,CHP-2,BL}$ = 6.811 GJ/t a.d.m.[R1, section B.1];

$LE_{CHP-2,BL,y}$ is the total quantity of liquors fed to evaporator plants of CHP-2 under the baseline during the year *y*, t a.d.m.

$$LE_{CHP-2,BL,y} = LE_{CHP-2,BL\ CPP,BL,y},$$

where $LE_{CHP-2,BL\ CPP,BL,y}$ is the quantity of BL CPP fed to evaporator plants of CHP-2 under the baseline during the year *y*, t a.d.m.

$$LE_{CHP-2,BL\ CPP,BL,y} = LG_{BL\ CPP,BL,y},$$

where $LG_{BL\ CPP,BL,y}$ is the quantity of BL CPP fed for evaporation under the baseline during the year *y*, t a.d.m.

$$LG_{BL\ CPP,BL,y} = \alpha_{BL\ CPP,BL} \times P_{1,y},$$

where $\alpha_{BL\ CPP,BL}$ is the specific yield of BL CPP under the baseline, t a.d.m./ t a.d.p. This value is assumed constant over years and equal to $\alpha_{BL\ CPP,BL}$ = 1.202 t a.d.m./t a.d.p. [R1, section B.1],

$P_{1,y}$ is the quantity of pulp produced in the cooking workshop SAS-1 during the year *y*, t a.d.p.

$$HC_{CHP-3,BL,y} = \beta_{HC,CHP-3,BL} \times LE_{CHP-3,BL,y},$$

where $\beta_{HC,CHP-3,BL}$ is the specific heat consumption by evaporator plant of CHP-3 under the baseline, GJ/t a.d.m. This value is assumed constant over years and equal to $\beta_{HC,CHP-3,BL}$ = 3.244 GJ/t a.d.m. [R1, section B.1];

$LE_{CHP-3,BL,y}$ is the total quantity of liquors fed to evaporator plant of CHP-3 under the baseline during the year *y*, t a.d.m.

$$LE_{CHP-3,BL,y} = LE_{CHP-3,BL\ SBPP,BL,y}$$

where $LE_{CHP-3,BL\ SBPP,BL,y}$ is the quantity of BL SBPP fed to evaporator plant of CHP-3 under the baseline during the year *y*, t a.d.m.

$$LE_{CHP-3,BL\ SBPP,BL,y} = LE_{CHP-2,BL\ SBPP,PJ,y} + LE_{CHP-3,BL\ SBPP,PJ,y},$$

where $LE_{CHP-2,BL\ SBPP,PJ,y}$ is the quantity of BL SBPP fed to evaporator plant of CHP-2 under the project during the year *y*, t a.d.m;

$LE_{CHP-3,BL\ SBPP,PJ,y}$ is the quantity of BL SBPP fed to evaporator plant of CHP-3 under the project during the year *y*, t a.d.m.

$$HC_{UkrNIIHimMash,BL,y} = \beta_{HC,UkrNIIHimMash,BL} \times LE_{UkrNIIHimMash,BL,y},$$

where $\beta_{HC,UkrNIIHimMash,BL}$ is the specific heat consumption by "UkrNIIHimMash" evaporator plant under the baseline, GJ/t a.d.m. It is assumed constant over years and equal to $\beta_{HC,UkrNIIHimMash,BL}$ = 18.260 GJ/t a.d.m. [R1, section B.1];

$LE_{UkrNIIHimMash,BL,y}$ is the total quantity of liquors fed to "UkrNIIHimMash" evaporator plant under the baseline during the year *y*, t a.d.m.

$$LE_{UkrNIIHimMash,BL,y} = LE_{UkrNIIHimMash,RL,BL,y},$$

where $LE_{UkrNIIHimMash,RL,BL,y}$ is the quantity of red liquor fed to "UkrNIIHimMash" evaporator plant under the baseline during the year *y*, t a.d.m.

$$LE_{UkrNIIHimMash,RL,BL,y} = LE_{CHP-2,RL,PJ,y},$$

where $LE_{CHP-2,RL,PJ,y}$ is the quantity of red liquor fed to evaporator plant of CHP-2 under the project during the year *y*, t a.d.m.

$$\Delta HS_{CHP,PJ,y} = \varphi_{HS,CHP,y} \times \Delta HG_{BLRB,PJ,y},$$

where $\varphi_{HS,CHP,y}$ is the factor of specific heat supply from ETHPS during the year *y*, GJ/GJ;

$\Delta HG_{BLRB,PJ,y}$ is the total additional heat production by liquor recovery boilers under the project during the year *y*, GJ.

$$\varphi_{HS,CHP,y} = \frac{HS_{CHP,PJ,y}}{HG_{CHP,PJ,y}},$$

where $HG_{CHP,PJ,y}$ is the total heat production by ETHPS boilers under the project during the year *y*, GJ;

$HS_{CHP,PJ,y}$ is the heat supply from ETHPS under the project during the year *y*, GJ.

$$HG_{CHP,PJ,y} = HG_{MGB,y} + HG_{BLRB,PJ,y} + HG_{BWWB,PJ,y},$$

where $HG_{MGB,y}$ is the heat production by the utilizing boiler during the year *y*, GJ;

$HG_{BLRB,PJ,y}$ is the total heat produced by liquor recovery boilers under the project during the year *y*, GJ;

$HG_{BWWB,PJ,y}$ is the total heat produced by BWW-fired boilers under the project during the year *y*, GJ.

$$\Delta HG_{BLRB,PJ,y} = \Delta HG_{BLRB,RL,PJ,y} + \Delta HG_{BLRB,BL\ CPP,PJ,y},$$

where $\Delta HG_{BLRB,RL,PJ,y}$ is the additional heat production by liquor recovery boilers under the project due to combustion of red liquor with a higher calorific value during the year *y*, GJ;

$\Delta HG_{BLRB,BL\ CPP,PJ,y}$ is the additional heat production by liquor recovery boilers under the project due to combustion of more BL CPP during the year *y*, GJ.

$$\Delta HG_{BLRB,RL,PJ,y} = HG_{BLRB,RL,PJ,y} - HG_{BLRB,RL,BL,y},$$

where $HG_{BLRB,RL,PJ,y}$ is the heat production by liquor recovery boilers under the project due to combustion of red liquor during the year *y*, GJ;

$HG_{BLRB,RL,BL,y}$ is the heat production by liquor recovery boilers under the baseline due to combustion of red liquor during the year *y*, GJ.

$$HG_{BLRB,RL,PJ,y} = LE_{CHP-2,RL,PJ,y} \times \left(NCV_{RL,PJ,y}\right)_{adm} \times \eta_{BLRB,y},$$

where $LE_{CHP-2,RL,PJ,y}$ is the quantity of red liquor fed to evaporator plant of CHP-2 under the project during the year *y*, t a.d.m.;

$\left(NCV_{RL,PJ,y}\right)_{adm}$ is the weighted average net calorific value of red liquor referred to absolutely dry mass under the project in the year *y*, GJ/t a.d.m;

$\eta_{BLRB,y}$ is the average efficiency of liquor recovery boilers in the year *y*.

$$\eta_{\mathrm{BLRB,y}} = \frac{HG_{BLRB,PJ,y}}{LE_{RL,PJ,y} \times (NCV_{RL,PJ,y})_{adm} + LE_{CHP-2,BLCPP,PJ,y} \times (NCV_{BLCPP,y})_{adm} + (LE_{CHP-2,BLSBPP,PJ,y} + LE_{CHP-3,BLSBPP,PJ,y}) \times \left(NCV_{BLSBPP,y}\right)_{adm} + FC_{fueloil,BLRB,PJ,y} \times NCV_{fueloil,y}}$$

where $LE_{RL,PJ,y}$ – is the quantity of red liquor fed to liquor recovery boilers under the project during the year *y*, t a.d.m., for 2010 $LE_{RL,PJ,y} = LE_{UkrNIIHimMash,RL,PJ,y}$;

$\left(NCV_{BL\ SBPP,y}\right)_{adm}$ is the weighted average net calorific value of BL SBPP referred to absolutely dry mass in the year *y*, GJ/t a.d.m.;

$NCV_{fuel\ oil,y}$ is the weighted average net calorific value of heavy fuel oil in the year *y*, GJ/t;

$FC_{fuel\ oil,BLRB,PJ,y}$ is the total heavy fuel oil consumption by liquor recovery boilers under the project during the year *y*, t;

$LE_{CHP-2,BL\ CPP,PJ,y}$ is the quantity of BL CPP fed to evaporator plant of CHP-2 under the project during the year *y*, t a.d.m.

$$HG_{BLRB,RL,BL,y} = LE_{UkrNIIHimMash,RL,BL,y} \times \left(NCV_{RL,BL,y}\right)_{adm} \times \eta_{BLRB,y},$$

where $\left(NCV_{RL,BL,y}\right)_{adm}$ is the weighted average net calorific value of red liquor referred to absolutely dry mass under the baseline scenario during the year *y*, GJ/t a.d.m. It is assumed constant over years and equal to $\left(NCV_{RL,BL,y}\right)_{adm}$ = 8.845 GJ/t a.d.m. [R1, section B.1].

$$\Delta HG_{BLRB,BL\ CPP,PJ,y} = \left(LE_{CHP-2,BL\ CPP,PJ,y} - LE_{CHP-2,BL\ CPP,BL,y}\right) \times \left(NCV_{BL\ CPP,y}\right)_{adm} \times \eta_{BLRB,y}.$$

$$\Delta HS_{MGB,y} = HG_{MGB,y} \times \left(1 - k_B\right),$$

where $HG_{MGB,y}$ is the heat output by the utilizing boiler firing malodorous gases and methanol fraction under the project during the year *y*, GJ;

k_B is the factor of heat consumption for auxiliary needs of the utilizing boiler. It is assumed constant over years and equal to k_B = 0.05. The value of relative heat consumption for auxiliary needs of the utilizing boiler in accordance with the order [R8, table 4] could have been assumed equal to 0.02. But for conservative reasons the value of k_B was fixed at the level of 0.05.

$$\Delta HC_{W,PJ,y} = HC_{CW,BL,y} + HC_{PC,BL,y} + HC_{TC,BL,y},$$

where $HC_{CW,BL,y}$ is the heat consumption for water heating to meet the process needs under the baseline scenario during the year *y*, which under the project will be substituted by reuse of warm water from the new evaporator plant, GJ;

$HC_{PC,BL,y}$ is the heat consumption for water heating to meet the process needs under the baseline scenario during the year *y*, which under the project will be substituted by reuse of relatively clean condensate from the new evaporator plant, GJ;

$HC_{TC,BL,y}$ is the heat consumption for water heating to meet the process needs under the baseline scenario during the year *y*, which under the project will be substituted by reuse of treated condensate from the new evaporator plant, GJ.

$$HC_{CW,BL,y} = \sum_{i=1}^{n} \frac{\rho_w \times c_w \times CWG_{PJ,i,y} \times (t_{2,CW,PJ,i,y} - t_{1,i,y})}{1 \times 10^6},$$

where i is the index indicating that the calculations will use hourly data;

n is the operation hours of evaporator plant in the year *y*;

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

$CWG_{PJ,i,y}$ is the volume of warm water produced under the project during *i*-hour of operation of the new evaporator plant from the beginning of the year *y*, m^3;

$t_{2,CW,PJ,i,y}$ is the average temperature of warm water under the project at the outlet from the new evaporator plant over the *i*-hour of evaporation from the beginning of the year *y*, ^oC;

$t_{1,i,y}$ is the average water temperature at the inlet over the *i*-hour of operation of the new evaporator plant from the beginning of the year *y* , ^oC;

ρ_w is the water density, kg/m^3. The water density is assumed constant: $\rho_w = 1000$ kg/m^3;

c_w is the specific thermal capacity of water, $\frac{kJ}{kg \times {}^oC}$. The specific thermal capacity of water is assumed constant: $c_w = 4.187 \frac{kJ}{kg \times {}^oC}$.

$$HC_{PC,BL,y} = \sum_{i=1}^{n} \frac{\rho_w \times c_w \times PCG_{PJ,i,y} \times (t_{2,PC,PJ,i,y} - t_{1,i,y})}{1 \times 10^6},$$

where $PCG_{PJ,i,y}$ is the volume of relatively clean condensate produced under the project during the *i*-hour of operation of the new evaporator plant from the beginning of the year *y*, m^3;

$t_{2,PC,PJ,i,y}$ is the average temperature of relatively clean condensate under the project at the outlet from evaporator plant of CHP-2 over the *i*- hour of operation from the beginning of the year *y*, ^oC.

$$HC_{TC,BL,y} = \sum_{i=1}^{n} \frac{\rho_w \times c_w \times TCG_{PJ,i,y} \times (t_{2,TC,PJ,i,y} - t_{1,i,y})}{1 \times 10^6},$$

where $TCG_{PJ,i,y}$ is the volume of treated condensate produced under the project during the *i*-hour of operation of the new evaporator plant from the beginning of the year *y*, m^3;

$t_{2,TC,PJ,i,y}$ is the average temperature of treated condensate under the project at the outlet from the new evaporator plant of CHP-2 over the *i*- hour of evaporation from the beginning of the year *y*, ^oC.

The results of automatic calculation of $HC_{CW,BL,y}$, $HC_{PC,BL,y}$, $HC_{TC,BL,y}$ on an hourly basis are given in Annex 4.

The formulae given further below were used to determine heat savings due to use of relatively clean condensate for the period from October 1, 2010 to December 31, 2010. These formulae use monthly (consumption and temperatures) and not hourly values as it was provided for in the monitoring plan. This deviation is due to the failure of the flow meter in October 2010.

Monthly volumes of relatively clean condensate produced at the new “Andritz” evaporator plant and then used in production process were calculated for the entire monitoring period from October 2010 till December 2010 using liquor evaporation data (See Annex 3). The calculations used monthly-minimum values of evaporated water quantity which are recorded every week. This, in its turn, resulted in a minimum value of condensate production, and therefore also in a minimum GHG emission reduction effect from using condensate.

This approach was used for emission reduction monitoring in 2008-2009, within the framework of which comparison was made of calculated and actual volumes of relatively clean condensate supplied to the production. It was established that the calculated values are lower than the actual values by 6.7 – 15.9 %. Therefore it is fair to say that the method proposed for determining relatively clean condensate volumes is adequate and conservative.

Heat consumption for water heating to meet the process needs under the baseline scenario during the year y, which under the project will be substituted by reuse of relatively clean condensate from the new evaporator plant, GJ;

$$HC_{PC,BL,y} = \sum \frac{\rho_w \times c_w \times PCG_{PJ,j,y} \times (t_{2,PC,PJ,j,y} - t_{1,j,y})}{10^6},$$

where $PCG_{PJ,j,y}$ is the volume of relatively clean condensate produced under the project during month *j* of year *y*, m^3;

$t_{2,PC,PJ,j,y}$ is the average project temperature of relatively clean condensate at the outlet from the evaporator plant of CHP-2 during month *j* of year *y*, ^oC (See Table F.2.1);

$t_{1,j,y}$ is the average water temperature at the inlet to the new evaporator plant during month *j* of year *y*, ^oC, (See Table F.2.1).

Table F.2.1. Monthly average temperatures of water and relatively clean condensate, ^oC

Parameter	October,2010	November,2010	December,2010
The average water temperature at the inlet to the new evaporator plant, $t_{1,j,y}$	18.46	15.13	12.56
The average project temperature of relatively clean condensate at the outlet from the evaporator plant, $t_{2,PC,PJ,j,y}$	54.20	55.30	56.51

$$PCG_{PJ,j,y} = EWQ_{PJ,j,y} \cdot \chi ;$$

where $EWQ_{PJ,j,y}$ is the volume of water evaporated at the new evaporator plant during month *j* of year *y*, m^3;

$\chi = 0.3098$ is the mass fraction of relatively clean condensation in the total volume of evaporated water calculated using design technical specification of the evaporator plant (See Annex 2).

$$EWQ_{PJ,j,y} = EWQ_{BL,CPP,PJ,j.y} + EWQ_{BL,SBPP,PJ,j,y} ,$$

where $EWQ_{BL,CPP,PJ,j,y}$ is the volume of water evaporated from BL CPP during month *j* of year *y*, m^3;

$EWQ_{BL,SBPP,PJ,j,y}$ is the volume of water evaporated from BL SBPP during month *j* of year *y*, m^3.

$$EWQ_{BL,CPP,PJ,j,y} = \alpha^{EWQ}_{BL,CPP,PJ,j,y} \cdot LE_{BL,CPP,PJ,j,y} ;$$

where $\alpha^{EWQ}_{BL,CPP,PJ,j,y}$ is the evaporator water quantity per 1 t a.d.m. of BL CPP under the project during month *j* of year *y*, m^3/a.d.m.; the minimum weekly value over month *j* of year *y* is assumed.

$LE_{BL,CPP,PJ,j,y}$ the quantity of BL CPP supplied to the evaporator plant of CHP-2 under the project over month *j* of year *y*, t a.d.m.;

$$\alpha^{EWQ}_{BL,CPP,PJ,j,y} = MIN\left[\frac{\left(100 - \varphi_{BL,CPP,in,l,j,y}\right)}{\varphi_{BL,CPP,in,l,j,y}} - \frac{\left(100 - \varphi_{BL,CPP,out,l,j,y}\right)}{\varphi_{BL,CPP,out,l,j,y}}\right],$$

where $\varphi_{BL,CPP,in,l,j,y}$ is the inlet dryness factor of BL CPP supplied to the evaporator plant of CHP-2 recorded over week *l* of month *j* of year *y*, % a.d.m.;

$\varphi_{BL,CPP,out,l,j,y}$ is the outlet dryness factor of BL CPP supplied to the evaporator plant of CHP-2 recorded over week *l* of month *j* of year *y*, % a.d.m.

$$EWQ_{BL,SBPP,PJ,j,y} = \alpha^{EWQ}_{BL,SBPP,PJ,j,y} \cdot LE_{BL,SBPP,PJ,j,y};$$

where $\alpha^{EWQ}_{BL,SBPP,PJ,j,y}$ is the evaporator water quantity per 1 t a.d.m. of BL SBPP under the project during month *j* of year *y*, m^3/a.d.m.; the minimum weekly value over month *j* of year *y* is assumed;

$LE_{BL,SBPP,PJ,j,y}$ is the quantity of BL SBPP supplied to the evaporator plant of CHP-2 under the project over month *j* of year *y*, t a.d.m.;

$$\alpha^{EWQ}_{BL,SBPP,PJ,j,y} = MIN\left[\frac{\left(100-\varphi_{BL,SBPP,in,l,j,y}\right)}{\varphi_{BL,SBPP,in,l,j,y}} - \frac{\left(100-\varphi_{BL,SBPP,out,l,j,y}\right)}{\varphi_{BL,SBPP,out,l,j,y}}\right],$$

where $\varphi_{BL,SBPP,in,l,j,y}$ is the inlet dryness factor of BL SBPP supplied to the evaporator plant of CHP-2 recorded over week *l* of month *j* of year *y*, % a.d.m.;

$\varphi_{BL,SBPP,out,l,j,y}$ is the outlet dryness factor of BL SBPP supplied to the evaporator plant of CHP-2 recorded over week *l* of month *j* of year *y*, % a.d.m.

The conservatism of parameters $\alpha^{EWQ}_{BL,CPP,PJ,j,y}$ and $\alpha^{EWQ}_{BL,SBPP,PJ,j,y}$ is demonstrated by the fact that they are calculated using monthly-minimum evaporated water quantity values that are recorded every week. This in its turn gave minimum quantity of generated condensate and therefore minimum GHG emission reduction effect.

F.3. Leakage calculation

Leakages during the year *y*, t CO_2e:

$$L_y = L_{ES,y},$$

where $L_{ES,y}$ is the leakages from fuel combustion by power plants to offset the reduction of electricity supply to the grid due to the project during the year *y*, t CO_2e.

$$L_{ES,y} = \Delta ES_y \times EF_{CO_2,grid,y},$$

where $EF_{CO2,grid,y}$ is the CO_2 emission factor for grid electricity, tCO_2/MWh. For Russia according to "Operational Guidelines for Project Design Documents of Joint Implementation Projects" [R4] depending on considered year: $EF^{2010}_{CO2,grid}$ = 0.55 t CO_2/MWh;

ΔES_y is the reduction of electricity supply to the grid as a result of the project implementation during the year *y*, MWh.

$$\Delta ES_y = \Delta ES_{CHPP-1,y} - \Delta EC_{PJ,y},$$

where $\Delta EC_{PJ,y}$ is the total electricity savings in the pulp production cycle as a result of the project implementation during the year *y*, MWh;

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

$$\Delta ES_{CHPP-1,y} = \frac{0.2445 \times \Delta HC_{PJ,y}\left(1 - e_{CHPP-1}\right)}{3.6 \times \left(1 - \omega_{HN}\right)},$$

where e_{CHPP-1} is the value of relative electricity consumption for auxiliary needs of CHPP-1. This value is assumed constant over years and equal to e_{CHPP-1} = 0.05 [R10, page 28];

ω_{HN} is the relative losses in the Mill's steam network. This value is assumed constant over years and equal to ω_{HN} = 0.02 [R6, page 22];

0.2445 is the factor which describes the relation between variation of heat-consumption-based electricity generation and variation of steam extraction from turbines (See Annex 1);

$\Delta HC_{PJ,y}$ is the total savings of heat in the pulp production cycle as a result of the project during the year *y*, GJ.

$$\Delta EC_{PJ,y} = \Delta EC_{CHP,PJ,y} + \Delta ES_{CHP,PJ,y},$$

where $\Delta EC_{CHP,PJ,y}$ is the reduction of electricity consumption for liquor evaporation as a result of the project during the year *y*, MWh;

$\Delta ES_{CHP,PJ,y}$ is the additional electricity supply from ETHPS due to additional heat production by liquor recovery boilers during the year y, MWh.

$$\Delta EC_{CHP,PJ,y} = EC_{CHP,BL,y} - EC_{CHP,PJ,y},$$

where $EC_{CHP,PJ,y}$ is the total electricity consumption for liquor evaporation under the project during the year y, MWh;

$EC_{CHP,BL,y}$ is the total electricity consumption for liquor evaporation under the baseline during the year y, MWh.

$$EC_{CHP,PJ,y} = EC_{CHP-2,PJ,y} + EC_{CHP-3,PJ,y},$$

where $EC_{CHP-2,PJ,y}$ is the electricity consumption by evaporator plant of CHP-2 under the project during the year y, MWh;

$EC_{CHP-3,PJ,y}$ is the electricity consumption by evaporator plant of CHP-3 under the project during the year y, MWh.

$$EC_{CHP,BL,y} = EC_{CHP-2,BL,y} + EC_{CHP-3,BL,y} + EC_{UkrNIIHimMash,BL,y},$$

where $EC_{CHP-2,BL,y}$ is the electricity consumption by evaporator plants of CHP-2 under the baseline during the year y, MWh;

$EC_{CHP-3,BL,y}$ is the electricity consumption by evaporator plant of CHP-3 under the baseline during the year y, MWh;

$EC_{UkrNIIHimMash,BL,y}$ is the electricity consumption by "UkrNIIHimMash" evaporator plant under the baseline during the year y, MWh.

$$EC_{CHP-2,BL,y} = \beta_{EC,CHP-2,BL} \times LE_{CHP-2,BL,y},$$

where $\beta_{EC,CHP-2,BL}$ is the specific electricity consumption by evaporator plant of CHP-2 under the baseline, MWh/t a.d.m. It is assumed constant over years and equal to $\beta_{EC,CHP-2,BL}$ = 0.0103 MWh/t a.d.m [R1, section B.1];

$LE_{CHP-2,BL,y}$ is the total quantity of liquors fed to evaporator plant of CHP-2 under the baseline during the year y, t a.d.m.

$$EC_{CHP-3,BL,y} = \beta_{EC,CHP-3,BL} \times LE_{CHP-3,BL,y},$$

where $\beta_{EC,CHP-3,BL}$ is the specific electricity consumption by evaporator plant of CHP-3 under the baseline, MWh/t a.d.m. It is assumed constant over years and numerically equal to $\beta_{EC,CHP-3,BL}$ = 0.0194 MWh/t a.d.m; [R1, section B.1];

$LE_{CHP-3,BL,y}$ is the total quantity of liquors fed to evaporator plant of CHP-3 under the baseline during the year y, t a.d.m.

$$EC_{UkrNIIHimMash,BL,y} = \beta_{EC,UkrNIIHimMash,BL} \times LE_{UkrNIIHimMash,BL,y},$$

where $\beta_{EC,UkrNIIHimMash,BL}$ is the specific electricity consumption by “UkrNIIHimMash” evaporator plant under the baseline, MWh/t a.d.m. It is assumed constant over years and numerically equal to $\beta_{EC,UkrNIIHimMash,BL}$ = 0.2153 MWh/t a.d.m; [R1, section B.1];

$LE_{UkrNIIHimMash,BL,y}$ is the total quantity of liquors fed to UkrNIIHimMash evaporator plant under the baseline during the year y, t a.d.m.

$$\Delta ES_{CHP,PJ,y} = \varphi_{ES,CHP,y} \times \Delta HG_{BLRB,PJ,y},$$

where $\varphi_{ES,CHP,y}$ is the factor of specific electricity supply from ETHPS under the project during the year y, MWh/GJ;

$\Delta HG_{BLBR,PJ,y}$ is the total additional heat production by liquor recovery boilers under the project during the year y, GJ.

$$\varphi_{ES,CHP,y} = \frac{ES_{CHP,PJ,y}}{HG_{CHP,PJ,y}},$$

where $ES_{CHP,PJ,y}$ is the electricity supply from ETHPS under the project during the year y, MWh;

$HG_{CHP,PJ,y}$ is the total heat production by ETHPS boilers under the project during the year y, GJ.

F.4. Emission reductions calculation

GHG emission reductions during the year y, t CO_2e:

$$ER_y = BE_y - PE_y - L_y$$

The calculation method of GHG emission reductions was implemented in the computational model in the form of excel-files (See Annex 5). This model is integral part of the monitoring report. Main results of calculations are summarized in Table F.4.1.

Table F.4.1. Summary table of GHG emission reductions in 2010

Parameter	Symbol	Unit	Value
Baseline emissions			
Baseline emissions of CO_2 from natural gas combustion	$BE_y = BE_{NG,y}$	t CO_2e	314 547
Project emissions			
Project emissions of CO_2 from natural gas combustion in the utilizing boiler and in the flare	$PE_y = PE_{NG,y}$	t CO_2e	7 171
Leakages			
Leakages from fuel combustion by power plants to offset the reduction of electricity supply to the grid	$L_y = L_{ES,y}$	т CO_2-экв	148 939
GHG emission reductions			
GHG emission reductions	ER_y	**t CO_2e**	**158 437**

F.5. Comparison of actual emission reductions with estimates in the PDD

In accordance with the PDD the estimated GHG emission reductions in 2010 amount to 175 871 tCO_2e. GHG emission reductions according to the monitoring amounted to 158 437 tCO_2e, which is less than the projected level by 17 434 tCO_2e or by 9.91%.

Main factors of decrease in emission reduction units (ERUs) in 2010 against the PDD values:

- actual heat savings due to use of warm water are less than the projected level by 248 129 GJ or by 9.6% (See Table E.5.1). This factor decreased the amount of ERUs by 19 755 tCO_2e or by 11.2 % (See Table E.5.2);

- actual heat savings due to use of treated condensate are less than the projected level by 96 667 GJ or by 25.7%. This factor decreased the amount of ERUs by 7 696 tCO_2e or by 4.4 %.

However there are positive factors which increased the amount of ERUs, such as:

- actual heat savings due to use of relatively clean condensate are higher than the projected level by 63 534 GJ or by 52.2 %. This factor increased the amount of ERUs by 5 059 tCO_2e or by 2.9%;

- actual leakages are below the projected level by 9 002 MW·h or by 3.2%. This factor increased the amount of ERUs by 4 952 tCO_2e or by 2.8%.

The influence of other factors on decrease in expected ERUs is insignificant and their effects are canceled out.

Thus, taking into account both negative and positive factors the decrease in the amount of ERUs totaled 17 434 tCO_2e or 9.91% of the level projected in the PDD.

Table F.5.1. Performance parameters in 2010

Parameter	Unit	PDD	Monitoring Report	Δ
Volume of warm water	m^3	29 497 229	26 115 751	-3 381 478
Volume of relatively clean condensate	m^3	937 999	1 194 714	256 715
Volume of treated condensate	m^3	2 089 327	1 178 815	-910 512
Average annual temperature of cooling water (inlet)	^oC	24	19,06	-4,94
Average annual temperature of warm water	^oC	45	40,49	-4,51
Average annual temperature of relatively clean condensate	^oC	55	55,93	0,93
Average annual temperature of treated condensate	^oC	67	75,25	8,25
Consumption of natural gas for utilizing boiler	GJ	96 688	85 322	-11 366
Consumption of natural gas for flare unit	GJ	18 401	43 138	24 737
Leakages (reduction in electricity supply to the grid)	MWh	279 800	270 798	-9 002
Heat savings, total	GJ	4 222 563	3 950 743	-271 820
Including saving due to:				
- supply of heat by utilizing boiler	GJ	120 475	133 256	12 781
- use of warm water and condensates, total	GJ	3 091 505	2 810 242	-281 263
Due to:				
- warm water	GJ	2 593 603	2 345 474	-248 129
- relatively clean condensate	GJ	121 738	185 272	63 534
- treated condensate	GJ	376 164	279 497	-96 667
- additional supply of heat from ETHPS	GJ	260 028	256 898	-3 130
- decrease in heat consumption for evaporation	GJ	750 555	750 346	-209

Table F.5.2. Impact of various factors on the level of ERUs

Factor	Change in ERUs level against the PDD values	
	t CO_2e	%
Reduction in heat savings due to use of warm water	-19 755	-11.2%
Reduction in heat savings due to use of treated condensate	-7 696	-4.4%
Increase in heat savings due to use of relatively clean condensate	5 059	2.9%
Reduction in leakages	4 952	2.8%
Increase in consumption of natural gas fired in the flare unit	-1 381	-0.79%
Reduction in consumption of natural gas fired in the utilizing boiler	635	0.36%
Reduction in heat savings from liquor evaporation	1 018	0.58%
Increase in heat supply by the utilizing boiler	-17	-0.01%
Reduction in heat supply from ETHPS	-249	-0.14%
Total	**-17 434**	**-9.91%**

CCGS LLC

27.05.2011

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ANNEX 1

Characteristics of CHPP-1 steam turbines

Heat savings due to the project implementation lead to reduction of steam extraction from CHPP-1 turbines. In order to determine reduction of fuel consumption by CHPP-1 it is necessary to find the variation of fresh steam flow to the turbines. At the same time it is also necessary to determine the reduction of electricity generation on the basis of heat consumption (which in general case has to be compensated by additional electricity generation in the grid). The input parameter will be the variation of heat supply from the production stream extraction.

To generate electricity CHPP-1 operates 7 turbine units (No.No.1 to 3 of VPT-25-4 (PT-25-90/10) type; No.4 of PT-60-90/13 type; No.No.5 and 6 of PT-60-130/13 type; No. 7 of R-50-130/13 type).

One of the turbines installed at CHPP-1 is non-condensing (R-50-130/13). As a rule, non-condensing turbines, under a stable demand of industrial steam, operate in the base mode, and regulation of heat and electricity loads is ensured by turbines with less rigid operation modes, in this case by PT turbines.

Based on the steam-consumption diagrams and energy characteristics of the turbines presented in analytical form [R9, page 95, table 4.6], the following pairs of equations were established:

1. Turbines of VTP-25-4 type:

$$\Delta Q_0 = 1.204 \times \Delta Q_p$$

$$\Delta N_t = \frac{0.201 \times \Delta Q_p}{3.6}$$

2. Turbine of PT-60-90/13 type:

$$\Delta Q_0 = 1.181 \times \Delta Q_p$$

$$\Delta N_t = \frac{0.178 \times \Delta Q_p}{3.6}$$

3. Turbines of PT-60-130/13 type:

$$\Delta Q_0 = 1.310 \times \Delta Q_p$$

$$\Delta N_t = \frac{0.305 \times \Delta Q_p}{3.6}$$

where ΔQ_0 is the variation of heat (fresh steam) flow to turbines, GJ;

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

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

3.6 is the GJ to MWh conversion factor.

The worst, in terms of energy efficiency, are the turbines with the lowest initial steam parameters and the highest steam parameters of steam extraction. It is such least efficient turbines that the enterprise will try to unload in the first place as the opportunity arises. At CHPP-1 of KPPM such turbine is PT-60-90/13 turbine. However in actual practice it is impossible to determine precisely which of the turbines and how long will participate in load regulation, therefore for estimating GHG emissions we shall use averaged, in terms of installed capacity, characteristics of all PT type turbines (i.e. assuming uniform reduction of the number of running hours of all turbines), which is a moderately conservative solution:

$$\Delta Q_0 = \frac{1.204 \times 3 \times 25 + 1.181 \times 1 \times 60 + 1.310 \times 2 \times 60}{3 \times 25 + 1 \times 60 + 2 \times 60} \times \Delta Q_p = 1.2485 \times \Delta Q_p$$

$$\Delta N_t = \frac{0.201 \times 3 \times 25 + 0.178 \times 1 \times 60 + 0.305 \times 2 \times 60}{3.6 \times (3 \times 25 + 1 \times 60 + 2 \times 60)} \times \Delta Q_p = \frac{0.2445 \times \Delta Q_p}{3.6}.$$

ANNEX 2

Substantiation of the mass fraction of treated condensate in the total evaporated water quantity

Mass fraction of treated condensate in the total water quantity evaporated during a month was calculated based on the design technical data of the evaporator plant (see also www.ilimgroup.ru/techprocess/evaporator-station/facts1/).

The scheme of collection, treatment and utilization of condensates is given in Fig. A.1.1.

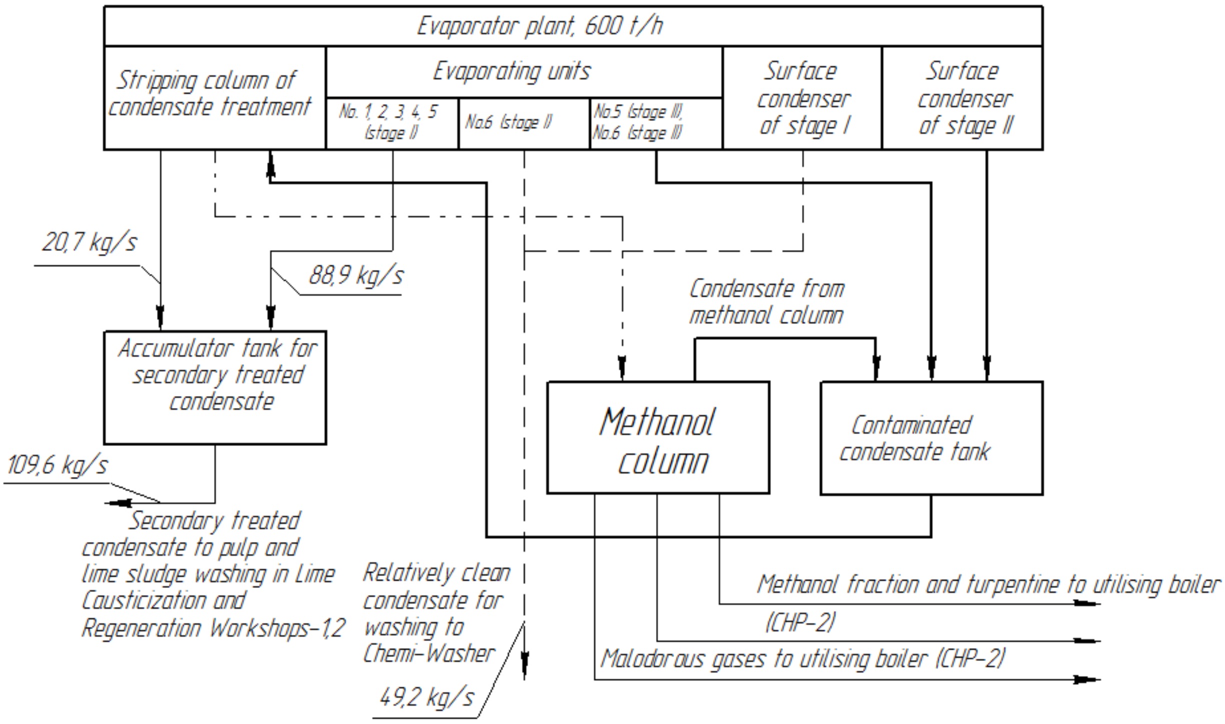

Fig. A.1.1. Scheme of collection, treatment and utilization of condensates from the new evaporator plant

Secondary condensate is pumped from units 1, 2, 3 and 4 and from the first stage of unit 5 to the secondary treated condensate tank where it is mixed with condensate treated in the stripping column, and then used for process needs.

Relatively clean secondary condensate from stage I of unit 6 together with condensate from the surface condenser of stage I is fed for pulp washing to "Chemi-Washer" unit.

Second stages of evaporating units 5 and 6 are equipped with an internal methanol stripping system. Steam is fed to the lower section of the heat exchanger and goes upward against the condensate flow. The heat exchanger functions like an internal stripping column. It is the counterflow scheme and a good contact of steam and liquid that ensure maximum treatment efficiency. Methanol-contaminated condensate is removed from a separate section in the upper part of the heat exchanger and is fed to the contaminated condensate tank, whence it is fed to the stripping column.

Treated condensate and dirty condensate streams are together pumped over for use on the PPM.

In accordance with the design technical data, second volumes of streams of condensates formed at new evaporator plant are following:

G_{condA}=88.9 kg/s for condensate A stream;

$G_{dirty.condensate}$=20.7 kg/s for dirty condensate;

G_{condB}=49.2 kg/s for condensate B stream (relatively clean).

Based on the aforesaid, the mass fraction of relatively clean condensate in the total evaporated water quantity can be determined by the following ratio:

$$\chi = \frac{49,2}{88.9 + 20.7 + 49.2} = 0.3098.$$

Accordingly the mass fraction of treated condensate is equal μ =1-0.3098=0.6902.

ANNEX 3

Liquor evaporation data

Date	Input and output dryness of liquors				Quantity of liquor	
	BL CPP, % a.d.m.		BL SBPP, % a.d.m.		BL CPP	BL SBPP
	input	output	input	output	Evaporated liquor, t a.d.m.	Evaporated liquor, t a.d.m.
4.10.2010	14.0	64.5	13.3	64.5	37 403.13	16 286.843
11.10.2010	12.8	65.0	14.1	65.0		
18.10.2010	15.1	66.9	13.5	66.9		
25.10.2010	13.0	65.8	14.7	65.8		
1.11.2010	13.1	68.1	12.4	68.1	43 101.215	13 251.806
8.11.2010	13.1	62.3	12.4	62.3		
15.11.2010	13.1	64.2	13.0	64.2		
29.11.2010	12.9	63.4	12.9	63.4		
06.12.2010	13.3	66.4	12.9	66.4	43 327.413	16 836.288
13.12.2010	13.8	65.0	12.9	65.0		
20.12.2010	12.4	63.1	13.5	63.1		

ANNEX 4

Heat savings from use of warm water and condensates*, GJ

Parameter	January	February	March	April	May	June	July	August	September	October	November	December	**2010 г.**
Heat savings from use of warm water	206 871	174 502	205 566	179 896	205 976	195 430	196 571	203 418	193 252	181 329	195 411	207 251	**2 345 474**
Heat savings from use of treated condensate (condensate A)	18 840	15 303	17 750	13 503	15 472	13 211	14 295	12 986	13 564	12 881	17 779	19 688	**185 272**
Heat savings from use of relatively clean condensate (condensate B)	26 862	21 704	25 454	22 219	24 423	23 402	22 594	22 016	23 450	-	-	-	**-**

* calcualtion of savings was made automaticvally on an hourly basis