MONITORING REPORT

Biomass utilization at JSC Segezha Pulp and Paper Mill (SPPM)

JI project reference number: 0133

Monitoring report #1

Monitoring period:
Start date: 01 January 2008
End date: 31 December 2010

Version 1.3

Date of preparation: 28 March 2011

Content

1. Introduction

This Monitoring report summarizes operation of the JI project "Biomass utilization at JSC Segezha Pulp and Paper Mill (SPPM)" and is aimed on calculation of the emission reductions achieved by the project activity during the period covered by this report.

1.1 Emission reductions for the monitoring period

During this monitoring period, the project activity has achieved emission reductions of **222 666** tCO2e.

1.2 Monitoring period

01 January 2008 0:00 to 31 December 2010 24:00

1.3 Comments

This is the first monitoring report since the determination of the project. This report is prepared in accordance with the determined project design documentation (PDD) "Biomass utilization at JSC Segezha Pulp and Paper Mill (SPPM)" Version 4.1 dd. 16 July 2010. All the data are collected and emission reductions calculation is made in accordance with the procedures described in Section D "Monitoring Plan" of the PDD.

Letter of Approval for the project by the Russian Government is issued in the decree N709 dated 30 December 2010. The project is listed under number 14 in the list of approved projects.

Letter of Approval for the project by the Secretary of State for Energy and Climate Change acting as the UK's Focal Point is issued 22 March 2011.

2. General project activity

2.1 Title of the project

Biomass utilization at JSC Segezha Pulp and Paper Mill (SPPM).

2.2 Sectoral scope

Sector: 1. Energy industries (renewable/non-renewable sources)

2.3 Crediting period

1 January 2008 - 31 December 2012

2.4 Location of the project

The considered project is located in the town of Segezha, Republic of Karelia, the Russian Federation. The town of Segezha is the administrative centre of Segezha District, the Republic of Karelia. It was founded in 1943. The town is located on the Segezha River and on the western bank of Lake Vygozero. Segezha is 700 km from Saint Petersburg. The population is 33 600 people. Segezha Pulp and Paper Mill is a large enterprise and the main employer in the town of Segezha.

2.5 Short description of the project

The project is aimed at increasing combustion efficiency of bark and wood wastes (BWW) used as fuel for steam production to cover in-house needs of the Mill and reduction of fossil fuel (fuel oil) consumption at the enterprise as a whole.

The project envisages the following measures:

- Reconstruction of the steam boiler No.7 of BKZ-75-39 GMA type running on fuel oil into a fluidized bed boiler of EEE-BKZ-100-3.9-440MDF type, which would enable combustion of BWW;
- Construction of a fuel feed facility and a BWW storage facility.

Bark and wood waste are generated indigenously at the Mill (in the process of paper manufacturing) and purchased from outside. Prior to the project implementation, BWW were fired in old utilization boilers No.1 to 5 with extremely low efficiency with large proportion of fuel oil used for stabilization of BWW burning.

2.6 Status of the project implementation

Currently all actions according to the project are totally completed.
Steam boiler No.7 with fluidized bed was commissioned according to the Certificate of acceptance of a reconstructed facility #1 dd 14.05.2008.
Fuel feed and a BWW storage facility was commissioned according to the Certificate of acceptance in operation #2 dd 30.05.2008.
From December of 2007 to May of 2008 steam boiler #7 and fuel feed and a BWW storage facility worked in the testing mode and supplied steam to the plant internal consumers.

2.7 Responsible party for the monitoring report

OJSC Segezha Pulp and Paper Mill (SPPM)

- Leading expert on environmental and legal aspects of technological development – Gladenyuk N.V.

Camco Carbon Russia Limited

- JI Manager – Ryumin O.V.

3. Monitoring plan and results of the project monitoring

3.1 Monitoring plan

3.1.1 Methodological approach

3.1.1.1 Baseline methodology

The baseline was developed in compliance with "Guidance on criteria for baseline setting and monitoring"[1]. The project developer uses JI specific approach, but definitely coordinating it with the requirements set forth in Decision 9/CMP.1, Annex *B* "Criteria for baseline setting and monitoring"[2].

3.1.1.2 Monitoring methodology

Selection of monitoring approach was made in compliance with "Guidance on criteria for baseline setting and monitoring" and requirements of Decision 9/CMP.1, Appendix B "Criteria for baseline setting and monitoring". The project developer used JI specific approach for establishing the monitoring.

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[1] Guidance on criteria for baseline setting and monitoring (version 02), JISC

[2] Report of the Conference of the parties serving as the meeting of the Parties to the Kyoto Protocol on its first session, held at Montreal from 28 November to 10 December 2005. Decision 9/CMP.1 Guidelines for the implementation of Article 6 of the Kyoto protocol. Appendix B Criteria for baseline setting and monitoring. p.12-13.

Collection of all key parameters required to calculate greenhouse gas emissions is undertaken in compliance with the established practice of OJSC Segezha Pulp and Paper Mill. The monitoring plan data should be stored for at least 2 years after the end of the crediting period.

3.1.2 Monitored parameter in the project

According to the Monitoring Plan following parameter are controlled (Please see the Table 3.1).

Table 3.1.

Data to be collected according to the monitoring plan

ID	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	Comment
1. $FC^{m}_{oil+pitch,PJ,y}$	Total mass of fuel oil and pitch combusted in the boiler house under the project	Department of Chief Power Engineer	t	m	Continuously	100 %	Electronic and paper	Readings of fuel oil flow meters. Total amount is a sum. Cross checked with suppliers' data and fuel remaining on the storage.
2. $FC^{m}_{oil+pitch,7,PJ,y}$	Mass of fuel oil and pitch combusted in Boiler No.7 under the project	Department of Chief Power Engineer	t	m	Continuously	100 %	Electronic and paper	Readings of fuel oil flow meters
3. $FC^{m}_{oil+pitch,8-10,PJ,y}$	Mass of fuel oil and pitch combusted in Boilers No.8-10 under the project	Department of Chief Power Engineer	t	m	Continuously	100 %	Electronic and paper	Readings of fuel oil flow meters
4. $NCV_{oil,y}$	Net calorific value of fuel oil	Certificate for fuel or reference data	GJ/ t	m, e	For each incoming batch of fuel oil	100 %	Electronic and paper	Weighted average value is determined at the end of year y
5. $HG_{7,PJ,y}$	Heat production by Boiler No.7 under the project	Department of Chief Power Engineer	GJ	m	Continuously	100 %	Electronic and paper	Calculated from the readings of steam meter, steam temperature and pressure

6. $HG_{8-10,PJ,y}$	Heat production by Boilers No.8-10 under the project	Department of Chief Power Engineer	GJ	m	Continuously	100 %	Electronic and paper	Readings of heat meter
7. $FC^{m}_{pitch,PJ,y}$	Overall mass quantity of pitch combusted in the boiler house under the project	Department of Chief Power Engineer	t	m	Upon accumulated	100 %	Electronic and paper	Density and volume are measured.
8. $NCV_{pitch,y}$	Weighted average net calorific value of pitch	Certificate of laboratory	GJ/t	e	Quarterly	100 %	Electronic and paper	Weighted average value is determined at the end of year y
9. $\eta_{oil,1-5}$	Efficiency of fuel oil combustion in boilers 1-5	Calculation of the boiler efficiency		c	Annually	100 %	Electronic and paper	Efficiency is monitored for boilers in operation
10. $\eta_{BWW,1-5}$	Efficiency of BWW combustion in boilers 1-5	Calculation of the boiler efficiency		c	Annually	100 %	Electronic and paper	Efficiency is monitored for boilers in operation
11. $\eta_{oil,7}$	Efficiency of fuel oil combustion in boiler 7	Calculation of the boiler efficiency		c	Annually	100 %	Electronic and paper	
12. $\eta_{BWW,7}$	Efficiency of BWW combustion in boiler 7	Calculation of the boiler efficiency		c	Annually	100 %	Electronic and paper	
13. $\eta_{oil,8-10}$	Efficiency of fuel oil combustion in boiler 8-10	Calculated from fuel consumption and heat production		c	Annually	100 %	Electronic	
14. EF_{oil}	Emission factor for fuel oil	IPCC	tCO_2e/GJ	e	Annually	100 %	Electronic	Latest available version of IPCC guidelines

3.1.3 QA/QC for the project monitoring

Data *(Indicate table and ID number)*	Uncertainty level of data (high/medium/low)	Объясните методики контроля качества/гарантии качества, разработанные для этих данных
ID 1,2,3	Low	Fuel oil flow meters are installed at the boilers: • Boilers No. 2, 3, 5 – primary detectors (differential pressure gage) of JUMO dTRANS p02 DELTA (Germany); • Boilers No.1,8,9,10 – Ultrasonic Flowmeters URSV «Vzlet MR»– 110 type; • No. 7 - Ultrasonic Flowmeters URSV «Vzlet MR»– 110 type (Coriolis acceleration flowmeter Promass with the same accuracy level was installed in December 2010). All data from the flowmeters is displayed in PIRS electronic system, where data is accumulated and daily, monthly and annual reports are delivered. Fuel oil flowmeters are calibrated regularly. Results of calibrations are recorded in the instrumentation certificates. Total mass of fuel oil and pitch combusted in the boiler house are cross-checked with the data of level gauges of fuel-oil storage tank at the end of each month during inventory.
ID 4,8	Low	Analyzes of the net calorific value are taken place at the special accredited laboratory. The laboratory equipment is subject to regular calibration. For each batch of fuel oil a certificate is available, which states the fuel quality.
ID 5,6	Low	Heat meters are calibrated regularly and readings are regularly cross-checked with balance data. The results of calibration are recorded in the instrumentation certificates. All heat production data is displayed in PIRS electronic system, where data is accumulated and daily, monthly and annual reports are delivered.
ID 7	Low	The volume of pitch is measured by tanks with definite volume and measuring rod.
ID 9,10,11,12	Low	The data are obtained by testing of the boilers and included into parameters charts
ID 13	Low	The efficiency is calculated using high accuracy measured parameters
ID 14	Low	IPCC data can be considered reliable

Table 3.3.

Information about verification and calibration equipment necessary for monitoring project

Title of equipment	Type	Data variable	Serial number	Uncertainty level of device	Installation time	Date of the last check before 2008	Date of check in 2008	Date of check in 2009	Date of check in 2010	Date of the next check
UltrasonicFlowmeter URSV "Vzlet MR"	URSV -110	Mass of fuel oil and pitch combusted in Boiler No.1 under the project	601230	0.5	21.06.2006	Not required	Not required	Not required	12.07.10	12.07.11
Differential pressure gage	JUMO	Mass of fuel oil and pitch combusted in Boiler No.2 under the project	009612800100 5470001	0.5	15.02.07	15.02.07	14.02.08	10.02.09	27.01.10	27.01.11
Differential pressure gage	JUMO	Mass of fuel oil and pitch combusted in Boiler No.3 under the project	43000400	0.5	16.03.06	01.03.07	20.03.08	09.04.09	01.04.10	01.04.11
Differential pressure gage	JUMO	Mass of fuel oil and pitch combusted in Boiler No.5 under the project	011484320100 7340001	0.5	05.05.06	10.05.07	20.05.2008	22.07.09	01.07.10	01.07.11
UltrasonicFlowmeter URSV "Vzlet MR" Coriolis acceleration flowmeter	URSV -110 URSV -110 Promass80F Promass83F	Mass of fuel oil and pitch combusted in Boiler No.7 under the project	601307 400655 4A056D02000 97113302000	0.5 0.5 0.5 0.5	20.10. 07 20.10. 07 09.12.10 09.12.10	20.03.07 08.10. 07 - -	Not required - -	Not required - -	Not required 08.12.10 08.12.10	- - 08.12.14 08.12.14
UltrasonicFlowmeter URSV "Vzlet MR"	URSV -110	Mass of fuel oil and pitch combusted in Boilers No.8-10 under the project	400637 601226 400654	0.5 0.5 0.5	20.01.05 20.01.05 20.01.05	21.01.04 21.06.06 21.01.04	21.02.08 Not required 21.02.08	23.04.09 Not required Not required	Not req. 15.07.10 Not req.	23.04. 13 15.07.14 21.02. 12

		Net calorific value of fuel oil	Certificate of fuel oil from supplier							
Differential manometer - flowmeter	Metran 43F-DD	Heat production by Boiler No.7 under the project	82519 42637 (reserve)	0.5 0.5	17.12.04 02.09.07	20.06.07 02.09.07	09.09.08 02.09.08	02.12.09 02.09.09	27.12.10 02.09.10	27.12.11 02.09.11
Differential manometer - flowmeter	Sapfir 22DD DM Sapfir 22DD	Heat production by Boilers No.8-10 under the project	15259 77297 520108	1.0 1.5 1.0	29.09.93 29.09.93 29.09.93	02.02.07 07.11.07 26.01.07	31.01.08 17.10.08 21.01.08	13.02.09 21.10.09 25.02.09	27.02.10 07.10.10 15.02.10	27.02.11 07.10.11 15.02.11
Gauge stick	MER-3,5/4,5	Overall mass quantity of pitch combusted in the boiler house under the project	322 334 0781	Error ± 2mm throughout the scale length	portable	14.05.07 - -	14.05.08 -	14.05.09 14.05.09 -	- 14.05.10 14.05.10	- - 14.05.11
		Weighted average net calorific value of pitch	Certified laboratory conducted measuring							
Gas analyzer	MRU Delta65	Efficiency of fuel oil combustion in boilers 1-5	021238	In line with operational manual of the device	portable	-	initial 28.07.08	Not required	14.05.10	14.05.11
		Efficiency of BWW combustion in boilers 1-5								
		Efficiency of fuel oil combustion in boiler 7								
		Efficiency of BWW combustion in boiler 7								

3.1.3.1 Personnel training

Training of workers and maintenance qualification upgrade for personnel has been made during the project realization.

In line with requirements of Russian Technical Inspection steam boiler operators pass courses "Rules for arrangement and safe operation of boilers, vessels, steam and hot-water pipelines", take an examination and gain clearance to work with boilers. Knowledge assessment of operators is provided annualy.

The personnel of SPPM responsible for the boiler operation was trained by the specialists of «FOSTER WHEELER ENERGIA OY» (base project equipment supplier) in order to secure proper operation of the reconstructed boiler.

3.1.3.2 Monitoring system

Operational and management structure applied by SPPM corresponds to determined Monitoring Plan of the PDD.
SPPM is responsible for initial data that presented to the project developer. The input data for monitoring is provided by the Technical department, Environmental department and CHPP-1 according to the SPPM order #6 dd. 17.11.2011 "On the monitoring of the project "Biomass utilization at JSC SPPM". n case of any doubt regarding the accuracy of the input data, those are checked and revised by the specialists of SPPM. The preliminary version of the monitoring report is submitted to the management of SPPM for review. In case any mistakes are identified, specialists of Camco Carbon Russia Limited correct the report accordingly.

Table 3.4

The procedure of preparation documentation for monitoring

№	Data variable	Recording frequency	Recording registration: manually/ automatically	Title of temporary report and recording frequency	Responsible, who will processing this documentation	The order and storage of data	Storage method (Electronic and paper), Where	Type of document where is storage data	Responsible who approving the report	Comments
1. $FC^{m}_{oil+pitch,PJ,y}$	Total mass of fuel oil and pitch combusted in the boiler house under the project	Continuously	Automatically, PIRS[3]	workshop technical report	senior engineer, production and technical department (PTD) of CHPP1	Paper, 10 years	paper, PTD CHPP1	Technical report , 6-TP	chief engineer	The data are cross-checked with the data of level gauges of fuel-oil storage tank
2. $FC^{m}_{oil+pitch,7,PJ,y}$	Mass of fuel oil and pitch combusted in Boiler No.7 under the project	Continuously	Automatically, PIRS	workshop technical report	senior engineer, PTD CHPP1	Paper, 10 years	paper, PTD CHPP1	Technical report , 6-TP	chief engineer	
3. $FC^{m}_{oil+pitch,8-10,PJ,}$	Mass of fuel oil and pitch combusted in Boilers No.8-10 under the project	Continuously	Automatically, PIRS	workshop technical report	senior engineer, PTD CHPP1	Paper, 10 years	paper, PTD CHPP1	Technical report , 6-TP	chief engineer	
4. $NCV_{oil,y}$	Net calorific value of fuel oil	Certificate for each incoming batch of fuel oil		workshop technical report	senior engineer, PTD CHPP1	Paper, 10 years	paper, PTD CHPP1	Technical report , 6-TP	chief engineer	

[3] At the plant in 2000 installed display technology information (PIRS), developed by the Perm Center at ASU

5. $HG_{7,PJ,y}$	Heat production by Boiler No.7 under the project	Continuously	Automatically, PIRS	workshop technical report	senior engineer, PTD CHPP1	Paper, 10 years	paper, PTD CHPP1	Technical report , 6-TP	chief engineer	
6. $HG_{8-10,PJ,y}$	Heat production by Boilers No.8-10 under the project	Continuously	Automatically, PIRS	workshop technical report	senior engineer, PTD CHPP1	Paper, 10 years	paper, PTD CHPP1	statistical report , 6-TP	chief engineer	
7. $FC^{m}_{pitch,PJ,y}$	Overall mass quantity of pitch combusted in the boiler house under the project	Upon accumulated	manually	workshop technical report	senior engineer, PTD CHPP1	Paper, 10 years	paper, PTD CHPP1	statistical report , 6-TP	chief engineer	
8. $NCV_{pitch,y}$	Weighted average net calorific value of pitch	Once per quarter	analysis	workshop technical report	senior engineer, PTD CHPP1	Paper, 10 years	paper, PTD CHPP1	statistical report , 6-TP	chief engineer	
9. $\eta_{oil,1-5}$	Efficiency of fuel oil combustion in boilers 1-5	Once per a year and after repairs	manually	Parameter charts, test results	senior engineer, Department of Chief Power	Paper, 10 years	paper, PTD CHPP1			
10. $\eta_{BWW,1-5}$	Efficiency of BWW combustion in boilers 1-5	Once per a year and after repairs	manually	Parameter charts, test results	senior engineer, at Department of Chief Power	Paper, 10 years	paper, PTD CHPP1			
11. $\eta_{oil,7}$	Efficiency of fuel oil combustion in boiler 7	Once per a year and after repairs	manually	Parameter charts, test results	senior engineer, at Department of Chief Power	Paper, 10 years	paper, PTD CHPP1			
12. $\eta_{BWW,7}$	Efficiency of BWW combustion in boiler 7	Once per a year and after repairs	manually	Parameter charts, test results	senior engineer, at Department of Chief Power	Paper, 10 years	paper, PTD CHPP1			
13. $\eta_{oil,8-10}$	Efficiency of fuel oil combustion in boiler 8-10	Once per a year and after repairs	manually	Parameter charts, test results	senior engineer, at Department	Paper, 10 years	paper, PTD CHPP1			

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3.1.4 Calculation of GHG emission reductions

The amount GHG emission reductions over a year y, are is result of fuel oil combustion reduction calculated by following equation t CO2-eq:

$$ER_y = \Delta FC_{oil,y} \cdot EF_{oil} \quad (3.1)$$

where

EF_{oil} -is the emission factor for fuel oil, kg CO_2/GJ is accepted at 77.4 according to the table 3.2;

$\Delta FC_{oil,y}$ - is the fuel oil consumption reduction due to the project implementation (calculated by formulae 3.2), GJ.

$$\Delta FC_{oil,y} = FC_{oil,1-5,BL.,y} - FC_{oil,7,PJ,y} - FC_{oil,8-10,PJ,y} \quad (3.2)$$

where

$FC_{oil,1-5,BL.,y}$ - is the amount of fuel oil combusted in Boilers No.1-5 under the baseline (calculated by formulae 3.3), GJ;

$FC_{oil,7,PJ,y}$ - is the amount of fuel oil combusted in Boiler No.7 under the project (calculated by formulae 3.8), GJ;

$FC_{oil,8-10,PJ,y}$ - is the amount of fuel oil combusted in Boilers No. 8-10 under the project (calculated by formulae 3.14), GJ.

The amount of fuel oil combusted in Boilers No.1-5 under the baseline during the year *y*, calculated by following equation:

$$FC_{oil,1-5,BL.,y} = FC_{oil+pitch,1-5,BL.,y} - FC_{pitch,1-5,BL.,y} \quad (3.3)$$

where

$FC_{oil+pitch,1-5,BL.,y}$ - is the consumption of fuel oil and pitch mixture by the boilers No.1-5 under the baseline (calculated by formulae 3.5), GJ;

$FC_{pitch,1-5,BL.,y}$ - is the consumption of pitch by the boilers No.1-5 under the baseline (calculated by formulae 3.4), GJ.

Consumption of pitch under the baseline is equal to the consumption of pitch under the project by the boilers influenced by project (boilers No.7 and No.8-10), therefore:

$$FC_{pitch,1-5,BL.,y} = FC_{pitch,7,PJ,y} + FC_{oil+pitch,8-10,PJ,y} * \varpi_{pitch,PJ,y} \quad (3.4)$$

where

$FC_{pitch,7,PJ,y}$ - is the quantity of pitch (by heat) combusted under the project in the Boiler No.7 (calculated by formulae 3.9), GJ;

$FC_{oil+pitch,8-10,PJ,y}$ - is the quantity of fuel oil with pitch (by heat) combusted under the project in the boilers No.8-10 (calculated by formulae 3.13), GJ;

$\varpi_{pitch,PJ,y}$ - is a share of pitch in the fossil fuels mixture by heat under the project (calculated by formulae 3.15).

$$FC_{oil+pitch,1-5,BL,y} = \frac{FC_{BWW,1-5,BL,y}}{1-0.79} \times 0.79 \quad (3.5)$$

where

$FC_{BWW,1-5,BL,y}$ - is the BWW consumption in boilers No.1-5 under the baseline, GJ, assumed equal to BWW combusted in boiler No.7 under the project.

$$FC_{BWW,1-5,BL,y} = FC_{BWW,7,PJ,y} \quad (3.6)$$

where

$FC_{BWW,7,PJ,y}$ - is the BWW combusted in boiler No.7 under the project (calculated by formulae 3.7), GJ.

$$FC_{BWW,7,PJ,y} = \frac{(HG_{7,PJ,y} - (FC_{oil,7,PJ,y} + FC_{pitch,7,PJ,y}) \cdot \eta_{oil,7})}{\eta_{BWW,7}} \quad (3.7)$$

where

$HG_{7,PJ,y}$ - is the heat production by boiler No.7 under the project, obtained from the monitoring, identification number (ID5) GJ;

$FC_{oil,7,PJ,y}$ - is the quantity of fuel oil combusted in boiler No.7 under the project (calculated by formulae 3.8), GJ;

$FC_{pitch,7,PJ,y}$ - is the quantity of pitch combusted in boiler No.7 under the project (calculated by formulae 3.9), GJ;

$\eta_{BWW,7}$ - is the efficiency of BWW combustion in boiler No.7 obtained from the monitoring, identification number (ID12) GJ;

$\eta_{oil,7}$ - is the efficiency of fuel oil combustion in boiler No.7 obtained from the monitoring, identification number (ID11) GJ.

$$FC_{oil,7,PJ,y} = FC^{m}_{oil,7,PJ,y} \cdot NCV_{oil} \quad (3.8)$$

where

$FC^{m}_{oil,7,PJ,y}$ - is the mass of fuel oil combusted in boiler No.7 (calculated by formulae 3.12), t;

$NCV_{oil,y}$ - is the net calorific value of fuel oil, obtained from the monitoring, identification number (ID4), GJ/t.

$$FC_{pitch,7,PJ,y} = FC^{m}_{pitch,7,PJ,y} \cdot NCV_{pitch} \quad (3.9)$$

where

$FC^{m}_{pitch,7,PJ,y}$ - is the mass of pitch combusted in boiler No.7 (calculated by formulae 3.10), t;

$NCV_{pitch,y}$ - is the net calorific value of pitch, obtained from the monitoring, identification number (ID8), GJ/t.

$$FC^{m}_{pitch,7,PJ,y} = FC^{m}_{oil+pitch,7,PJ,y} \cdot \varpi^{m}_{pitch,PJ,y} \quad (3.10)$$

where

$FC^{m}_{oil+pitch,7,PJ,y}$ - is the mass of fuel oil and pitch mixture consumed by the boiler No.7 under the project, obtained from the monitoring, identification number (ID2), t;

$\varpi^{m}_{pitch,PJ,y}$ - is a share of pitch in the fossil fuels mixture by mass under the project (calculated by formulae 3.11).

$\varpi^{m}_{pitch,PJ,y}$ is calculated as:

$$\varpi^{m}_{pitch,PJ,y} = \frac{FC^{m}_{pitch,PJ,y}}{FC^{m}_{oil+pitch,PJ,y}} \quad (3.11)$$

where

$FC^{m}_{pitch,PJ,y}$ - is the mass of pitch combusted in the boiler house under the project, obtained from the monitoring, identification number (ID7) t;

$FC^{m}_{oil+pitch,PJ,y}$ - is the total mass of fuel oil and pitch mix burned in the boiler house under the project, obtained from the monitoring, identification number (ID1), t.

The mass of fuel oil combusted in Boiler No.7 over a year y is calculated following equation:

$$FC^{m}_{oil,7,PJ,y} = FC^{m}_{oil+pitch,7,PJ,y} - FC^{m}_{pitch,7,PJ,y} \quad (3.12)$$

where

$FC^{m}_{oil+pitch,7,PJ,y}$ - is the mass of fuel oil and pitch mixture consumed by the boiler No.7 obtained from the monitoring, identification number (ID2), t;

$FC^{m}_{pitch,7,PJ,y}$ - mass of pitch combusted in boiler No.7 under the project (calculated by formulae 3.10), t.

The quantity of fuel oil with pitch (by heat) combusted under the project in the boilers No.8-10 is calculated in following equation:

$$FC_{oil+pitch,8-10,PJ,y} = \frac{HG_{BL,y} - HG_{7,PJ,y}}{\eta_{oil,8-10}} \quad (3.13)$$

where

$HG_{7,PJ,y}$ - is the heat production by boiler No.7 under the project, obtained from the monitoring, identification number (ID5), GJ;

$HG_{BL,y}$ - is the heat generated by the boilers No.1-5 under the baseline due to combustion of the same amount of BWW as in boiler No.7 under the project and necessary amount of fuel oil and pitch mixture (calculated by formulae 3.16), GJ;