INITIAL AND FIRST JI MONITORING REPORT

VERSION 1.0 DATED 25 JULY 2011

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Annexes

SECTION A. General project activity and monitoring information

A.1 Title of the project activity:

Slag usage and switch from wet to dry process at Yugcement, Ukraine.
Sectoral scope 4: Manufacturing industries

A.2. JI registration number:

The project is registered with the number of JI0188.
ITL ID of the Project is UA2000027

A.3. Short description of the project activity:

Cement production is an energy intensive process that generates significant volume of greenhouse gas emissions, in particular, CO_2. There are three main sources of CO_2 emissions in the cement production process: the first source is fossil fuel combustion; the second source is chemical decomposition of limestone into calcium oxide and carbon dioxide; the third source, being smaller as to compare with the first two, is the grid emissions due to electricity consumption of plant motor drives (e.g. kiln rotation, pumping, fans) and other power consumers.
Before the project start, slag has not been added into the raw meal for the kilns.

The project aims to significantly decrease emissions from the first two sources (from fossil fuel combustion and calcination) at Yugcement factory. The project foresees introduction of alternative raw materials, namely blast furnace slag (BFS), as a decarbonized raw material in the raw meal supplied to the kilns. Addition of slag reduces emissions due to calcination and emissions due to fuel consumption. According to the plan, BFS will be added from 1 January 2009.

It is foreseen that slag addition process will be implemented in two steps. Under the first step about 4% of unground BFS will be added. The second step will follow when all technical issues related to slag adoption are solved. It provides for introduction of slag milling facility and gradual increase of slag proportion to about 15%.

A.4. Monitoring period:

- Monitoring period starting date: 01.01.2009 at 00:00;
- Monitoring period closing date: 31.03.2011 at 24:00[1]

A.5. Methodology applied to the project activity (incl. version number):

JI specific approach regarding baseline setting and monitoring has been developed in accordance with Appendix B of the JI Guidelines and with the JISC Guidance. This specific approach is based on selected elements of the ACM0015[2] and JI Guidance on Criteria for Baseline Setting and Monitoring, Version 02[3].

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[1] Both days included

[2] http://cdm.unfccc.int/EB/036/eb36_repan15.pdf

A.5.1. Baseline methodology:

The “Guidance on criteria for baseline setting and monitoring, Version 02”, issued by the Joint Implementation Supervisory Committee (JISC) allows using approved methodologies of the Clear Development Mechanism (CDM)[4]. The project design document (PDD), determined by an accredited independent entity (AIE), uses a JI project specific approach to establish the baseline scenario.

Baseline scenario provides for producing of clinker without addition alternative raw material. Baseline emission sources are:

- GHG emissions from fuel combustion – emissions from combustion of fuel in the kiln, combustion of fuel for coal drying;
- GHG emissions from calcination process – limestone $CaCO_3$ at high temperature decomposes into calcium oxide CaO used for clinker and carbon dioxide CO_2 which emits into the atmosphere;
- Power is used for operation of kilns and devices maintaining clinker production process thus causing indirect GHG emissions from grid electricity consumption.

A.5.2. Monitoring methodology:

A JI specific monitoring approach was developed for this project in line with the JI Guidance on Criteria for Baseline Setting and Monitoring, Version 02. The resulting Monitoring Plan was determined as part of the determination process.

Monitoring activities include personnel training, measurement activities, checking of all meters used within project frames, monitoring of environmental impact and calculation of GHG emission reduction.

The parameters involved in the Project frames are monitored in a following manner:

- The amount of clinker produced is determined taking into account load of kilns and properties of raw meal supplied into them;
- Fuel consumption for clinker production (kiln reheating, slag and coal drying) is being metered by gas meters and coal weight feeders;
- Electricity consumption is monitored by a group of power meters located in the central distributing substation of the plant and transforming substation #11;
- Weight feeder of slag and flow meters of slurry carry out measurement of raw material consumption for raw meal;
- The plant laboratory is responsible for issuing reports on content of CaO and MgO in clinker, raw materials and slag.

A.6. Status of implementation including time table for major project parts:

The Letters of Approval for the Project were obtained from parties involved:
The LoA from National Environmental Investment Agency of Ukraine #1399/23/7 from 16 September 2010
The LoA from Federal Environment Agency; German Emission Trading Authority from 22 July 2010
The LoA from Ministry of Economic Affairs, Netherlands #2009JI14 from 7 January 2010
The mentioned documents can be found at:

[3] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf

[4] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf

http://ji.unfccc.int/JI_Projects/DB/PZ7FNGT0G2M88MMXVUCPU4B5J1NUBA/Determination/Bureau%20Veritas%20Certification1285667148.21/viewDeterminationReport.html

The project implementation started on the 1st of January 2009. The actual achieved share of slag addition in the raw meal is presented in a table below:

Year	Slag addition percentage achieved, %
2009	0,74
2010	0,1
2011	0,52

Table 1: Status of project implementation during 2009 -2011

Please refer to the explanations on the actual percentage of slag addition achieved provided in the Section A.7. of this report.

A.7. Intended deviations or revisions to the registered PDD:

The JI project was made publicly available on the UNFCCC website. The full text of PDD could be found at
http://ji.unfccc.int/JI_Projects/DB/PZ7FNGT0G2M88MMXVUCPU4B5J1NUBA/Determination/Bureau%20Veritas%20Certification1285667148.21/viewDeterminationReport.html

Monitored amount of emission reduction differs from the one expected in PDD for the respective period stated in A.4. as shown in a table 2 below:

Year	2009	2010	2011[5]
ERs in MR001 in tons of CO_2 equiv.	15316	786	2020
ERs in determined PDD in tons of CO_2 equiv.	12778	17953	67324

Table 2: Monitored and estimated amounts of ERU for 2010 year

In order to master slag addition technology special slag feeding facility has been installed and commissioned. As one may know, slag addition causes increase of saturation coefficient in the kiln making clinker production more complicated. Thus after project start in 2009 the facility has been working in a test mode varying volume of slag addition for adjusting the technology of clinker production. In 2010 there were difficulties with slag procurement therefore share of slag addition was 0,1%.

For 2011, owner of the plant, Dyckerhoff AG has planned that Yugcement plant must achieve 2% slag addition level by the end of the year. In future it is foreseen to install slag grinding facility that will allow increasing of slag addition up to 15%, but this activity is postponed due to the lack of financing caused by financial crisis in Ukraine.

Thereby during the Project implementation the slag has been added in lesser volume than that of foreseen in PDD, which, in its turn, caused lesser amount of emission reductions achieved in the monitoring period.

[5] From 01.01.2011 to 31.03.2011

There are no other deviations to the determined PDD.

A.8. Intended deviations or revisions to the registered monitoring plan

Slag addition has very minor effect on electricity consumption for kiln operation and raw material preparation and handling. According to the selected approach, it is assumed that substituting some raw materials with slag will result in emission reductions due to lesser amount of required raw materials and, consequently, lower electricity consumption. Baseline electricity consumption for kiln operation and raw material preparation has been fixed ex-ante in the monitoring plan contained in the registered PDD. However, in practice this parameter is influenced not only by the project activity but also by a number of different factors: conditions at the raw materials excavation site, production level etc. Therefore, it can be hard to isolate project activity impact on this parameter from other influences. In order to provide clear calculation of greenhouse gas emissions and decrease uncertainty level it was decided to use actual monitoring data for baseline electricity consumption for kiln operation and raw material preparation. Thus BE_{EL} = PE_{EL} making emission reduction due to electricity consumption for kiln operation and raw material preparation equal to 0. Proposed approach is, therefore, conservative.

Proposed monitoring plan:			**Previous monitoring plan:**		
Variable	**Units**	**Method of monitoring**	**Variable**	**Units**	**Method of monitoring**
$BE_{EL,y}$	tCO_2	Calculated by formula: $BE_{El,y} = EF_{el,y} \times EL_y \times CLNK_y$ Where: $BE_{EL,y}$ - Baseline emission due to electricity consumption for preparation of raw meal and kilns electricity consumption in year y (tCO_2); $EF_{el,y}$ - CO2 emission factor for electricity consumed from the grid by the project activity; EL_y - Specific electricity consumption of equipment for raw meal preparation and wet kilns operation in year *y;* $CLNK_y$ - Volume of annual clinker production in year *y*	$BE_{EL,y}$	tCO_2	Calculated by formula: $BE_{EL,y} = EF_{el,y} \times EL_{BSl} \times CLNK_y$ Where: $BE_{EL,y}$ - Baseline emission due to electricity consumption for preparation of raw meal and kilns electricity consumption in year y; $EF_{el,y}$ - CO2 emission factor for electricity consumed from the grid by the project activity; EL_{BSL} - Specific electricity consumption of equipment for raw meal preparation and wet kilns operation in the Baseline scenario (fixed ex-ante); $CLNK_y$ - Volume of annual clinker production in year *y*

Table 3: Deviations to the previous monitoring plan

There are no other deviations to the determined monitoring plan (MP).

A.10. Person(s) responsible for the preparation and submission of the monitoring report:

Public Joint Stock Company “Yugcement”.

- Julia Golovchuk, Chief ecologist.

Global Carbon Ukraine

- Denis Prusakov, Senior JI consultant;
- Iurii Petruk, Junior JI consultant.

SECTION B. Key monitoring activities

The emission sources of greenhouse gases in the baseline and in the project are:

- Emissions due to fuel combustion (combustion for kiln heating and combustion for slag and coal drying);
- Emissions from calcination of raw materials at high temperatures in the kilns;
- Indirect emissions due to consumption of electricity from the grid.

The following parameters are monitored in order to calculate greenhouse gas emission reductions:

1. Kiln fuel consumption
Cement plant has 2 rotary kilns. Each kiln has capacity of 72 t clinker/hour and can operate up to 320 days per year. Originally only natural gas (NG) was used as fuel for rotary kilns but due to tendency of constant price increase, rotary kilns have been switched to coal as main fuel. Since then natural gas has been used for initial reheating and ignition of coal in the furnaces and as backup fuel for kilns. Consumption of natural gas of both kilns is constantly monitored by a gas metering facility "Siemens PLC s7-416" which obtains and analyzes data from pressure, flow and temperature sensors located within gas supply system of the kilns. Coal consumption for kiln heating is constantly measured by 2 weight feeders Schenck MULTICOR K50 located between coal dust silo and each kiln.
2. Fuel consumption for pre-drying of coal and alternative raw materials
Alternative raw materials (ARM) are added into the kiln in dry state separately from the slurry. Their drying is being conducted in a drying drum which is reheated by NG. Electronic device OE-DM IZ meters natural gas consumption of the drum in normalized m^3 by use of processing values that are being obtained from pressure diaphragm, temperature converter and pressure converter installed on the gas supply pipe. Coal supplied to the plant has high content of moisture; prior to be used it has to be dried and milled to dust. Coal drying is being carried out in a heat generator using NG as fuel. Turbine type meter Actaris D-76161 meters amount of natural gas consumed by the heat generator.
3. Net calorific values of fuels used
The fuels used for clinker production are natural gas and coal. The net calorific value (NCV) of natural gas is monitored using fuel certificates issued by Kharkivtransgas monthly. The NCV of coal is monitored by use of reports of special accredited SGS laboratory that performs chemical analysis of coal per each shipment.
4. Electricity consumption
Electricity consumption for kiln operation and raw material preparation and handling is measured by the group of electrical meters. Meters of electricity consumed for kiln operation and coal drying are located in the central distributing substation (CDS) of the plant. Meters involved in monitoring of electricity consumed for raw meal preparation and handling are located in Transforming substation #11 (TS#11).

5. CaO and MgO content in the clinker produced
Plant laboratory is responsible for constant monitoring of CaO and MgO content in clinker produced and materials used for clinker manufacturing. The chemical analysis of clinker on MgO and CaO content is conducted once per twenty four hours.
6. Non-carbonated CaO and MgO content in raw meal
Monitoring of non-carbonated content of CaO and MgO in the raw meal is calculated by use of next data: • Quantity of slurry supplied to the kilns. CaO and MgO content in the slurry, quantity of dry material in the slurry. • Quantity of dry ARM supplied to the kilns. CaO and MgO content in the slag. The chemical analysis on MgO and CaO content in the slurry is conducted once per twelve hours. The chemical analysis on MgO and CaO content in slag is conducted for each shipment.
7. Quantity of raw meal (RM) consumed by the kilns
The monitoring is based on constant measurement of amount of slurry and BFS consumed by each rotary kiln. It takes into account composition, moisture content of slurry in order to define amount of dry material in the raw meal. These properties of slurry are tested every 12 hours by the laboratory of Yugcement. Amount of slurry supplied to the kilns is metered by flow meters Yokogawa AXF150 installed before each kiln. Quantity of slag added to the slurry is measured by one weight feeder Schenck Multidos MTD1020 supplying slag to both kilns.
8. Quantity of clinker produced by the kilns
Clinker production is calculated based on constant metering of raw meal volume, chemical composition of RM (moisture and chemical composition monitored by plant laboratory) and operational time of the kilns.

Table 4: General information on data monitoring

B.1. Monitoring equipment:

The monitoring equipment can be divided into four groups: gas flow meters, power meters, weight meters and slurry flow meters.

Gas flow meters

<u>Natural gas consumption of the kilns:</u>
Microprocessor device “Siemens PLC s7-416” constantly obtains and analyzes data from pressure, flow and temperature sensors located within gas supply system of the kilns.
The orifice pressure drop method is used for measuring kiln fuel consumption (natural gas): orifice is installed together with the pressure sensor; it causes increase of the gas flow rate in the narrow area and decrease of absolute pressure there; thus gas flow is metered by measuring the difference of pressure in the device and in a pipe area after it. Pressure and temperature sensors measure corresponding parameters of the gas. In order to obtain normalized values of natural gas consumption, flow, temperature and pressure are used for calculations.

Natural gas consumption of the heat generator for coal drying:

The meter Actaris D-76161 with a turbine mechanism measures consumption of natural gas for coal drying. Its principle of operation is: turbine wheel that is located in the gas channel propels under gas flow; by use of reducer and a magnetic clutch the rotating motion is being transferred to the counting mechanism.

Natural gas consumption of the slag drying drum:

Natural gas consumption is monitored by calculating-recording device OE-DM IZ which obtains values from flow meter, pressure meter and temperature sensor and displays normalized m^3 consumption. It this case gas flow is calculated by use of monitoring and processing of differential pressure in the pipeline.

Three gas meters are used for measurement of amount of natural gas consumed for clinker production as shown in Figure 1 below. One of them monitors natural gas consumption of kilns, one – NG consumption for coal drying and the other one measures NG consumption for slag drying.

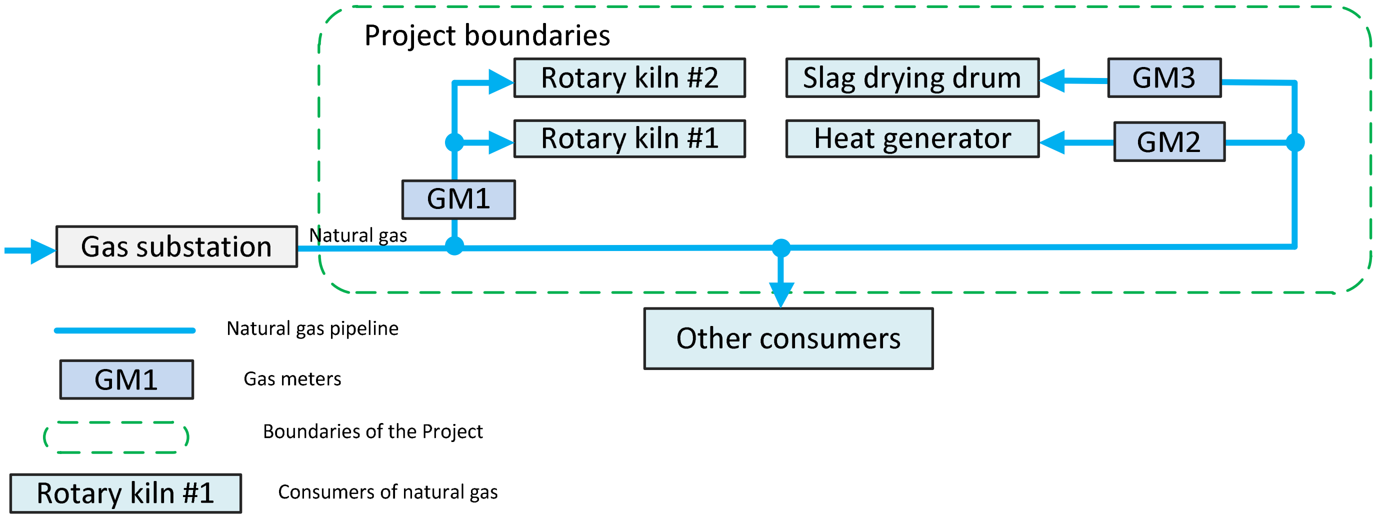

Figure 1: Gas supply and metering diagram

Data on natural gas consumption are collected daily and transferred to automatic control system (ACS) where processed and transferred to financial department of the plant.

Coal weight meters

The weight of coal combusted in the kilns is measured by 2 weight feeders Schenck MULTICOR K50 that are installed at the line of coal dosing and supply of each kiln.

Power meters

Power meters measure electricity consumed for the following activities:

- Rotary kiln operation;
- Preparation and transfer of slurry;
- Preparation and transfer of slag;
- Preparation and conveying of coal;
- Operations of compressors and pumps involved in clinker production.

Measurement of electricity within project boundaries is carried out by 27 electricity meters. 18 of them are located in the central distributing substation of the plant and 9 are situated in transforming substation #11.

Daily report is issued based on data collected from the electricity meters. The data are transferred to financial department where processed using software “1C-Electricity” and stored.

Slurry flow meters

Two flow meters “Yokogava” measure amount of slurry fed into the kilns. The devices are located at the supply line of the kilns.

Slag weight meters

The weight of slag supplied into the kilns is measured by weight feeder Schenck Multidos MTD1020 that is installed before the supply line of kilns.

B.1.2. Table providing information on the equipment used (incl. manufacturer, type, serial number, date of installation, date of last calibration)

Gas meters

Equipment	Variable	Unit	Producer/type	Serial number	Installation date	Last calibration	Next calibration	Accuracy	Comments
Gas meter #1 (GM1)	$FC_{NG,y}$	normalized m^3	Siemens PLC s7-416	6ES7416-3ER05-0AB0	07/2010	n/a	n/a	± 0.91 %	Rotary kiln fuel consumption
Gas meter #2 (GM3)	$FC_{heat\_gen, y}$	normalized m^3	Actaris D-76161	3138611001/c	05/2010	n/a	n/a	n/a	NG consumption heat generator
Gas meter #3 (GM3)	$FC_{slag, y}$	normalized m^3	OE-22DM IZ	0550	03/2010	03/2011	03/2012	± 3 %	NG consumption slag drying drum

Table 4: Gas flow meters

Coal weight feeders

Equipment	Variable	Unit	Producer/type	Serial number	Installation date	Calibration frequency	Accuracy	Comments
Coal weight feeder #1 (WF1)	$FC_{coal,y}$	t	Schenck MULTICOR K50	V040091A01	05/2010	On manufacture necessity	± 0,5 %	Coal supply of the kiln #1
Coal weight feeder #2 (WF2)			Schenck MULTICOR K50	V040092A01	05/2010		± 0,5 %	Coal supply of the kiln #2

Table 5: Coal weight feeders

Power meters

Equipment	Location/ meter abbreviation	Manufacturer/ type	Serial number	Unit	Installation date	Accuracy	Last calibration	Next calibration	Comments
Power consumption for coal drying									
Electricity meter #1	**CDS, EM1**	CECE680 5B	0851490802797405	kWh	n/a	± 1 %	n/a	n/a	
Electricity meter #2	**CDS, EM2**	CECE680 5B	9561821	kWh	n/a	± 1 %	n/a	n/a	
Electricity meter #3	**CDS, EM3**	CECE680 5B	0851490802797195	kWh	n/a	± 1 %	n/a	n/a	
Electricity meter #4	**CDS, EM4**	CECE680 5B	95261813	kWh	n/a	± 2 %	n/a	n/a	
Power consumption for raw meal preparation									
Electricity meter #5	**TS #11, EM5**	CE6811	1101815	kWh	n/a	± 1 %	n/a	n/a	
Electricity meter #6	**TS #11, EM6**	CE6805	42063759	kWh	n/a	± 1 %	n/a	n/a	
Electricity meter #7	**TS #11, EM7**	CE6811	1101835	kWh	n/a	± 1 %	n/a	n/a	
Electricity meter #8	**TS #11, EM8**	CA3U-I670M	036179	kWh	n/a	± 2 %	n/a	n/a	

Electricity meter #9	**TS #11, EM9**	CA3U-I670M	036398	kWh	n/a	± 2 %	n/a	n/a	
Electricity meter #10	**TS #11, EM10**	CE6811	1100997	kWh	n/a	± 1 %	n/a	n/a	
Electricity meter #11	**TS #11, EM11**	CECE6805B	139101	kWh	n/a	± 1 %	n/a	n/a	
Electricity meter #12	**TS #11, EM12**	CE6805	42063935	kWh	n/a	± 1 %	n/a	n/a	
Electricity meter #13	**TS #11, EM13**	CE6811	1101889	kWh	n/a	± 1 %	n/a	n/a	
Kiln power consumption									
Electricity meter #14	**CDS, EM14**	CA3U-I670M	067590	kWh	n/a	± 2 %	n/a	n/a	
Electricity meter #15	**CDS, EM15**	CA3U-I670M	985999	kWh	n/a	± 2 %	n/a	n/a	
Electricity meter #16	**CDS, EM16**	CA3U-I670M	653903	kWh	n/a	± 2 %	n/a	n/a	
Electricity meter #17	**CDS, EM17**	CA3U-I670M	887602	kWh	n/a	± 2 %	n/a	n/a	
Electricity meter #18	**CDS, EM18**	CA3U-I670M	946051	kWh	n/a	± 2 %	n/a	n/a	

Electricity meter #19	**CDS, EM19**	CA3U-I670M	881423	kWh	n/a	± 2 %	n/a	n/a	
Electricity meter #20	**CDS, EM20**	CA3U-I670M	890941	kWh	n/a	± 2 %	n/a	n/a	
Electricity meter #21	**CDS, EM21**	CA3U-I670M	891248	kWh	n/a	± 2 %	n/a	n/a	
Electricity meter #22	**CDS, EM22**	CA3U-I670M	176118	kWh	n/a	± 2 %	n/a	n/a	
Electricity meter #23	**CDS, EM23**	CA3U-I670M	259271	kWh	n/a	± 2 %	n/a	n/a	
Electricity meter #24	**CDS, EM24**	CA3U-I670M	322890	kWh	n/a	± 2 %	n/a	n/a	
Electricity meter #25	**CDS, EM25**	CA3U-I670M	618297	kWh	n/a	± 2 %	n/a	n/a	
Electricity meter #26	**CDS, EM26**	CA3U-I670M	132743	kWh	n/a	± 2 %	n/a	n/a	
Electricity meter #27	**CDS, EM27**	CA3U-I670M	074823	kWh	n/a	± 2 %	n/a	n/a	

Table 6: Power meters

Slag weight feeder

Equipment	Variable	Unit	Producer/type	Serial number	Installation date	Calibration frequency	Accuracy	Comments
Slag weigh feeder #1		t	Schenck Multidos MTD1020	V038534.B01	2004	On manufacture necessity	± 0,5 %	Slag supply of kiln #1 and kiln #2

Table 7: Slag weight feeder

Flow meters of slurry

Equipment	Unit	Producer/type	Serial number	Installation date	Last calibration	Next calibration	Accuracy	Comments
Flow meter #1	m^3/h	Yokogawa, AXF150	S5E607296 526	n/a	08/11/2010	08/11/2012	± 0.04 %	Rotary kiln #1
Flow meter #2		Yokogawa, AXF150	S5GB01610 743	n/a	08/11/2010	08/11/2012	± 0.26 %	Rotary kiln #2

Table 8: Flow meters of slurry supplied to the kilns

B.1.3. Calibration procedures:

For natural gas flow meters

QA/QC procedures	Body responsible for calibration and certification
Calibration interval is determined by business necessity. Regular cross-checks with commercial metered data are performed.	Plant internal service

For power meters

QA/QC procedures	Body responsible for calibration and certification
Calibration interval is determined by business necessity. Regular cross-checks with	Plant internal service

commercial metering data are performed.	

For weigh feeders

QA/QC procedures	Body responsible for calibration and certification
Calibration interval of such equipment is not specified and is performed on technical demand.	Plant internal service

For slurry flow meters

QA/QC procedures	Body responsible for calibration and certification
Calibration interval of such meters is 2 years.	Plant internal service

B.1.4. Involvement of Third Parties:

Ukrainian Centre for Standardization and Metrology
Gas distribution company “Gasprомzbut Ukraine”;
Coal distribution company “Kremenchukpropangaz”;
Coal distribution company “Ukrenergy Coal ltd”

B.2. Data collection (accumulated data for the whole monitoring period):

B.2.1. List of fixed default values:

Data variable	Source of data	Data unit	Value	Comment
EF_{NG} emission factor of the NG combustion process	IPCC 2006[6]	tCO2/GJ	0.0561 tCO2/GJ	IPCC 2006 default value for natural gas combustion Volume 2 "Energy" Chapter 2 "Stationery combustion" Table 2.3
EF_{Coal} emission factor of the coal combustion process	IPCC 2006	tCO2/GJ	0.0983 tCO2/GJ	IPCC 2006 default value for anthracite combustion Volume 2 "Energy" Chapter 2 "Stationery combustion" Table 2.3
EF_{el} CO2 emission factor for electricity consumed from the grid during the project activity	According to the «Standardized emission factors for the Ukrainian electricity grid". See Annex 2 to PDD ver5.0 from 20 September 2010	tCO2/MWh	0.896 tCO2/MWh	

Table 9: Baseline and Project fixed default values

Data variable	Source of data	Data unit	Value	Comment
CaO_{RM_Bsl} baseline ex ante contents of non-carbonated CaO in the raw meal	Baseline information	Tons non-carbonated CaO in ton of raw meal	0	See PDD ver.5.0, Section B.1

[6] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf

MgO_{RM_Bsl} baseline ex ante contents of non-carbonated MgO in the raw meal	Baseline information	Tons non-carbonated MgO in ton of raw meal	0	See PDD ver.5.0, Section B.1
CaO_{CLNK_Bsl} baseline ex ante contents of CaO in the clinker	Baseline information	Tons of CaO in ton of clinker	0.6524	See PDD ver.5.0, Annex 2.
MgO_{CLNK_Bsl} baseline ex ante contents of MgO in the clinker	Baseline information	Tons of MgO in ton of clinker	0.0181	See PDD ver.5.0, Annex 2.
KE_{BSL} Baseline kiln efficiency	Baseline information	GJ/ton of clinker	6.08	See PDD ver.5.0, Annex 2.
$ELSP_{coalmill,y}$ Specific electricity consumption for coal milling and coal conveying in year *y*	Baseline information	MWh/ton of coal	0,017 MWh/ton of coal	See PDD ver.5.0, Annex 2.

Table 10: Baseline ex-ante factors

B.2.2. List of variables:

Data variable	**Data unit**	**Method of monitoring**	**Meters used for calculation**
$CLNK_y$ Volume of annual clinker production in year *y*	Tons	Sum of daily kiln production reports	Slag weight feeders, slurry flow meters
RM_y Annual RM consumption in year *y*	Tons	Calculated by use of data from slurry flow meters and slag weigh feeder.	Slag weight feeders, slurry flow meters
$CaO_{CLNK,y}$ Average annual contents of CaO in the clinker in year *y*	Tons CaO in ton of clinker	Weighted average made on monthly basis laboratory measurements	Chemical analysis made at plant chemical lab according to DSTU B V.2.7-202:2009
$MgO_{CLNK,y}$	Tons MgO in	Weighted average made on monthly	Chemical analysis made at plant chemical lab according to

Annual average contents of MgO in the clinker in year *y*	ton of clinker	basis laboratory measurements	DSTU B V.2.7-202:2009
$CaO_{RM, y}$ Annual average contents of CaO in the raw meal in year *y*	Tons CaO in ton of RM	Calculated using weighted average of CaO content in slurry and slag made on monthly basis laboratory measurements	Chemical analysis made at plant chemical lab according to DSTU B V.2.7-202:2009
$MgO_{RM, y}$ Annual average contents of MgO in the raw meal in year *y*	Tons MgO in ton of RM	Calculated using weighted average of MgO content in slurry and slag made on monthly basis laboratory measurements	Chemical analysis made at plant chemical lab according to DSTU B V.2.7-202:2009
$FC_{coal, y}$ Kiln coal consumption in year *y*	Tons	Measured by coal weigh feeders	$FC_{coal, y}$ = WF1+WF2 (see Table 5)
$FC_{NG, y}$ Kiln NG consumption in year *y*	Thousands normalized m^3	Measured by gas flow meters	$FC_{NG, y}$ = GM1 (see Table 4)
$FC_{heat\_gen, y}$ Fuel consumption for drying of coal in year *y*	Thousands normalized m^3	Measured by gas flow meters	$FC_{heat\_gen, y}$ =GM2 (see Table 4)
$NCV_{coal, y}$ Net calorific values of coal used in year *y* (annual average) [2]	GJ/ton.	Coal laboratory certificates	SGS laboratory provides NCV certificate on each shipment of coal.
$NCV_{NG, y}$ Net calorific values of natural gas used in year *y* (annual average)	GJ/1000 normalized m^3	Gas laboratory certificates	Gas laboratory provides NCV certificate on monthly basis;
$EL_{slag, y}$ Grid electricity consumption for slag drying and conveying in year *y*	MWh	Calculated based on specific power consumption for slag drying	Slag weight feeder
EL_y Specific electricity consumption of equipment for raw meal preparation and wet kilns operation in year *y*	MWh/ton of clinker	Calculated using amount of electricity consumed for clinker production and volume of annual clinker production	EL_y= ∑(EM5........EM27)/$CLNK_y$ (see Table 6)
$FC_{slag, y}$ Fuel consumption of slag dryer in year *y*	GJ	Calculated using amount of natural gas combusted for slag drying	$FC_{slag, y}$ =GM3*$NCV_{NG, y}$ (see Table 4)

Table 11: Project monitored variables

B.2.3. Data concerning GHG emissions by sources of the project activity:

Variable	Description	Unit	2009	2010	2011[7]
$CLNK_y$	Clinker production in the year y	Ton	471025	491620	108830
RM_y	Consumption of raw meal in y	Ton	763492	797630	173127
$CaO_{CLNK,y}$	Average annual contents of CaO in the clinker in the year y	Tons CaO in ton of clinker	0.6551	0.6516	0.64923
$MgO_{CLNK,y}$	Average annual contents of MgO in the clinker in the year y	Tons MgO in ton of clinker	0.0153	0.0176	0.018566
$CaO_{RM,y}$	Annual average contents of non-carbonated CaO in the raw meal in the year y	Tons CaO in ton of RM	0.0034	0.00045	0.00244
MgO_{RMy}	Annual average contents of non-carbonated MgO in the raw meal in the year y	Tons MgO in ton of RM	0.00036	0.000054	0.000266
$FC_{NG, y}$	Kiln NG consumption in the year y	Thousands normalized m^3	77238,36	36684,392	593,522
$FC_{coal, y}$	Kiln coal consumption in y	Ton	-	65524,63	23184,56
$FC_{slag,y}$	Consumption of NG for slag drying in the year y	Thousands normalized m^3	88547	12266	16309
$FC_{heat\_gen,y}$	Consumption of NG for coal drying in the year y	Thousands normalized m^3	-	861846	341207
EL_y	Power consumption for clinker production including raw meal preparation and fuel preparation in the year y	GCal/1000 normalized m^3	0,08303	0,08873	0,1077
$NCV_{NG\ y}$	Average net calorific value of natural gas in the year y	MWh/t	8.1547	8.127	8.1083
$NCV_{coal\ y}$	Average net calorific value of coal in the year y	GCal/t	-	6.5081	6,5768
$EL_{slag, y}$	Grid electricity consumption for slag drying in the year y	MWh	53,1	53,1	8,4
$EL_{coalmill, y}$	Grid electricity consumption for coal milling in the year y	MWh	N/A[8]	1114	394

Table 12: Project monitored variables

B.2.4. Data concerning GHG emissions by sources of the baseline:

Variable **Description** **Unit** **Value**

[7] From 01.01.2011 to 31.03.2011

[8] During 2009 only natural gas was used as a fuel

$CaO_{\text{CLNK,Bsl}}$	Average annual contents of CaO in the clinker	Tons CaO in ton of clinker	0.6524
$MgO_{\text{CLNK,Bsl}}$	Average annual contents of MgO in the clinker	Tons MgO in ton of clinker	0.0181
KE_{BSL}	Baseline kiln efficiency	GJ/ton of clinker	6.08
$ELSP_{coalmill, y}$	Specific electricity consumption for coal milling and coal conveying in year y	MWh/ton of coal	0,017
$FSP_{heat\_gen, i, 2010}$	Specific fuel consumption of coal mill heat generator for coal drying in 2010	GJ/ton of coal	0,447
$FSP_{heat\_gen, i, 2011}$	Specific fuel consumption of coal mill heat generator for coal drying in 2011[9]	GJ/ton of coal	0,499

Table 13: Data used in the baseline scenario

B.2.5. Data concerning leakage:

No leakage has been identified in PDD; therefore this section is not applicable.

B.2.6. Data concerning environmental impacts:

Cement production has certain impact on the local environment. In Ukraine emission levels in industry are regulated by operating licenses issued by regional offices of the Ministry for Environmental Protection on the individual basis for every enterprise that has significant impact on the environment. The current levels of the emissions of the main pollutants (dust, sulphur oxides and nitrogen oxides), are in compliance with the requirements of the plant's operational license. The environmental impacts of the project are positive as the project expects to reduce the impact of the existing facility.

The allowance #15.10/11 from 06 April 2011 limiting the volume of wastes to be produced by PJSC Yugcement was issued by the State Administration of Environmental Protection of Mykolayiv oblast. The wastes resulted from plant activities should be temporary displaced within the plant’s area with further utilization or storage at landfills. Only entities that are licensed for operations with wastes should perform waste utilization.

The allowance #01-04/3372-06 from 11.06.2011 limiting the emissions into the atmosphere was issued by the State Administration of Environmental Protection of Mykolayiv oblast. This document requires that:

- The amount of emissions into the atmosphere must not exceed the designated level;
- The report on the monitoring of emissions should be issued on the quarter basis;
- The manufacturing works should be carried out according to the ecological requirements and restrictions;
- Maintenance, monitoring and troubleshooting of equipment used in manufacturing should be carried out on the constant basis;
- Gas-dust flow should be filtered;

[9] From 01.01.2011 to 31.03.2011

- Analysis of emissions should be carried out according to the designated schedule;
- Exploitation of the plant should be carried out according to all safety requirements.

The plant has obtained allowance #UKR 2820 A/NIK from 24 December 2008 issued by the State Administration of Environmental Protection of Mykolayiv oblast for special water utilization valid until 22 December 2011. It is stated that the plant is authorized for surface water intake from Yuzhniy Bug river and for water intake from one subsurface well. Resulting waste water is to be passed to municipal entity “Olshansky vodokanal” where the water is to be refined.

B.3. Data processing and archiving (incl. software used):

Fuel consumption

Fuel consumption is measured by gas meters and coal weight feeders as shown in Table 4 and Table 5. Responsible person collects data from meters on a daily basis. Afterwards the data are transferred to the energy department where they are processed and transferred to the financial department. Financial department is responsible for data storage in electronic and paper form.

Power consumption

Metering of power consumed for raw meal preparation and handling, operation of the kiln, including the auxiliaries and fuel handling is organized by 27 power meters (See table 6). All the data metered are transferred to the automatic control system of energy department where data are processed. From the energy department the data are transferred to financial department where they areprocessed using software “1C-Electricity” and stored in electronic and paper form.

CaO and MgO contents

CaO and MgO content in clinker and slurry is being periodically monitored by the use of chemical tests at the plant laboratory. The obtained data is transferred to the technology department where these data are stored and archived.

Raw meal consumption

RM consumption is constantly measured by weight feeders of slag and flow meters of slurry. The daily sum data are collected and transferred to the technology department and financial department where these data are stored and archived.

Clinker production

Clinker production is calculated based on constant metering of raw meal volume and chemical composition of RM (moisture and chemical composition are measured). Daily totals of clinker produced volumes are included in technology department daily reports. The data are transferred to the financial department where these are stored in electronic and paper form.

B.4. Special event log:

All special and exceptional events (critical equipment failures, reconstruction works, emergencies etc.) are documented by the special notes to the management of the company. The nature of the project and underlying operations does not foresee any factors that can cause unintended emissions due to emergencies. Possible emergencies can have impact on the continuation of operations (shutdowns) which will lead to a decreased number of ERUs which is, in turn, conservative.

SECTION C. Quality assurance and quality control measures

C.1. Documented procedures and management plan:

C.1.1. Roles and responsibilities:

Three departments of Yugcement will be responsible for collecting the information for monitoring purposes:

The laboratory of Yugcement
The laboratory of Yugcement is responsible for quality control of cement, clinker and raw components and performing their chemical analysis determining CaO and MgO content.

Energy department
The energy department is responsible for control of fuel and electricity consumption at Yugcement. This department is responsible for collecting and analyzing data from fuel meters. Also it collects data from the individual electricity meters installed at the production units that consume electricity, and the data of the commercial electricity meter that belongs to the regional power distribution company and measures the overall electricity consumption at the plant. The data from individual electricity meters is cross-checked with the data of the commercial meter. For the purposes of monitoring, the energy department will report electricity consumption level of the kiln system and the raw milling system, and provide it to the financial department.

Financial department
The financial department of the plant is responsible for accounting, controlling and planning. It will hold the overall responsibility for implementation of the monitoring plan, organizing and storing the data and providing necessary inputs for the calculation of the emission reductions. The financial department will also prepare the annual Monitoring Protocols, to be presented to a Verifier of the emission reductions. Other departments of Yugcement will submit relevant data to the financial department for the monitoring purposes. In addition to the preparation of the Annual Monitoring Protocols, the laboratory will conduct an internal audit annually to assess project performance and if necessary make corrective actions.

The general management of the monitoring team is implemented by the chief ecologist through coordinating activities. On-site day-to-day (operational) management is implemented by heads of corresponding units.

The data on fuel consumption as well as electricity consumption are collected in the department of chief energy officer and then transferred to the financial department.

The data of contents of CaO and MgO in clinker, ARM are collected in the plant laboratory that is certified for making analysis and supplied to the department of chief technologist. The data on raw meal consumption, clinker production, are collected in the department of chief technologist and together with the data from plant laboratory are supplied to the financial department.

Reporting procedures in place are approved by plant instructions which include, among others, daily collection and reporting of RM consumption, clinker and cement production, slag usage as raw material, fuels and power usage, chemical composition of RM, clinker and cement.

All data necessary for the CO_2 emission reductions calculation is collected in the ecology department by the chief ecologist. The calculation of emission reduction is made on a regular basis by Global-Carbon.
For this monitoring period the names of the personnel involved is as follows:

- Director of the plant;
- Production manager;
- Chief ecologist;
- Chief Process engineer;
- Chief energy officer;
- Head of laboratory;
- Head of maintenance;
- Head of mechanics;
- Financial department manager.

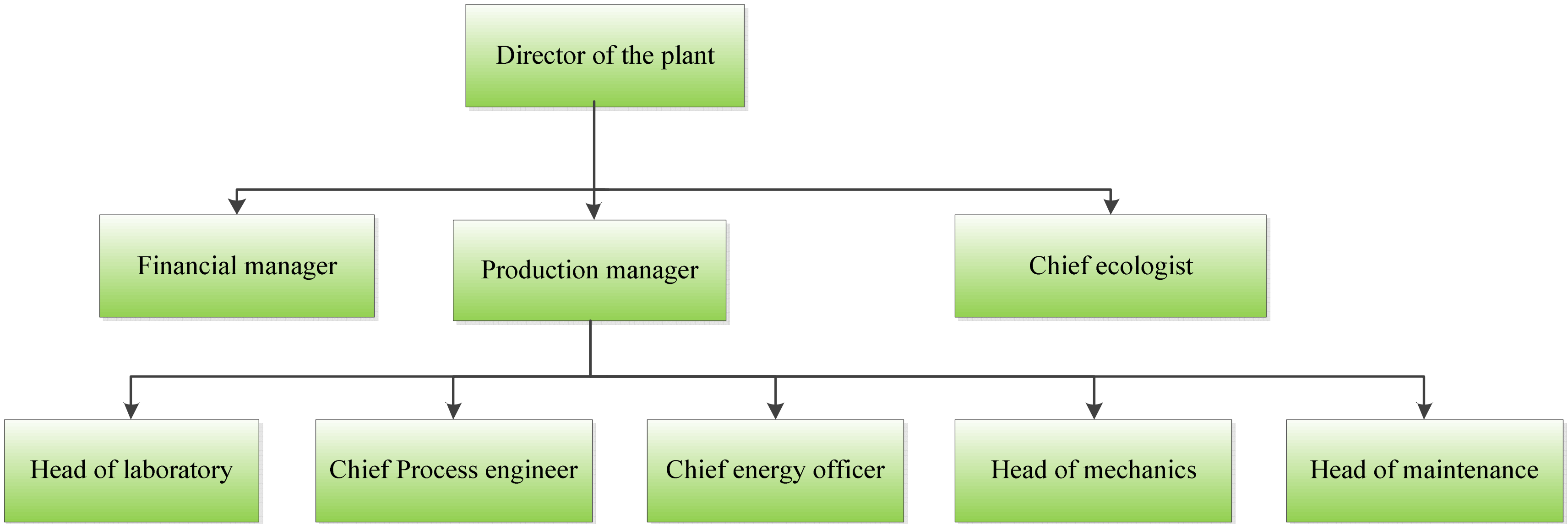

Figure 2: Positions and subordination

C.1.2. Trainings:

The personnel involved in maintenance and operation of equipment used has gone through safety and technical trainings necessary for correct operation. Special instruction was developed for ensuring professional development of plant workers. It is stated that workers can obtain internal (with experienced colleagues) or external (in educational centers) trainings. In case of external trainings the certificate is being issued after completion of the course. Internal trainings are carried out according to the schedule with resulting examination test.

C.2. Involvement of Third Parties:

The following third parties were involved in quality control and quality assurance during the monitoring period stated in the Section A.4:

The Ukrainian state body - Centre for Standardization and Metrology;
Coal SGS laboratory;
Natural gas laboratory of Kharkivtransgas.

C.3. Internal audits and control measures:

The internal quality system at Yugcement is functioning in accordance with the national standards and regulations in force. The quality of cement, clinker and all raw components is continuously controlled by the laboratory of the plant. The laboratory is certified by the Mykolayiv Regional State Metrology, Standardization and Accreditation Agency of Ukraine, certificate №PH-0032 /2010 from 08 April 2010.

The flows of materials (raw meal consumption, clinker production, cement production, slag consumption and other) are additionally audited by conducting of monthly inventory reports. This would allow for regular cross checking of values. All energy flows (electricity, coal and NG) are monitored by energy department.

C.4. Troubleshooting procedures:

Operational service is responsible for constant monitoring of device validity. In case of a of meter failure, it is being replaced by a similar meter. The consumption during meter failure period will be calculated using cross checking method. Operating hours, capacity, working load of equipment, data from other meters will be analyzed and used for estimations.

SECTION D. Calculation of GHG emission reductions

D.1. Table providing the formulae used:

Formula number from PDD	***Formula***	***Formula description***
Equation 1	$BE_y = BE_{Calcin,y} + BE_{FC,y} + BE_{EL,y} + BE_{Coal,y}$	Baseline emissions calculation (tCO2)
Equation 2	$BE_{Calcin,y} = \begin{pmatrix} 0.785 \times (CaO_{CLNK\_Bsl} \times CLNK_y - CaO_{RM\_Bsl} \times RM_y) + \\ +1.092 \times (MgO_{CLNK\_Bsl} \times CLNK_y - MgO_{RM\_Bsl} \times RM_y) \end{pmatrix}$	Baseline CO_2 emissions from calcinations of calcium carbonate and magnesium carbonate (tCO2)
Equation 3	$BE_{FC,y} = KE_{BSL} \times \frac{\sum_i (FC_{fuel\_i,y} \times NCV_{fuel\_i,y} \times EF_{fuel\_i})}{\sum_i (FC_{fuel\_i,y} \times NCV_{fuel\_i,y})} \times CLNK_y$	Baseline emissions due to kiln fuel combustion (tCO2)
Equation 4	$BE_{EL,y} = EF_{el,y} \times EL_y \times CLNK_y$	Baseline emissions due to electricity consumption for preparation of raw meal and kilns electricity consumption in year y (tCO_2)
Equation 5	$BE_{coal,y} = BE_{coal\_EL,y} + BE_{coal\_FC,y}$	Baseline emissions due to coal preparation (tCO2)
Equation 6	$BE_{coal\_el,y} = ELSP_{coalmill,y} \times FC_{coal\_BL,y} \times EF_{el,y}$	Baseline emissions due to electricity consumption for coal milling and conveying (tCO2)
Equation 7	$BE_{coal,FC,y} = \sum_i FSP_{heat\_gen,i,y} \times FC_{coal\_BL,y} \times EF_{fuel\_i}$	Baseline emissions due to fuel consumption by heat generator used for drying the coal in year y (tCO_2)
Equation 8	$FC_{coal\_BL,y} = KE_{BSL} \times CLNK_y$	Baseline consumption of coal by kilns in year y (tons)

Table 14: Formulae used for calculation in the Baseline scenario

Formula number from PDD	***Formula***	***Formula description***
Equation 9	$PE_y = PE_{calc,y} + PE_{kiln,y} + PE_{El,y} + PE_{coal,y} + PE_{slag,y}$	Project emission in year y (tCO_2)

Equation 10	$PE_{calc,y} = 0.785(CLNK_y \times CaO_{CLNK,y} - RM_y \times CaO_{RM,y}) + +1.092(CLNK_y \times MgO_{CLNK,y} - RM_y \times MgO_{RM,y})$	Project emission due to calcinations in year y (tCO_2)
Equation 11	$PE_{FC,y} = \sum_i FC_{fuel\_i,y} \times EF_{fuel\_i} \times NCV_{fuel\_i,y}$	Project emission from combustion of kiln fuels in year y (tCO_2)
Equation 12	$PE_{El,y} = EF_{el,y} \times EL_y \times CLNK_y$	Project emission due to fuel and electricity consumption for raw meal preparation (drying, milling, handling) and kiln electricity consumption (tCO_2)
Equation 13	$PE_{coal,y} = PE_{coal\_electr,y} + PE_{coal\_fuel,y}$	Project emission due to kiln fuel (coal) preparation (grinding, drying, conveying) in year y (tCO_2)
Equation 14	$PE_{coal\_electr,y} = EF_{el,y} \times EL_{Coalmill,y}$	Project emissions due to electricity consumption for coal milling and conveying (tCO_2)
Equation 15	$PE_{coal\_fuel,y} = EF_{fuel\_i} \times FC_{heat\_gen,y}$	Project emissions due to fuel consumption by heat generator used for drying the coal in year y (tCO_2)
Equation 16	$PE_{slag,y} = EL_{slag,y} \times EF_{el,y} + FC_{slag,y} \times EF_{fuel\_i}$	Project emission due to slag preparation in year y (tCO_2)

Table 15: Formulae used for calculation in the Project scenario

Formula number from PDD	***Formula***	***Formula description***
Equation 25	$ER_y = BE_y - PE_y$	Emission reduction of the JI project in year y (tCO_2e)

Table 16: Formulae used for calculation of emission reductions

D.2. Description and consideration of measurement uncertainties and error propagation:

The uncertainties related to project activity data (RM consumption, clinker production, consumption of energy and fuel, and the chemical composition of materials) can be considered low as described in IPCC Volume 3, Chapter 2 (mineral industry emissions), 2.2.2 Uncertainty assessment[10].

[10] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_2_Ch2_Mineral_Industry.pdf

D.3. GHG emission reductions (referring to B.2. of this document):

D.3.1. Project emissions:

Amount of GHG emissions of the Project scenario during the monitoring period is shown in a table below:

Project emissions PE_y	**2009**	**2010**	**2011**[11]
From calcination $PE_{calc,y}$	247719	260636	57287
From kiln fuel combustion $PE_{kiln,y}$	147947	243899	63239
From slag preparation $PE_{slag,y}$	217	30	39
From coal preparation $PE_{coal,y}$	0	2644	1002
From electricity consumption $PE_{EL,y}$	35042	38095	10149
Total for the year	**430925**	**545304**	**131716**
Total for the monitoring period			**1107945**

Table 17: Project emissions

D.3.2. Baseline emissions:

Amount of GHG emissions of the Baseline scenario during the monitoring period is shown in a table below:

Baseline emissions BE_y	**2009**	**2010**	**2011**[11]
From calcination $BE_{calc,y}$	250538	261545	57887
From kiln fuel combustion $BE_{FC,y}$	160661	242697	64674
From coal preparation $BE_{coal,y}$	0	3753	1026
From electricity consumption $BE_{EL,y}$	35042	38095	10149
Total for the year	**446241**	**546090**	**133736**
Total for the monitoring period			**1126067**

Table 18: Baseline emissions

[11] From 01.01.2011 to 31.03.2011

D.3.3. Leakage:

No leakage occurs. Not applicable.

D.3.4. Summary for the emission reductions during the monitoring period:

Emission reduction	**2009**	**2010**	**2011**[12]
ER y, tCO_2	15316	786	2020
Total for the monitoring period	**18122**		

Table 19: Emission reductions

[12] From 01.01.2011 to 31.03.2011

Annex 1

Definitions and acronyms

Acronyms:

ACS	Automatic control system
ARM	Alternative raw materials
BFS	Blast furnace slag
CDM	Clear Development Mechanism
CO_2	Carbon Dioxide
ERU	Emission Reduction Units
GHG	Greenhouse Gases
GJ	Gigajoule
IPCC	Intergovermental Panel on Climate Change
JISC	Joint Implementation Supervisory Committee
MWH	Megawatt Hour
NCV	Net calorific value
NG	Natural gas
PDD	Project Design Document
RM	Raw meal

Definitions:

Baseline	The scenario that reasonably represents what would have happened to greenhouse gases in the absence of the proposed project, and covers emissions from all gases, sectors and source categories listed in Annex A of the Protocol and anthropogenic Removals by sinks, within the project boundary.
Emissions reductions (ER)	Emissions reductions generated by a JI project that have not undergone a verification or determination process as specified under the JI guidelines, but are contracted for purchase.
Greenhouse gas (GHG)	A gas that contributes to climate change. The greenhouse gases included in the Kyoto Protocol are: carbon dioxide (CO2), Methane (CH4), Nitrous Oxide (N2O), Hydrofluorcarbons (HFCs), Perfluorcarbons (PFCs) and Sulphurhexafluoride (SF6).
Joint Implementation (JI)	Mechanism established under Article 6 of the Kyoto Protocol. JI provides Annex I countries or their companies the ability to jointly implement greenhouse gas emissions reduction or sequestration projects that generate Emissions Reduction Units.
Monitoring plan (MP)	Plan describing how monitoring of emission reductions will be undertaken. The monitoring plan forms a part of the Project Design Document (PDD).