JI MONITORING REPORT

VERSION 1.0 DATED 02 APRIL 2010

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SECTION A. General project activity information

A.1 Title of the project activity:

Usage of alternative raw materials at Kryvyi Rih Cement, Ukraine.

A.2. JI registration number: JI0194

A.3. Short description of the project activity:

The project is aimed at significant decrease of the emissions originating from calcination of raw materials in the clinker kiln at PJSC Heidelbergcement Ukraine (formerly Kryvyi Rih Cement plant). Emissions from calcination can be decreased by addition of alternative raw materials[1] (AMC) which do not contain carbonates. Such alternative materials are metallurgical slag of different types, ashes generated at power plants that use coal fuel.

Kryvyi Rih cement is the major cement producers in Central Ukraine. The plant is owned by HeidelbergCement, one of the world's leading producers of building materials. Kryvyi Rih Cement was built in 1952 and fully modernized in 1983. Since the modernization the plant uses dry production process – one rotary kiln with calciner and multistage cyclone system capable to produce approximately 1.0 to 1.1mln ton of clinker annually.

It was planned to increase step by step over 2 to 3 years the share of AMC in the raw material mix to approximately 20% by mass from the level of about 4% which was achieved before the project start in 2004. This level is taken for the baseline. To adopt such high proportion of AMC the composition of raw materials had been adjusted by increasing the number of components to keep the clinker chemical composition and quality within the required limits.

Conventional raw materials for clinker manufacturing are limestone and clay with addition of small amounts of correcting additives (ferrous oxide).

As stated in the plan, from 2004 blast furnace slag was being added into raw material mix, thus partially replacing the natural raw materials. The actual annual amount of slag added since the beginning of the project is presented in Table 1. The slag is being added into the raw mix, prior to raw mills, and mixed/milled together with other raw materials (limestone, clay, additives) prior to entering the clinker kiln. The slag being originated from blast furnace process had already passed the treatment at high temperature and does not contain calcium and magnesium carbonates. Therefore, during thermal processing in clinker kiln at high temperature it does not decarbonizes with emission of CO_2 like natural raw materials do. The more slag in the raw mill, the less CO_2 is emitted during burning of materials in the kiln (emission from calcinations).

A.4. Monitoring period:

- Monitoring period starting date: 01.01.2008 at 00:00;
- Monitoring period closing date:31.12.2009 at 24:00

[1] AMC is defined as de-carbonated materials (…), see ACM0015/version02

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

A.5.1. Baseline methodology: The "Guidance on criteria for baseline setting and monitoring", issued by the Joint Implementation Supervisory Committee allows using approved methodologies of the CDM. The PDD, determined by an AIE, uses a JI project specific approach to establish baseline scenario

A.5.2. Monitoring methodology: A JI-specific monitoring approach was developed for this project in line with the "Guidance on criteria for baseline setting and monitoring". The resulting Monitoring Plan was determined as part of the determination process.

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

The project implementation started within planned timeschedule. The actually achieved proportion of slag addition is presented in a table below:

Year	Clinker production	Slag addition percentage achieved
2004		11.51
2005		18.03
2006		20.62
2007		16.67
2008		**18.4**
2009		**20.4**

Table 1: Status ofproject implementationduring 2004 -2009

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

There are no deviation to the determined PDD

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

There is no deviations to the determined MP.

A.9. Changes since last verification:

Not applicable

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

PJSC Heidelbergcement

- Andrey Prekhrest, Chief technologist
- Luydmila Rudneva, Chief environmental officer

Global Carbon B.V.

- Alexey Doumik, Senior JI Consultant

SECTION B. Key monitoring activities according to the monitoring plan for the monitoring period stated in A.4.

Key monitoring activities for each subproject could be described as follows.

The emission sources in the project are:

- Emission due to fuel combustion (in the kiln and auxiliary combustion for material drying);
- Emissions from calcinations of raw materials at high temperatures in the kiln;
- Indirect emissions due to consumption of grid electricity.

The following paramerers are monitored in order to calculate the emissions:

Monitoring of kiln fuel consumption .
Cement plant has 1 kiln, which is operation for the whole year except for overhaul/maintenance shutdowns. The fuel during monitoring period stated in A.4. was natural gas.Gas consumption is constantly monitored by the two gas flow meters – one for the kiln burner and the second one for calciner of the kiln.

Monitoring of fuel consumption for pre-drying of raw materials and components
Some of the materials added into the kiln require drying prior to be mixed and put into the kiln. Such materials are slags used to partially substituted the natural raw materials. The drying of them is conducted in drying drums using NG as fuel. Gas consumption for drums is measured by gas meters.

Monitoring of the calorific values of fuels used
The fuel during monitoring period stated in A.4. was natural gas (NG). The NCV of NG has been monitored by the fuel certificates issued by the gas supplyer which have been regularly requested by cement plant on monthly basis.

Monitoring of electricity consumption for raw materials preparation and handling to kiln, for kiln operation and for fuel preparation and handling.
This consumption is used by the group of electricial meters.

Monitoring of CaO and MgO content in the clinker produced
Monitoring of oxides content in clinker is made by conducting regular chemical analisys in the plant laboratory.

Monitoring of non-carbonated CaO and MgO content in raw mill
Monitoring of non-carbonated content of these oxides in the raw mill is made by performing the chemical analysys of CaO and MgO content in alternative raw materials (AMC) added into raw mill, quantity of AMC added and further calculation to obtain the proportion of non-carbonated content of these oxides in the raw mill.

Monitoring of quantity of raw mill (RM) consumed by kiln
The weignt meters are used to monitor of the RM quantity supplied to the kiln

Monitoring of cliker quantity produced

B.1. Monitoring equipment:

The monitoring equipment can be devided into four groups: electrical meters, gaseous flow meters, weigth meters and laboratory chemical test equipment.

Gas meters

There are six gas meters used to measure the gas consumption as shown in Fig 1 below, the GM1 and GM2 are measuring the kiln fuel consumption, which includes also the calciner of the kiln, and the four meters GM3 to GM6 measure the consumption for raw materials drying.

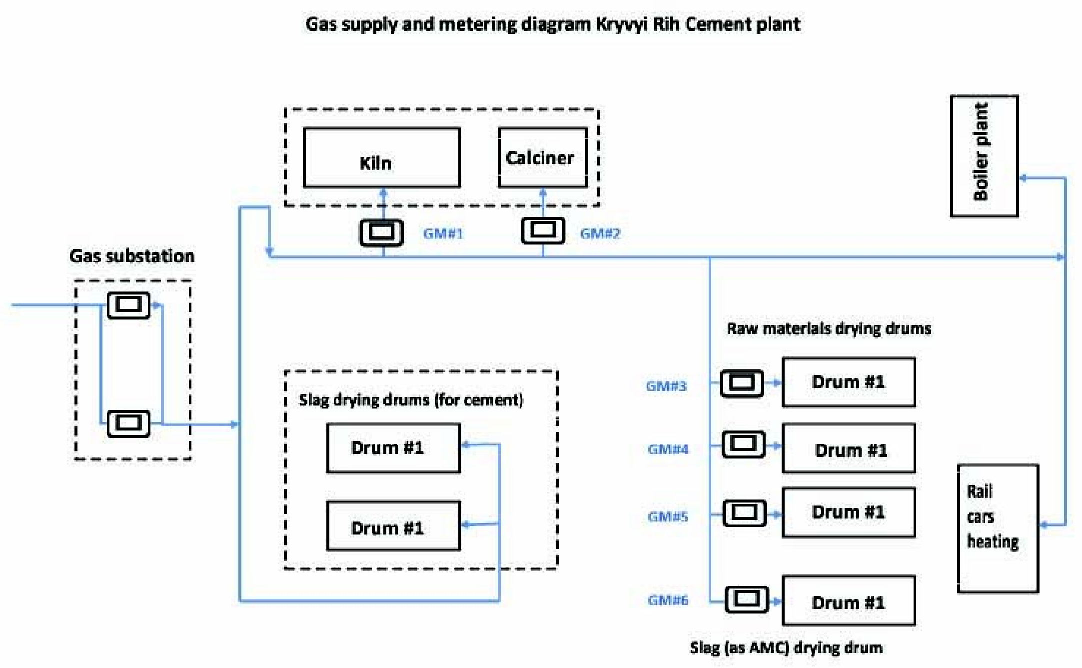


Figure 1. Gas supply and meteringdiagrame

Meters are connected to the PC allowing for monitoring and storage of data.

Gas meters GM3 to GM6 outputs (flow rate, pressure and temperature of the gas) are processed in electronic processors “UNIVERSAL” which converts the actual gas flow rate into normalized Nm^3 . The processors are connected to the PC allowing for monitoring and storage of data. The PC to which the data are logged and stored is installed in the departmet of chief power engineer.

The outputs of GM 1 nad GM2, including gas flow rate, pressure and temperature are logged in the server of kiln automation system where the normalization of gas flow rate in Nm^3 is performed and data are stored. The daily consumption data is transferred to the departmet of chief power engineer.

Power meters

To measure the total power consumption of raw material preparation chain (which includes mixing, milling grinding and handling to the kiln); kiln consumption and fuel preparation (if coal is used) the 23 meters are used installed at switchrooms #6, 7 and 8.

Weight meters

To monitor the consumption of raw mill fed into the kiln the weight feeders are used as shown in the Fugure 2 below.

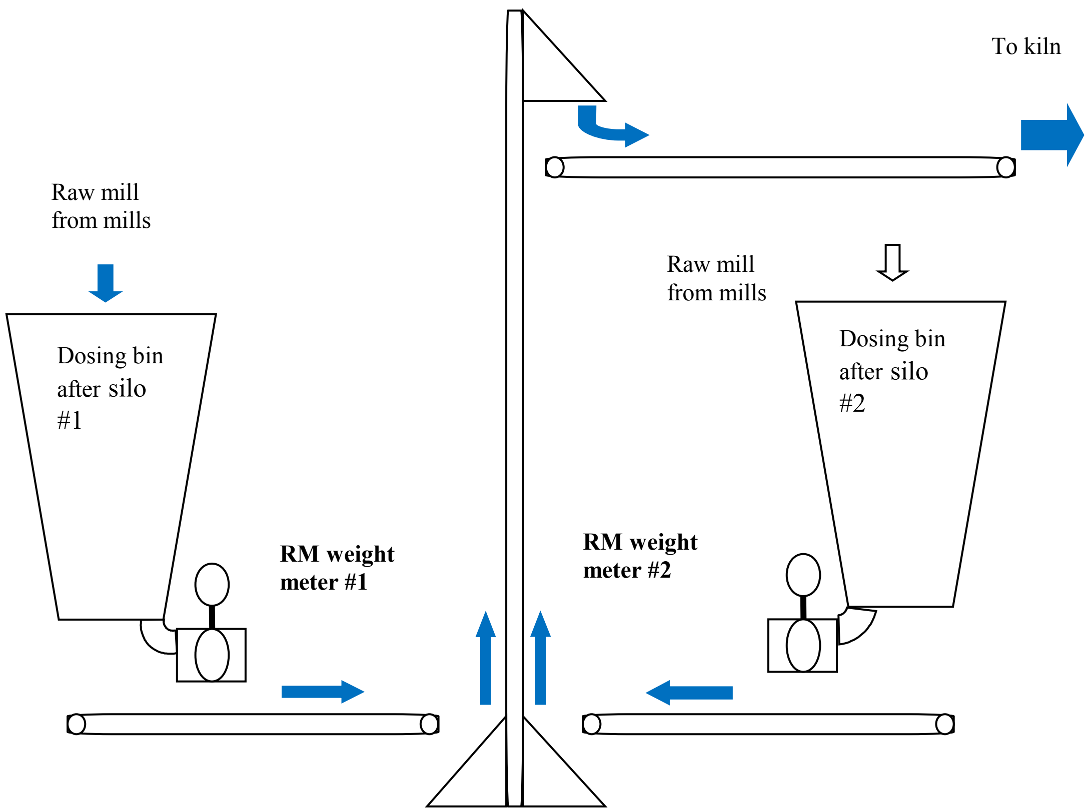


Figure 2. RM flow and measurement devices.

B.1.2. Table providing information on the equipment used (incl. manufacturer, type, serial number, date of installation, date of last calibration, information to specific uncertainty, need for changes and replacements):

Gas meters

Equipment	Variable	Unit	Producer/type	Serial number	Installation date	Last calibration	Next calibration	Accuracy	Comments
Gas meter #1	$FC_{i\ kiln,y}$	Nm3	ABB 265DS	6600031172	12/2007	12/1/2010	12/1/2011	± 0.1 %	Rotary kiln fuel consumption
Gas meter #2			ABB 265DS	6600031173	12/2007	12/1/2010	12/1/2011	± 0.1 %	Calciner of the kiln fuel consumption
Gas meter #3	$FC_{drums,y}$	Nm^3	ABB 2600	6404031065	12/2009	12/1/2009	12/1/2011	± 0.1 %	NG consumption drum#1
Gas meter #4			ABB 2600	6404031066	12/2009	12/1/2009	12/1/2011	± 0.1 %	
Gas meter #5			ABB 2600	6404031063	12/2009	12/1/2009	12/1/2011	± 0.1 %	
Gas meter #6			ABB 2600	6404031068	12/2009	12/1/2009	12/1/2011	± 0.1 %	

Table 2: Gas meters

Power meters

($EL_{RM,\ kiln,\ y}$)

Equipment	Location/ meter abbreviation	Manufacturer/ type	Serial number	Unit	Installation date	Accuracy	Last calibration	Next calibration	Comments
Power consumption for drying of raw materials in drying drums									
Consumption of draft fan №1, 6kV	SR8, cubicle14/ **EM1**	Elster-Metronica EA05RL-B-4	1090927	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	

Consumption of draft fan №2, 6kV	SR8 cubicle15/ **EM2**	Elster-Metronica EA05RL-B-4	1090909	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
Consumption of draft fan №3, 6kV	SR8 cubicle16/ **EM3**	Elster-Metronica EA05RL-B-4	1090893	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
Consumption of draft fan №4, 6kV	SR8 cubicle17/ **EM4**	Elster-Metronica EA05RL-B-4	1090951	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
Concumption of 0.4 kV dryer drums auxiliaries TS17 TR#1	SR8 cubicle27/ **EM5**	Elster-Metronica EA05RL-B-4	1090943	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
Concumption of 0.4 kV dryer drums auxiliaries TS16TR#2	SR8 cubicle20/ **EM6**	Elster-Metronica EA05RL-B-4	1090965	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
Consumption for raw materials milling									
Consumption of raw mill #1 at 6 kV	SR7 cubicle15/ **EM7**	Elster-Metronica EA05RL-B-4	1090925	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
6 kV fan of raw mill #1consumption	SR7 cubicle17/ **EM8**	Elster-Metronica EA05RL-B-4	1090947	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
Consumption of raw mill #2 at 6 kV	SR7 cubicle16/ **EM9**	Elster-Metronica EA05RL-B-4	1090917	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
Consumption of 6 kV fan of raw mill #2	SR7 cubicle20/ **EM10**	Elster-Metronica EA05RL-B-4	1090933	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
Consumption of 0.4 kV auxiliaries of raw mills at TS13/TR#1	SR7 cubicle23/ **EM11**	Elster-Metronica EA05RL-B-4	1090962	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
Consumption of 0.4 kV auxiliaries of raw mills at TS13/TR#2	SR7 cubicle26/ **EM12**	Elster-Metronica EA05RL-B-4	1090920	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	

Kiln power consumption										
Consumption of kiln main drive #1	SR6 cubicle14/ **EM13**	Elster-Metronica EA05RL-B-4	1090896	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
Consumption of kiln main drive #2	SR6 cubicle5/ **EM14**	Elster-Metronica EA05RL-B-4	1090954	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
Consumption of kiln end draft fan	SR7 cubicle27/ **EM15**	Elster-Metronica EA05RL-B-4	1090950	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
Consumption of aspiration fan #1	SR6 cubicle15/ **EM16**	Elster-Metronica EA05RL-B-4	1090906	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
Consumption of aspiration fan #2	SR6 cubicle24/ **EM17**	Elster-Metronica EA05RL-B-4	1090974	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
6 kV consumption of afterkiln fan	SR9 cubicle7/ **EM18**	Elster-Metronica EA05RL-B-4	1090923	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
0.4 kV consumption of afterkiln fan	SR9 cubicle2/ **EM19**	Elster-Metronica EA05RL-B-4	1090963	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
0.4 kV consumption of kiln auxiliaries from TS11/TR#1	SR6 cubicle7/ **EM20**	Elster-Metronica EA05RL-B-4	1090938	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
0.4 kV consumption of kiln auxiliaries from TS11/TR#2	SR6 cubicle12/ **EM21**	Elster-Metronica EA05RL-B-4	1090930	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	
0.4 kV consumption of kiln auxiliaries from TS14/TR#1	SR7 cubicle25/ **EM22**	Elster-Metronica EA05RL-B-4	1090920	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	

0.4 kV consumption of kiln auxiliaries from TS14/TR#2	SR7 cubicle28/ **EM23**	Elster-Metronica EA05RL-B-4	1090920	kWh	2004	± 0.5 %	1/9/2004	1/9/2010	

Table 3: Power meters

Weight meters for raw mill

Equipment	Variable	Unit	Producer/type	Serial number	Installation date	Calibration frequency	Accuracy	Comments
RM weight meter #1	RM_y	tonnes	Shenk Process, Multistream G400	06186	11/02/2003	Each 2 months	± 1 %	
RM weight meter #2				06187	11/02/2003			

Table 4: Rawe mill weight meters

B.1.3. Calibration procedures:

For Natural Gas Meters

QA/QC procedures	Body responsible for calibration and certification
Calibration interval of such meters is 2 years.	Ukrainian Centre for Standardization and Metrology

For power meters

QA/QC procedures	Body responsible for calibration and certification
Calibration interval of such meters is 6 years.	Ukrainian Centre for Standardization and Metrology

B.1.4. Involvement of Third Parties:

Ukrainian Centre for Standardization and Metrology
Gas distribution company "Kryvyi Rig city gas"

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

Ukrainian Centre for Standardization and Metrology

B.2.1. List of fixed default values:

Data variable	Source of data	Data unit	Comment
EF_{NG}, emission factor of the NG burning process	IPCC 2006	tCO2/GJ	IPCC 2006 default value = 0.561 tCO2/GJ
$EF_{el,y}$, Standardized emission factor of the Ukrainian grid for reducing project	See Annex 4 of PDD	tCO2/MWh	= 0.896 tCO2/MWh

Table 5: Project fixed default values

Data variable	Source of data	Data unit	Comment
EF_{NG}, emission factor of the NG burning process	IPCC 2006	tCO2/GJ	IPCC 2006 default value = 0.561 tCO2/GJ
$EF_{el,y}$, emission factor of the Ukrainian grid for reducing project	See Annex 4	tCO2/MWh	= 0.896 tCO2/MWh

Table 6:Baseline fixed default values

Data variable	Source of data	Data unit	Comment
$CLNK_{Bsl}$ the baseline ex-ante annual clinker production volume	Baseline information	tonnes	See PDD, Annex 2. = 738 567 tonnes
RM_{Bsl}	Baseline	tonnes	See PDD, Annex 2.

the baseline ex ante annual consumption of raw mill for clinker production	information		= 1163977 tonnes
CaO_{RM_Bsl} baseline ex ante contents of non-carbonated CaO in the raw mill	Baseline information	Tonnes non-carbonated CaO in tonne of raw mill	See PDD, table 25 Annex 2. = 1.61% or 0.016 tonnes of non-carbonated CaO/ton of raw mill
MgO_{RM_Bsl} baseline ex ante contents of non-carbonated MgO in the raw mill	Baseline information	Tonnes non-carbonated MgO in tonne of raw mill	See PDD, table 25 Annex 2. = 0.212% or 0.00212 tonnes of non-carbonated MgO/ton of raw mill
CaO_{CLNK_Bsl} baseline ex ante contents of CaO in the clinker	Baseline information	Tonnes of CaO in tonne of clinker	See PDD, table 25 Annex 2. = 65.67% or 0.6567 tonnes of CaO/ton of clinker
MgO_{CLNK_Bsl} baseline ex ante contents of MgO in the clinker	Baseline information	Tonnes of MgO in ton of clinker	See PDD, table 25 Annex 2. = 1.8% or 0.018 tonnes of MgO/ton of clinker
KE_{BSL} *baseline ex-ante kiln efficiency(specific fuel consumption)*	Baseline information	GJ/ton of clinker	See PDD, table 24 of Annex 2. = 3.67 GJ/ton of clinker
$EL_{RM, kiln, BSl}$ is the baseline ex ante specific power consumption for clinker production including raw mill preparation and fuel preparation	Baseline information	kWh/ton of clinker	See PDD, table 27 of Annex 2. =101.06 kWh/ton of clinker
$FC_{dry, Bsl}$ baseline consumption of fuel for raw materials drying and kiln fuel preparation	Baseline information	GJ	See PDD, table 26 of Annex 2. =169084
CKD_{Bsl} is the annual amount of cement kiln dust left the kiln system	Baseline information	tonnes	See SD3 Dust emissions estimate. = 657 tonnes
D_{Bsl} is the cement kiln dust		fraction	0.5

calcination rate			

Table 7:Baseline ex-ante factors

B.2.2. List of variables:

Data variable	**Data unit**	**Method of calculation**	**Meters used for calculation**
$CLNK_y$ the annual clinker production volume for the monitoring period stated in the A.5	tonnes	Sum of daily kiln production reports	
RM_y the annual RM consumption over the monitoring period stated in A.5	tonnes	Sum of daily RM production reports	Sum of RM1 + RM2 (see. Table 2)
$CaO_{CLNK,y}$ average annual contents of CaO in the clinker	Fraction - tonnes CaO in tonne of clinker	Weighted average made on montly basis laboratory measurements	Chemical analisys made at plant chemical lab according to GOST 5382 – 91
$MgO_{CLNK, y}$ annual average contents of MgO in the clinker	Tonnes MgO in tonne of clinker	Weighted average made on montly basis laboratory measurements	Chemical analisys made at plant chemical lab according to GOST 5382 – 91
$CaO_{RM, y}$annual average contents of CaO in the raw mill	Tonnes CaO in tonne of RM	Weighted average made on montly basis laboratory measurements	Chemical analisys made at plant chemical lab according to GOST 5382 – 91
$MgO_{RM, y}$ annual average contents of MgO in the raw mill	Tonnes MgO in tonne of RM	Weighted average made on montly basis laboratory measurements	Chemical analisys made at plant chemical lab according to GOST 5382 – 91
$FC_{i, y}$ kiln fuel consumption of type i in year y[2]. For the monitoring period stated in the A.5 only NG was used as fuel	Thousands nm^3	Measuring by gas meters	$FC_{i, y}$ = GM1+GM2 (see Table 2)

[2] For the monitoring period stated in the A.5 only NG was used as fuel.

$FC_{drums,y}$ Fuel consumption for drying of RM and kiln fuel in year y	Thousands nm^3	Measuring by gas meters	$FC_{drums,y}$ =GM3+GM4+GM5+GM6 (see Table 2)
$NCV_{i,y}$ net calorific values of fuels used in year y (annual average)	Gas supplier monthly certificate	GJ/1000 Nm^3. NCV given in the certificates in kcal/1000nm^3 is further converted into GJ/1000nm^3 using multiplication factor of 4.187[3]	Gas supplier provides the NCV certicicated on monthly basis
SKC_y	GJ/ton of clinker	Calculated as ratio of sum of $FC_{i,y}xNCV_{i\,y}$ and clinker produced $CLNK_y$	
$EL_{RM,\,kiln,\,y}$ is the annual power consumption for clinker production including raw mill preparation and fuel preparation	kWh	Measurement by power meters	$EL_{RM,\,kiln,\,y}$= ∑(EM1........EM23), see Table 3
CKD_y is the annual amount of cement kiln dust leaving kiln system (discarded CKD)	tonnes	Periodical testing of kiln flue gases after dedusting units	Plant reporting according to state form 2-TP "Air pollutions" based on periodical flue gas sampling for dust content
d_y is the CKD calcinations rate	fraction		Default data

Table 8:Project monitored variables

B.2.3. Data concerning GHG emissions by sources of the project activity (referring to paragraph 53(a)):

Variable	Description	Unit	Value
Period: year 2008			
$CLNK_{2008}$	Clinker productin 2008	tonnes	1089300
RM_{2008}	Consumption of raw mill in 2008	tonnes	1655736
$CaO_{CLNK,2008}$	average annual contents of CaO in the clinker	tonnes CaO in tonne of clinker	0.6574
$MgO_{CLNK,2008}$	average annual contents of MgO in the clinker	tonnes MgO in tonne of clinker	0.0204
$CaO_{RM,2008}$	annual average contents of non-carbonated CaO in the raw mill	tonnes CaO in tonne of RM	0.0882
MgO_{RM2008}	annual average contents of non-carbonated MgO in the raw mill	tonnes MgO in tonne of RM	0.0095
$FC_{1,\,2008}$	kiln fuel consumption in 2008	Thousands nm^3	102233.240

[3] http://www.unitconversion.org/unit_converter/energy.html

$FC_{drums,2008}$	consumption of fuel for RM drying in 2008	Thousands nm^3	5793.671
$EL_{RM,\ kiln,\ 2008}$	power consumption for clinker production including raw mill preparation and fuel preparation in 2008	kWh	95223700
CKD_{2008}	Annual volume of cement kiln dust left the kiln system	tonnes	906
d_{2008}	CKD calcinations rate	fraction	0.5
$NCV_{NG\ 2008}$	Average net calorific value of gas in 2008	GCal/1000 nm^3	8.1768
Period: year 2009			
$CLNK_{2009}$	Clinker productin 2009	tonnes	689500
RM_{2009}	Consumption of raw mill in 2009	tonnes	1048040
$CaO_{CLNK,2009}$	average annual contents of CaO in the clinker	tonnes CaO in tonne of clinker	0.6586
$MgO_{CLNK,2009}$	average annual contents of MgO in the clinker	tonnes MgO in tonne of clinker	0.0195
$CaO_{RM,2009}$	annual average contents of non-carbonated CaO in the raw mill	tonnes CaO in tonne of RM	0.0882
MgO_{RM2009}	annual average contents of non-carbonated MgO in the raw mill	tonnes MgO in tonne of RM	0.0095
$FC_{1,\ 2009}$	kiln fuel consumption in 2009	Thousands nm^3	72745.571
$FC_{drums,2009}$	consumption of fuel for RM drying in 2009	Thousands nm^3	4740.456
$EL_{RM,\ kiln,\ 2009}$	power consumption for clinker production including raw mill preparation and fuel preparation in 2009	kWh	63131500
CKD_{2009}	Annual volume of cement kiln dust left the kiln system	tonnes	152
d_{2009}	CKD calcinations rate	fraction	0.5
$NCV_{NG\ 2009}$	Average net calorific value of gas in 2009	GCal/1000 nm^3	8.1321

Table 9: Data collected in the project scenario

B.2.4. Data concerning GHG emissions by sources of the baseline (referring to paragraph 53(b)):

Variable	Description	Unit	Value
$CLNK_{Bsl}$	Clinker productin in the baseline	tonnes	738 567
RM_{Bsl}	Consumption of raw mill in the baseline	tonnes	1163977
$CaO_{CLNK,Bsl}$	average annual contents of CaO in the clinker	tonnes CaO in tonne of clinker	0.6567
$MgO_{CLNK,Bsl}$	average annual contents of MgO in the clinker	tonnes MgO in tonne of clinker	0.018
$CaO_{RM,Bsl}$	annual average contents of non-carbonated CaO in the raw mill	tonnes CaO in tonne of RM	0.016
$MgO_{RM,Bsl}$	annual average contents of non-carbonated MgO in the raw mill	tonnes MgO in tonne of RM	0.00212
$FC_{drums,Bsl}$	consumption of fuel for RM drying in the baseline	GJ	169084
$EL_{RM,\ kiln,\ Bsl}$	Specific power consumption for clinker production including raw mill preparation and fuel preparation in the baseline	kWh/ton clinker	101.06
CKD_{Bsl}	Annual volume of cement kiln dust left the kiln system	tonnes	657

d_{Bsl}	CKD calcinations rate in the baseline	fraction	0.5

B.2.5. Data concerning leakage (referring to paragraph 53(c)):

Any leakage has been identified in the PDD, therefore this section is not applicable.

B.2.6. Data concerning environmental impacts (referring to paragraph 53(d)):

The project foresees usage of different types of metallurgical slag being in most cases a waste product for metallurgy. Usage of such AMC does not directly influence the plant pollutions.

Starting slag addition required fulfilling the separate assessment of environmental impact (OVNS in Ukrainian abbreviation).

Such assessment was performed in 2005 by the Special Design & Engineering Bureau "Cement" (Kharkiv, Ukraine). This OVNS has received positive decision of the State Authority on Environmental Protection in Dnipropetrovs'k Region (# 168, 12 July 2006) and of the Dnipropetrovs'k Regional Sanitary Epidemic Station (# 140, 14 March 2006).

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

<u>Fuel consumption</u>
Kiln fuel consumption uses two gas meters measuring the NG consumption of kiln main burner and the calciner burner as shown in Figure 1 and Table 2.
Fuel consumption for drying of raw materials and AMC is measured by four identical gas meters.
All the data collected, transferred to the monitoring system and stored . Responcible for data collection and storage is within the energy department.
<u>Power consumption</u>
Metering of power consumed for raw mill preparation and handling, operation of the kiln, including the auxialiaries is organized by 23power meters (See table 3). All the data metered are transferred to the monitoring system and stored. Responcible for data collection and storage is within the energy department.
<u>CaO and MgO contents</u>
CaO and MgO contents in clinker are being periodically (daily) measured by chemical test at plant laboratory as a part of quality assurance procedure. Data are stored and arhived.
Non-carbonated CaO and MgO contents in raw meal are calculated at chemical laboratory on monthly basis using the result of chemical tests of all AMC added during the period and amounts of each types of AMC.
<u>Raw mill consumption</u>
RM consumption is measured constantly by weight meters (see Table 4) and daily sum data are collected and stored by kiln department in daily reports. Based on daily data, monthly and annual reports are prioduced and stored.
<u>Clinker production</u>
Clinker production is calculated based on constant metering of raw mill volume and chemical composition of RM (moisture and chemical composition measured my on-line x-ray spectrometer). Daily sum of clinker produced volumes are included in kiln department daily reports. Based on daily data, montly and annual reports are produced.
CKD volume

The annual volume of CKD leaving the kiln system is obtained by regular testing (4 times a year) of dust contents in kiln exhaust gases after the dedusting units. The data are collected and included in the state reporting form 2-TP "Air pollution".

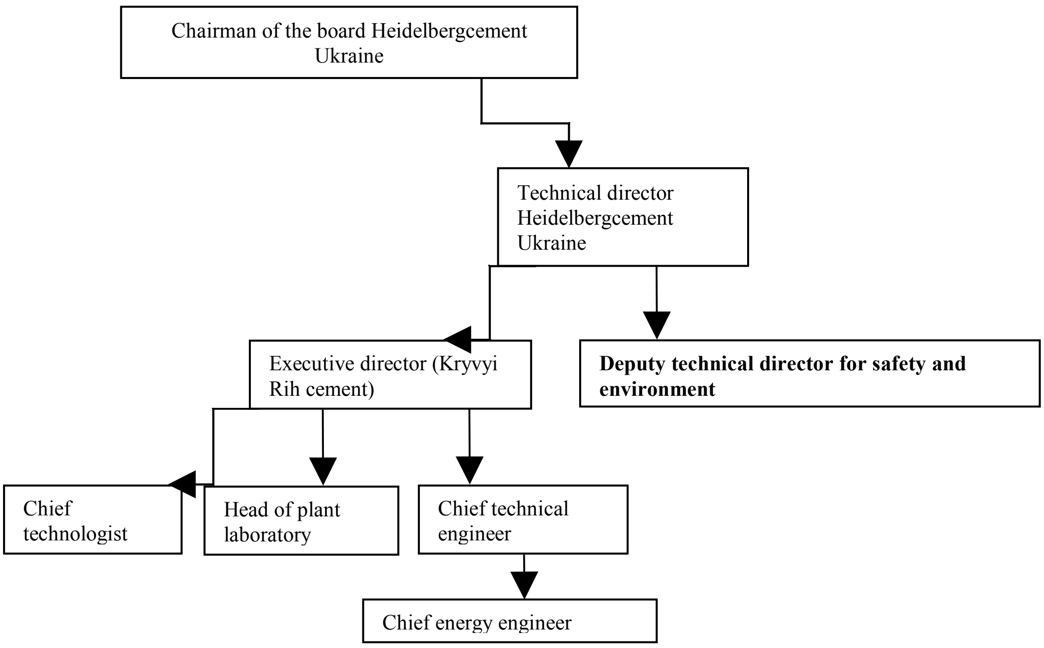
B.4. Special event log:

SECTION C. Quality assurance and quality control measures

C.1. Documented procedures and management plan:

C.1.1. Roles and responsibilities:

The general management of the monitoring team is implemented by the Deputy Technical Director for safety and environment through coordinating activities. On-site day-to-day (operational) management is implemented by the heads of corresponding units.
The data on fuel consumption by kiln and by RM dryind drums, as well as the electricity consumption of RM and kiln are collected in the department of chef energy engineer and then transferred to the department of Deputy technical director for safety and environment.
The data of contents of CaO and MgO in clinker, AMC are collected in the plant laboratory and supplied to the department of chief technologist. The data on raw mill consumption, clinker production, are collected in the department of chief technologist and together with the data from plant laboratory are supplied to the department of Deputy technical director for safety and environment.



All data necessary for the CO_2 emission reductions calculation is collected in the department of Deputy technical director for safety and environment. The calculation of emissions reduction are made on a yearly basis.

For this monitoring period the names of the personnel involved is as follows:

- Executive director of Kryvy Rih cement plant : Olexiy Turyvnyi;
- Deputy technical director for safety and environment: Lyudmila Rudneva;

- Chief technologist; Andriy Perekhrest;
- Chief energy officer: Valery Thorenko;
- Head of laboratory: Natalya Kravchenko.

C.1.2. Trainings:

All the equipment supplied foresaw personnel training as a separate contract clause. Training is providing by manufacturers. Technical and scientific support is being regularly provided to Kryvyy Rih plant by Heidelberg Technical Centre, a research unit responcible for new technologies/projects implementation support within the Heidelbergcement group worldwide.

C.2. Involvement of Third Parties:

The Ukrainian state body - Centre for Standardization and Metrology is a Third Party involved.

C.3. Internal audits and control measures:

The flows of materials (raw meal consumption, clinker production, cement production, slag consumption and other) are additionally audited by conducting of monthly inventarisation. This would allow for regular cross checking of values. All energy flows (electricity and NG) are logged on the server at Energy department.
Internally , the CO_2 emissions calculation are being performed regularily on the annual basis as a part of “CO_2 Protocol”, a commonly used reporting tool in world cement industry.
For the purpose of monitoring of emissions reductions in a JI project JI0194 a calculations are made in accordance with the Monitoring plan in PDD.

C.4. Troubleshooting procedures:

In accordance with standard cement producer practice the department of chief technologist prepares a daily report which includes:cement production, clinker production, RM consumption, consumption of kiln and auxiliary fuels, consumption of electricity, specific consumption of fuel per ton of clinler (Kiln Efficiency), specific consumption of electricity per ton of cement produced, CaO and MgO contents and other data.
In case of a falure of any meter, the latter is being replaced by an operational one. The consumption during meter failure period will be calculated using cross checking method.

SECTION D. Calculation of GHG emission reductions

D.1. Table providing the formulas used:

See section D.3 for description of formulae used for calculation of baseline, project emissions and resulting emissions reduction for the monitoring period stated in A.4.1.

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

The uncertainces related to acticity data (RM consumption, clinker production, consumption of energy and fuel) as well as 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.
The higher uncertainty asosiated with the calcination rate of discarded CKD, however does not present material influence on the resulting emissions due to very low volume of CKD discarded.

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

D.3.1. Project emissions:

The project emissions are calculated according to the forlmulae described below:

$$PE_y = PE_{calc,y} + PE_{Fuel\_kiln,y} + PE_{dust,y} + PE_{dry,y} + PE_{EL\_grid,y} \quad \textbf{(1)}$$

Where:

PE_y	Project emission in year y, (tCO_2)
$PE_{calc,y}$	Project emission due to raw mill calcination in year y (tCO_2)
$PE_{Fuel\_kiln,y}$	Project emission from combustion of kiln fuels in year y (tCO_2)
$PE_{dust,y}$	Project emission due to discarded dust from kiln bypass and dedusting units in year y (tCO_2)
$PE_{dry,y}$	Project emission due to fuel consumption for raw meal drying and fuel preparation in year y (tCO_2)
$PE_{EL\_grid,y}$	Project emission due consumption of grid electricity for clinker production y (tCO_2)

Calcination

Emissions from calcinations is defined as follows:

$$PE_{calc,y} = 0.785(CaO_{CLNK,y} \times CLNK_y - CaO_{RM,y} \times RM_y) + 1.092(MgO_{CLNK,y} \times CLNK_y - MgO_{RM,y} \times RM_y) \quad \textbf{(2)}$$

Where:

$PE_{calc,y}$	is the project emission due to calcination of calcium carbonate and magnesium carbonate contained in the raw mill during pyroporocessing in clinker kiln in year y (tCO_2)
0.785	is the stoichiometric emission factor for CaO (tCO2/tCaO)
1.092	is the stoichiometric emission factor for MgO(tCO2/tMgO)
$CaO_{CLNK,y}$	is the non-carbonate CaO content in clinker in year y (tonnes of CaO/tonne of clinker)
$CaO_{RM,y}$	is the non-carbonate CaO content in raw meal in year y(tonnes of CaO/tonne of raw meal)
$MgO_{CLNK,y}$	is the non-carbonate MgO content in clinker in year y (tonnes of MgO/tonne of clinker)
$MgO_{RM\_PR,y}$	is the non-carbonate MgO content in raw meal in year y (tonnes of MgO/ tonne of raw meal)
$CLNK_y$	is the annual production of clinker y (tonnes)
RM_y	is the annual consumption of raw meal in year y (tonnes)

Kiln fuel

The emissions due to kiln fuel combustions above are defined as follows:

$$PE_{dry,y} = FC_{drums,y} \times NCV_{fd,y} \times EF_{CO2} \quad \textbf{(3)}$$

Where:

$PE_{Fuel\_kiln,y}$ Project emission from combustion of kiln fuels in year y (tCO_2)

$FC_{i,kiln,y}$ is the fuel of type *i* consumed by the kiln during the year y (ton ot thousand Nm^3)

$EF_{CO2,i}$ fuel of type *i* Emission Factor (tCO_2/GJ)

$NCV_{NG,y}$ is the net (lower) calorific value of fuel of type i in year y(ton or thousand Nm^3)

Bypass dust

If there is a discarded bypass dust from kiln bypasses and dedusting units (CDK), the project emissions due to discarded dust shall be determined as follows:

$$PE_{dust,y} = PE_{calc\,y} \times ByPass_y + \frac{PE_{calc\,y} \times d_y}{\left[PE_{calc,y}(1 - d_y) + 1\right]} \times CKD_y \quad \textbf{(4)}$$

Where:

$PE_{dust,y}$ is the annual emission due to discarded dust from bypass and deducting unit (tCO_2)

$PE_{calc,y}$ is the project emissions from calcination of the raw mill in the year y (tCO_2)

$ByPass_y$ is the annual production of bypass dust living kiln system (tonnes)

CKD_y is the annual production of CKD dust leaving kiln systems (tonnes)

d_y is the CKD calcinations rate % (released CO_2 expressed as a fraction of the total carbonates CO_2 in the raw meal)

The dry kiln system of Kryvyi Rih Cement plant has no bypass duct, therefore ByPass = 0 and only CKD will be taken into account

Project emission from combustion of fuel for drying of raw mill and fuel

In addition to fuel consumption by the clinker kiln and calciner, fuel is also consumed by raw mill drying drums and dryer of coal mill.

$$PE_{kiln,y} = FC_{NG,kiln\,y} \times NCV_{NG,y} \times EF_{CO2,NG,y}$$

Where:

$PE_{kiln,y}$ is project emission from combustion of kiln fuels in year y (tCO_2);

$FC_{NG,\ kiln,y}$ is the fuel of type *i* consumed by the kiln during the year y (thousands Nm^3);

$NCV_{NG,y}$ is the net calorific walue of natural gas used in year y(GJ/thousand Nm^3);
$EF_{CO2,NG,yi}$ Carbon Emission Factor of NG (tCO_2/GJ) **(5)**

Project emission from grid electricity consumption for clinker manufacture
Within the frames of the project electricity is consumed for clinker kiln and its auxiliary systems operation, for preparation (handling, drying, grinding) of raw mill and for fuel preparation and feeding in the kiln system

$$PE_{El\_grid,y} = EL_{RM,kiln,y} \div 1000 \times EF_{el,y}$$ **(6)**

Where:
$PE_{El\_grid,y}$ is the project emission due to electricity consumption for preparation of raw mill, for clinker kiln system operation and for fuel feeding y (tCO_2)
$EF_{el,y}$ is the carbon emission factor of electricity grid of Ukraine in year y (tCO_2/MWh)
$EL_{RM,kiln,y}$ is the grid electricity consumption for clinker production, including consumption of electricity for raw mill preparation, kiln electricity consumption, fuel preparation and feeding in year y (kWh).

	2008	**2009**
Project emissions PE_y	**787,314**	**477,575**
Calcination PE_{calc}	494,409	287,651
Kiln fuel PE_{kiln}	195,551	124,166
PE_{dust}	906	152
From fuel for drying PE_{dry}	11,128	9,040
From grid power $PE_{EL\ RM,\ Kiln}$	85,320	56,566
Total for the monitoring period 2008-2009		**1,264,889**

Table 10: Project emissions

D.3.2. Baseline emissions:

Baseline emissions are calculated as follows:
Where:

$$BE_y = BE_{Calcin} + BE_{FC} + BE_{Dust} + BE_{dry} + BE_{EL\_grid} \quad (7)$$

Where:

BE_y is the baseline emissions for the year y (tCO_2)

BE_{Calcin} is the baseline CO_2 emissions from calcinations of calcium carbonate and magnesium carbonate contained in the raw materials during burning in the clinker kiln (tCO_2)

BE_{FC} is the baseline emissions due to kiln fuel combustion (tCO_2)

BE_{Dust} is the baseline emissions due to discarded dust from kiln bypass and kiln exhaust de-dusting system (tCO_2)

BE_{dry} is the baseline emissions due to additional fuel consumption for raw materials or fuel preparation, (tCO_2)

BE_{EL_grid} is the baseline emissions due to grid electricity consumption (tCO_2)

Baseline emission from calcinations

$$BE_{Calcin} = \frac{CLNK_y}{CLNK_{Bsl}} \times \left(0.785 \times \left(CaO_{CLNK\_Bsl} \times CLNK_{Bsl} - CaO_{RM\_Bsl} \times RM_{Bsl}\right) + 1.092 \times \left(MgO_{CLNK\_Bsl} \times CLNK_{Bsl} - MgO_{RM\_Bsa} \times RM_{Bsl}\right)\right) \quad \textbf{(8)}$$

Where:

BE_{Calcin} is the baseline CO_2 emission from calcinations of calcium carbonate and magnesium carbonate (tCO2)

0.785 is the stoichiometric emission factor for CaO (tCO2/tCaO)

1.092 is the stoichiometric emission factor for MgO(tCO2/tMgO)

CaO_{CLNK_Bsl} is the non-carbonate CaO content in clinker in baseline (tonnes of CaO/tonne of clinker)

CaO_{RM_Bsl} is the non-carbonate CaO content in raw meal in baseline (tonnes of CaO/tonne of raw meal)

MgO_{CLNK_Bsl} is the non-carbonate MgO content in clinker in baseline (tonnes of MgO/tonne of clinker)

MgO_{RM_Bsl} is the non-carbonate MgO content in raw meal in baseline (tonnes of MgO/ tonne of raw meal)

$CLNK_{Bsl}$ is the annual production of clinker in the baseline (tonnes)

$ClNK_y$ is the actual annual production of clinker in the project year y (tonnes)

RM_{Bsl} is the annual consumption of raw meal in the baseline (tonnes)

Baseline emissions from combustion of fuels in the kiln

In order to obtain the baseline value of emissions due to combustion of fuel(-s) in the kiln, the historical specific kiln energy consumption values were used

$$BE_{FC} = KE_{BSL} \times \frac{\sum_i \left(FC_{i,y} \times NCV_{NG} \times EF_{CO_2,NG}\right)}{\sum_i \left(FC_{i,y} \times NCV_{NG}\right)} \times CLNK_y \quad (9)$$

Where:

BE_{FC} is the baseline emissions due to kiln fuel combustion (tCO_2)
KE_{BSL} is the specific baseline kiln calorific consumption (kiln efficiency) (GJ/t clnk)
$FC_{i, y}$ is the kiln fuel of type i consumption during he year y (thousands Nm^3)
$EF_{CO2,i}$ is the carbon emission factor of fuel of type i (tCO_2/GJ)
NCV_i is the net (lower) calorific value of fuel of type I (GJ/ton or thousand Nm^3)
$CLNK_y$ is the annual clinker production in year y (tonnes)

Baseline emissions due to discarded dust from kiln exhaust gases de-dusting units

$$BE_{dust} = \left(BE_{calc} \times ByPass + \frac{BE_{calc} \times d}{\left[BE_{calc}(1 - d) + 1\right]} \times CKD_{Bsl} \right) \times \frac{CLNK_y}{CLNK_{Bsl}} \quad (10)$$

Where:
BE_{dust} is the annual baseline emission due to discarded dust from bypass and deducting unit (tCO_2)
BE_{calc} is the baseline emissions from calcination of the raw mill (tCO_2)
$ByPass_y$ is the annual production of bypass dust living kiln system (tonnes)
CKD_{Bsl} is the baseline production of CKD dust leaving kiln systems (tonnes)
d is the CKD calcinations rate % (released CO_2 expressed as a fraction of the total carbonates CO_2 in the raw meal)
$CLNK_y$ is the annual clinker production in year y (tonnes)
$CLNK_{Bsl}$ is the annual clinker production in baseline (tonnes)

Existing dry kiln at Kryvyi Rih Cement is not equipped with kiln gases by-pass; therefore discarded dust can occur only from cement kiln de-dusting units and only CKD will be taken into account.

Baseline emissions from fuel consumption for drying of raw meal or fuel preparation
Additional (to the kiln consumption) fuel can be consumed to pre-dry the raw materials and to dry the fuel (consumption of fuel by dryer of coal mill).
Emission due to additional fuel consumption are defined as follows:

$$BE_{dry} = \sum_i \left(FC_{dry,Bsl} \times EF_{CO2,i} \right) \times \frac{CLNK_y}{CLNK_{Bsl}} \quad (11)$$

Where:
BE_{dry} is the baseline emissions due to additional fuel consumption for raw materials or fuel preparation, (tCO_2)
FC_{dry_Bsl} is the baseline consumption of fuel of type i for raw meal drying and kiln fuel preparation (GJ)
$EF_{CO2,i}$ is the carbon emission factor of fuel of type i (tCO_2/GJ)
$CLNK_y$ is the annual clinker production in year y (tonnes)
$CLNK_{Bsl}$ is the annual clinker production in baseline (tonnes)

Baseline emission from grid electricity consumption for clinker production

Grid electricity is consumed in the baseline for kiln operation, raw mill preparation and for fuel preparation and feeding. Emissions from grid electricity consumption for these purposes are defined as follows:

$$BE_{El\_grid} = EL_{RM,kiln,Bsl} \div 1000 \times EF_{el,y} \times CLNK_y \quad \textbf{(12)}$$

Where:

$BE_{el,y}$ is the baseline emissions due to grid electricity consumption (tCO_2)

$EF_{el,y}$ is the carbon emission factor of electricity grid of Ukraine in year y (tCO_2/MWh)

$EL_{RM,kiln,Bsl}$ is the specific grid electricity consumption for clinker production, including consumption of electricity for raw mill preparation, kiln electricity consumption, fuel preparation and feeding in the baseline (kWh/ton clinker).

	2008	**2009**
Baseline emissions BE y	**895,287**	**566,694**
Calcination BE_{calc}	557,419	352,833
Kiln fuel BE_{kiln}	224,273	141,959
BE_{dust}	968.68697	613.15366
From fuel for drying BE_{dry}	13,990	8,855
From grid power $BE_{EL\ RM,\ Kiln}$	98,636	62,434
Total for the monitoring period 2008-2009		**1,461,981**

Table 11: Baseline emissions

D.3.3. Leakage:

No leakage occurs. Not applicable.

D.3.4. Summary of the emissions reductions during the monitoring period:

Emissions reduction	2008	2009
ER y, tCO2	107,973	89,120

Total for the monitoring period 2008-2009	**197,092**

Table 12: Eemissions reduction