CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Reduction in clinker usage in the production of cement through the increase in the use of additives at Lafarge Malayan Cement Berhad (LMCB)

Version number: 08
Date: 04/03/2008

A.2. Description of the project activity:

The purpose of the project activity is to increase the use of additive in cement production at various plants owned and operated in Peninsular Malaysia by Lafarge Malayan Cement, namely:

a) Langkawi Plant (LP)
b) Kanthan Plant (KP)
c) Rawang Plant (RP)
d) Pasir Gudang Plant (PGP)

Clinker is produced through the burning of 75% limestone with 25% additives materials (such as clay, iron rich material and sand) which is called raw meal, in a rotary kiln. The raw meal is preheated to about 900^{o}C in pre-heater's pre-calciner before it is further heated up to 1500^{o}C in the rotary kiln. The granulated product from the burning of calcined materials is called clinker. The clinker is ground in a cement grinding ball mill with the addition of other additives (such as gypsum, PFA, limestone, granulated slag etc) to produce cement

This project activity will reduce the total amount of clinker produced and/or used in the manufacturing of cement in all the 4 Lafarge cement manufacturing facilities mentioned above. The following additives will be used:

i) Pulverised fly ash (PFA)
ii) Granulated blast furnace slag(GBFS)
iii) Limestone

By reducing the proportion of clinker in the cement blend, the project activity will reduce CO_2 emissions associated with clinker production, which come both from the calcination reaction itself and from the use of fossil fuels to fire the kiln.

All the above are integrated plants and produce clinker and the final cement product except for PGW which has the grinding facility to produce cement only. All the clinker required for the cement production in PGW is shipped from Langkawi to Pasir Gudang. The cement produced from Langkawi Plant is mostly for the export market only and hence no emission reductions will be claimed for the cement produced at that facility. It is however included in the project activity.

The project contributes in fulfilling the host country's goal of promoting sustainable development as follows :

i) The production of clinker is an energy intensive process, which is reliant on the use of fossil fuels. Hence a reduction in the use of clinker will result in less fossil fuels being utilised and hence a reduction in Green House Gas emissions and a reduction on dependence on fossil fuels.

ii) Fly ash is a by product of electricity generation and is a product which poses a challenge with regards to disposal. As such the increased use of fly ash brings dual benefits in that less of the fly ash requires disposal and a reduction in the use of clinker, bringing the benefits as provided above.

iii) The research and development carried out by Lafarge Malayan Cement Berhad (LMCB) in developing various type of PPC subtype cement to cover the various usage of OPC subtype cement in the market is a first of its kind in Malaysia and has resulted in substantial amount of transfer of technical knowledge and technical capacity building of employees in LMCB.

iv) The project activity will increase the life of the limestone reserves in Malaysia as a result in reduction in limestone usage in clinker production as LMCB is the largest cement manufacturer in Malaysia.

A.3. Project participants:

Name of Party Involved (*)	Private and/or public entity(ies) project participants (*)(as applicable)	Kindly indicate if the Party involved wishes to be considered as a project participant (Yes/No)
The Government of Malaysia (Host)	Private Entity: Lafarge Malayan Cement Berhad	No
France	Private entity: Lafarge S.A	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

Table A1- Project Participants

Further contact information of project participants is provided in Annex 1.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

Lafarge Malayan Cement has 4 production facilities located within Peninsular Malaysia which are as follows:

a) Langkawi Plant
b) Kanthan Plant
c) Rawang Plant
d) Pasir Gudang Plant

The Kanthan and Rawang Plant produce the clinker and cement for domestic use only. Langkawi works produces the clinker and cement for export to countries such as Singapore, Sri Lanka , Indonesia and East and West African countries,. Pasir Gudang Plant produces cement using clinker transported from Langkawi Plant. Therefore all 4 locations are taken as the project activity sites. However the clinker and subsequently the cement produced for the export market by Langkawi Plant has to be omitted from the project activity as the methodology is only applicable for cement produced solely for the domestic market.

Figure A1 below, shows all of the cement and clinker manufacturing plants in Peninsular and East Malaysia

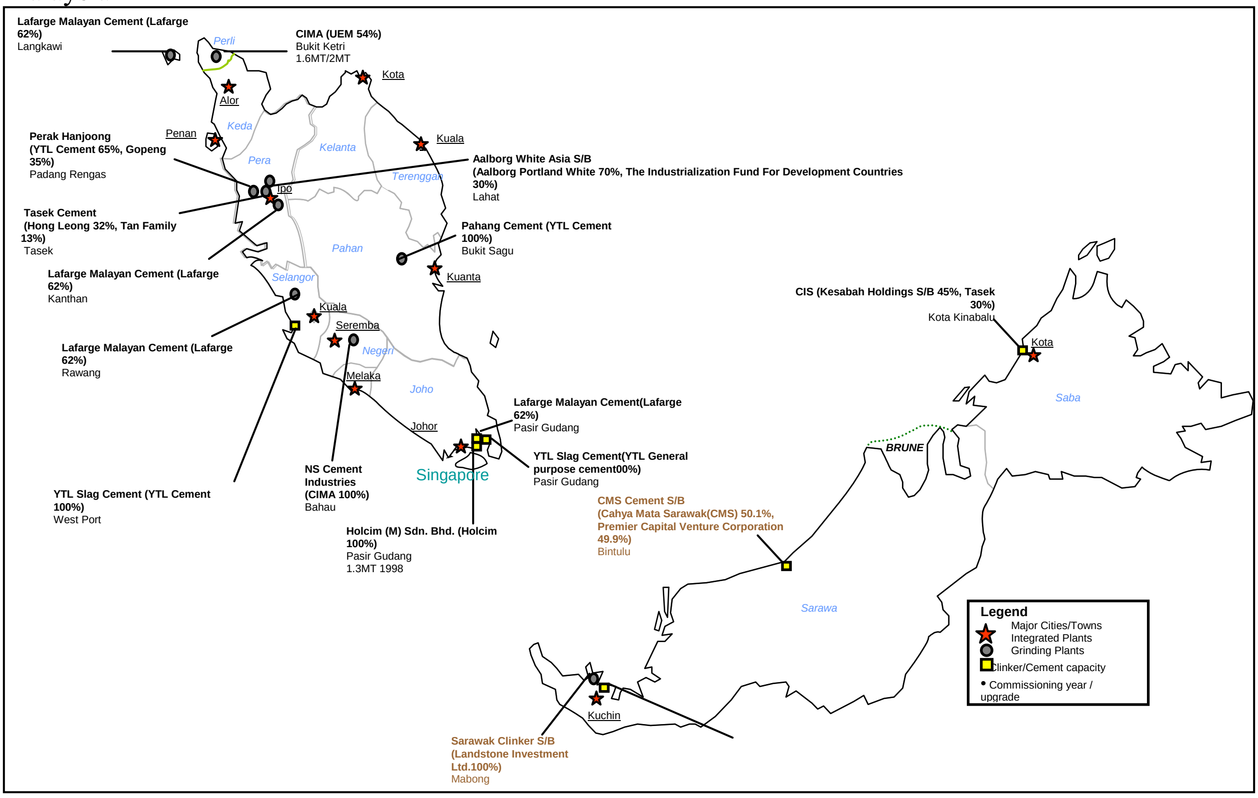

Figure A1: Map of Peninsular and East Malaysia showing the various plants manufacturing cement and producing clinker. *(Source: Lafarge Malayan Cement Berhad)*

The location of the various project activity sites within Peninsular Malaysia are shown on the map below:

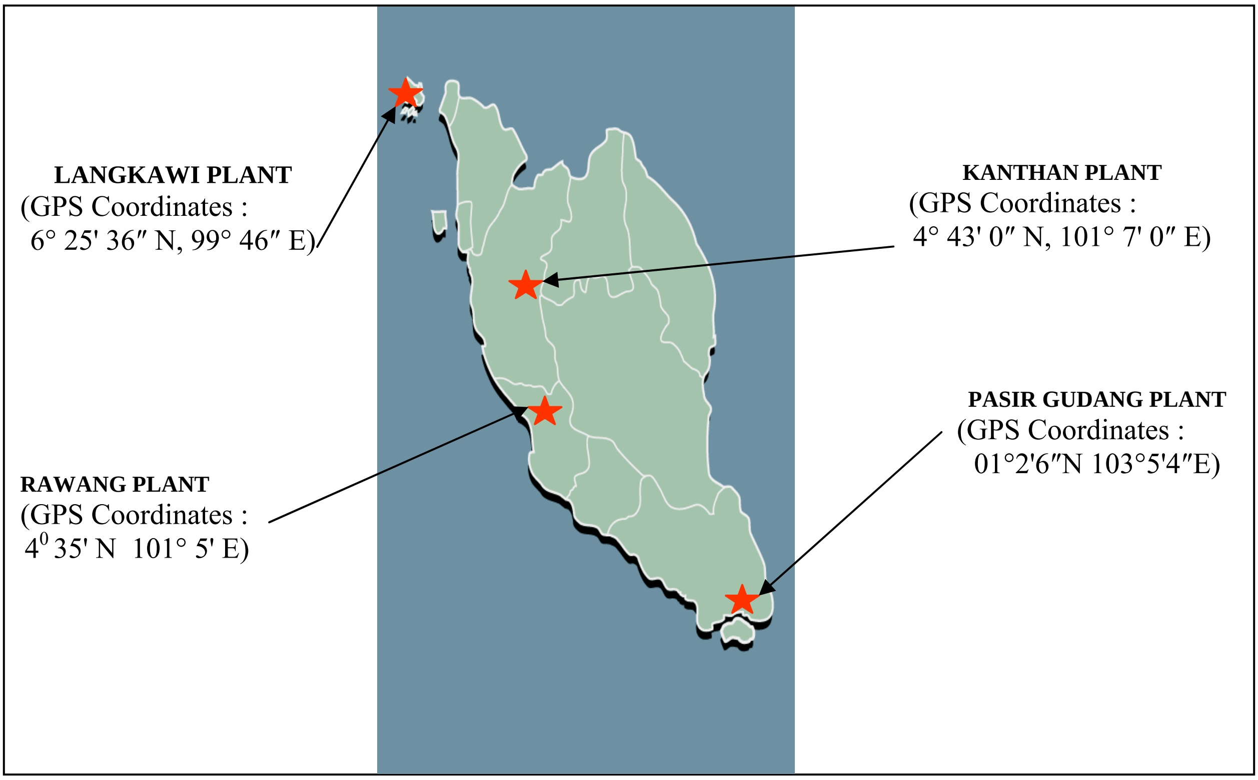

Figure A2: Location of the four sites comprising of the project activity located within Peninsular Malaysia *(Source: Lafarge Malayan Cement Berhad)*

A.4.1.1. Host Party(ies):

>>Malaysia

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

>>Refer to table A1

A.4.1.3. City/Town/Community etc:

>>Refer to table A1

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

The physical location of the project activity plants described in A.4.1 are shown in the table below:

Plant	City/Town	State	Location
Rawang Plant	Rawang	Selangor	48000 Rawang, Selangor Darul Ehsan (GPS Coordinates : 4^0 35' N 101° 5' E)
Kanthan Plant	Chemor	Perak	Batu 131/2, Jalan Kuala Kangsar, 31200 Chemor, Perak Darul Ridzuan (GPS Coordinates : 4° 43' 0″ N, 101° 7' 0″E)
Langkawi Plant	Langkawi	Kedah	Teluk Ewa, Mukim Air Hangat, 07000 Pulau Langkawi, Kedah Darul Aman, Malaysia (GPS Coordinates : 6° 25' 36″ N, 99° 46″ E)
Pasir Gudang Plant	Pasir Gudang	Johor	Lot 2, Jalan Kontena, Kawasan Pelabuhan Johor, 81700 Pasir Gudang, Johor Darul Takzim, Malaysia (GPS Coordinates : 01°2'6″N 103°5'4″E)

Table A2: Details Of Physical Location of the plants which form this project. Please note that the plant in Langkawi produces the Clinker for export as well as for Pasir Gudang Plant along with cement for export markets overseas *(Source: Lafarge Malayan Cement Berhad).*

Further information as the plant locations can be found in Figure A1 (plant map).

A.4.2. Category(ies) of project activity:

According to Annex A of the Kyoto Protocol, this project fits in Sectoral Category 4, Manufacturing Industries

A.4.3. Technology to be employed by the project activity:

The use of Pulverised Fly Ash (PFA), granulated granulated blast furnace slag(GBFS) and limestone as additives will be increased by Lafarge in the production of General Purpose Cement. Within this general purpose cement consists of two cement subtypes which are the Ordinary Portland Cement (OPC) and Pozzolanic Portland Cement (PPC).

Lafarge Malayan Cement has carried out an extensive R&D to ascertain the effect of the addition of the additives reduction on the properties of the cement. Additionally, the increase in the additive usage (reduction in clinker usage) in the production of general purpose cement type, and the consequential effect upon properties of this cement type, has also been extensively researched by LMCB.

Figure A3 below, illustrates a simplified schematic diagram of the cement manufacturing process employed at Lafarge's plants in Malaysia.

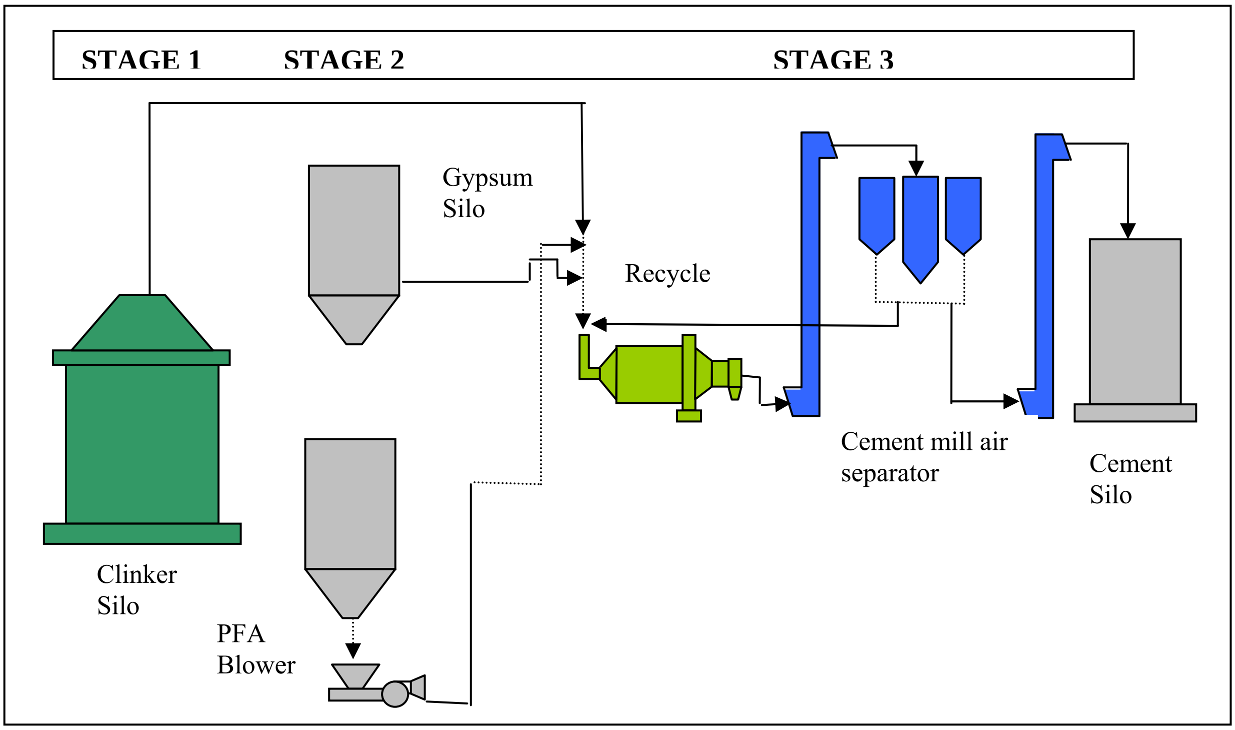

Figure A3: Simplified schematic diagram of the cement manufacturing process employed at Lafarge's plants in Malaysia. *(Source: Lafarge Malayan Cement Berhad)*

The cement manufacturing process as illustrated in figure A3 contains three steps. Further details of these have been provided below:

Stage 1

The clinker , stored in clinker silos with a capacity of 30,000 tons is extracted and transported via a series of conveyor belts to a cement grinding clinker hopper. A travelling overhead crane is used to feed the gypsum to a gypsum hopper. Clinker and gypsum are extracted from respective hoppers and transported by a series of conveyor belts to a cement mill . The clinker and gypsum feed belt conveyors are equipped with weighing devices .to ensure its quantity is propotionately fed into the cement mill for grinding.

Stage 2

Gypsum is fed at a rate equivalent to 5% by weight of the total mill feed while PFA is dosed by being blown into the cement mill at the same time. The amount of PFA is controlled by an impact weighing device and the content in the finished product is periodically monitored through chemical analysis to determine the content of the PFA. The result of the PFA content analysis is fed back to the cement mill controller to help determine if the amount of PFA in the feed needs to be varied. Gypsum content is determined at the same time by analysing the SO_3 content in the cement and the same feed back control steps are used to vary the amount as required. The whole cement grinding process is fully computerised .

The granulated blast furnace slag(GBFS) and the limestone additive are transported into and out of the hopper into the mill using the existing conveying system which transports the clinker and gypsum as well.

Stage 3

The finished cement product is pneumatically transported to the cement silo. A system of conveying pipe valves is used to ensure that the correct cement type is dispatched to the correct silo.

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

The Project activity will reduce GHG emissions by 532,757 tonnes of CO_2 (annual average) per year, totalling 3,729,301 tonnes of CO_2 during the 7 year crediting period.

Please indicate the chosen crediting period and provide the total estimation of emission reductions as well as annual estimates for the chosen crediting period. Information on the emissions reductions shall be indicated using the following tabular format.

For type (iii) small-scale projects the estimation of project emissions is also required.

Years	Annual estimation of emission reductions in tonnes of CO_2e			
	Kanthan Plant	Rawang Plant	Pasir Gudang Plant	Total
2008(Sept –Dec)	58,657	62,754	46,387	**167,798**
2009	172,168	211,226	140,742	**524,136**
2010	203,020	211,298	142,764	**557,082**
2011	206,813	209,657	144,953	**561,423**
2012	198,919	203,534	142,852	**545,305**
2013	191,026	197,411	140,750	**529,187**
2014	183,132	191,288	138,649	**513,069**
2015(Jan-Aug)	116,825	123,443	91,032	**331,300**
Total estimated reductions (tonnes of CO_2e)	1,330,561	1,410,610	988,130	**3,729,301**
Total number of crediting years	7	7	7	7
Annual average over the crediting period of estimated reductions (tonnes of CO2 e)	**190,080**	**201,516**	**141,161**	**532,757**

Table A3 Estimated amount of emission reductions

***The emission reductions for 2012-2015 is based on the 2011 cement production data as LMCB have only forecasted their cement production data up to year 2011.**

Please refer to section E for further details on the quantification of GHG emission reductions associated with the project activity.

A.4.5. Public funding of the project activity:

The project will not receive any public funding from Parties included in Annex I of the UNFCCC.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

ACM0005: "Consolidated Monitoring Methodology for Increasing the Blend in Cement Production", version 03, dated 19 May 2006.

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

ACM 0005 is applicable for projects that increases the share of additives (i.e. reduce the share of clinker) in the production of cement types beyond current practices in the country.

The methodology specifies three applicability conditions, which are provided below, along with reasons why this project falls within the specific applicability condition.

1) There is no shortage of additives related to the lack of blending materials. The project activity will increase the annual consumption of the pulverised fly ash (PFA) to a total of 370,000 tonnes per annum against the total available PFA in the country of 540,000 tonnes in 2007 (69% of the total available PFA consumed). By the year 2011 the consumption is 580,000 tonnes against the available supply of 940,000 tonnes (62% of the total available consumed).

Lafarge is only one of two cement manufacturers in Malaysia which uses PFA as an additive in the production of PFA blended cement. The other manufacturer producing PFA blended cement consumes approximately 62,000 tonnes per annum of PFA..Furthermore there is no other alternative use for the PFA in the country and there is an existing disposal problem of the PFA, which is a waste product from the coal fired power plants. Therefore it can be concluded that there will be no shortage of PFA in the country which could result in reduction of PFA usage in the manufacturing of general purpose cement in the project activity as well as by the other producers in the country.

The project activity will increase the use of granulated blast furnace slag(GBFS) to 78000 tonnes in 2007 which is abundantly available from countries such as Japan, South Korea and China. By year 2011 the consumption is expected to be 87,242 tonnes. The GBFS comes from iron slag waste from the steel industry.The world iron slag production was 200 million tonnes in 2003, 214 million tonnes in 2004 and 234 million tonnes in 2005 and approximately 50% of the world iron slag is granulated and used as GBFS additive(source : onestone and IISI). The remaining 50% of iron slag remains as waste material.
This clearly indicates that the GBFS is abundantly available due to excess availability of iron slag.

The limestone additive is also abundantly available in each of the project activity plant. It is expected that the limestone reserve for additive purpose in the each project activity plant will be increased further with this project as less limestone is required for the production of clinker per tonne of cement produced.

2) The methodology is applicable for domestically sold output of the project activity plant. The plants which are included in the project activity are involved in the production of general purpose cement types for the domestic market only.

3) There is adequate data available on cement types in the market. The data were obtained from the Cement and Concrete Manufacturers Association Of Malaysia. Confidential data such as the percentage of the clinker content in the blended cement by other manufacturers is obtained through a random and statistically significant sample analysis by an independent laboratory.

The reduction of clinker in the general purpose cement type production is achieved through the reduction in the production of OPC subtype which constitutes of 95% clinker. The OPC can only be replaced by another cement subtype within the general purpose cement type. The PPC production using additives(PFA, granulated blast furnace slag(GBFS) and limestone) at various level of blending has been identified to be comparable to general purpose cement . The following are the PPC used to cover the applications as below:

1) PPC with minimum 20% limestone for masonry work can replace OPC for wall plastering purpose.(bag cement)
2) PPC with 27% PFA called Mascrete LH can replace OPC for thick foundation and big concrete pour.(bulk cement)
3) PPC with 7% PFA and 7% Limestone called Mascrete E can replace OPC for cement which requires high early strength as a bulk cement
4) PPC with 15% PFA and 6% Limestone called called Phoenix can replace OPC for general purpose application with premium value.(mainly for bag cement).
5) PPC with 5% PFA and 10% limestone called Avancrete can replace OPC as a premium cement for brick laying purpose.
6) PPC with 20% PFA and 15% GBFS called Mas E-Tem can replace OPC as a low heat cement(Bulk Cement)
7) PPC with 23% PFA and 12% GBFS called Phoenix –Tern can replace OPC as for general purpose (bag cement)

The above types of PPC are blended with various additives at different percentage contents depending on the application and the above specification of the various PPC blend produced for various purpose is specified in LMCB’s specification sheet and brochures. Therefore the PPC subtype cement of the general purpose cement type will be produced on a larger scale and hence the OPC subtype cement production will be reduced. However this cement subtype has to be produced at various percentages of additive in order for it to cover the various applications as a general purpose cement.

Therefore the project activity increases the amount of additives used and reduces the share of clinker in the production of this particular cement type.

. B.3. Description of the sources and gases included in the project boundary

The emission sources and gases included for baseline and project emissions in the project boundary are listed below in Table B1:

	Source	Gas	Included(Y/N)	Justification

Baseline	Fuel combustion for firing the kiln and processing of raw materials	CO_2	Y	
		CH_4	N	Changes in CH_4 emissions are negligible
		N_2O	N	Changes in N_2O emissions are negligible
	Calcination of limestone	CO_2	Y	
		CH_4	N	Changes in CH_4 emissions are negligible
		N_2O	N	Changes in N_2O emissions are negligible
Baseline	Indirect emissions from crushing and grinding the raw materials, driving the kiln & kiln fans and finish grinding of cement	CO_2	Y	
		CH_4	N	Changes in CH_4 emissions are negligible
		N_2O	N	Changes in N_2O emissions are negligible
	Source	**Gas**	**Included(Y/N)N**	**Justification**
Project Activity	Fuel combustion for firing the kiln and processing of raw materials	CO_2	Y	
		CH_4	N	Changes in CH_4 emissions are negligible
		N_2O	N	Changes in N_2O emissions are negligible
	Calcination of limestone	CO_2	Y	
		CH_4	N	Changes in CH_4 emissions are negligible

		N_2O	N	Changes in N_2O emissions are negligible
	Indirect emissions from crushing and grinding the raw materials, driving the kiln & kiln fans and finish grinding of cement	CO_2	Y	
		CH_4	N	Changes in CH_4 emissions are negligible
		N_2O	N	Changes in N_2O emissions are negligible

Table B1: The emission sources and gases included for baseline emissions and project emissions in the project boundary

B.4.Description of how the baseline scenario is identified and description of the identified baseline scenario:

The identification of the baseline scenario is based upon the most plausible baseline scenario among all realistic and credible alternatives in relation to the production of blended cement type.

The baseline scenarios considered are as follows:

- The project activity itself, this being an increase in the share of additive in the production of the general purpose cement type, but not undertaken as a CDM activity
- Continuation of the current level of additive usage in the production of the general purpose cement.
- Production of the general purpose cement type with lower share of additives.
- A switch to production of other types of cement (e.g. Portland Blast Furnace Slag Cement) to replace the general purpose cement.

A switch to the production of other blended cement types e.g. Portland Blast Furnace Slag will require all the project activity plants to import the blast furnace slag from countries such as Japan, South Korea and China. Even though the granulated slag is abundantly available, importing large quantities in the cement production will pose logistical and storage challenges. Furthermore the quality of the cement produced will be inferior in quality and will not be able to substitute the general purpose cement type in the market. The only exception being for bridge construction over the sea, where slag blended cement performs better than the general purpose cement, however this use is very specific in nature.

The possibility of producing the general purpose cement type with lower percentage range of additives is possible, knowing the fact that the Malaysian market perception towards blended cement as being a cement type of inferior quality. By doing so the amount of clinker used in the production of general purpose cement will be higher as a reduction in the additive usage which results in the baseline emissions to be higher compared to the continuation of the current level of additive usage ACM 0005 states that "where more than one credible and plausible alternative remains, project participants shall, as a

conservative assumption, use the alternative baseline scenario that results in the lowest baseline emissions as the most likely baseline scenario”. Therefore this scenario can be excluded.

The realistic possible baseline scenarios are therefore the project activity itself of increasing the share of additive in the production of the general purpose cement (without CDM revenues) and the continuation of the current level of production of additive usage in the production of general purpose cement.

These two scenarios are further evaluated in section B.5 using the tool for the demonstration of additionality in order to determine the most likely baseline scenario, which results to be the Continuation of the current level of additive usage in the production of the general purpose cement

Baseline Emissions

Region Definition for project activity

The “Region” for the benchmark calculation is to be clearly determined and justified by the project participants. The project participant has chosen the National market which is defined as the default region in the methodology. The domestic sales of cement in the defined region are below in table B2:

<table>
<tr><td rowspan="8">Total CDM Cement type(OPC+PPC)</td><td rowspan="4"></td><td colspan="3">1.Lafarge</td><td rowspan="2">2.Cement Industries of Malayasia</td><td rowspan="4">3. Holcim(Malaysia) Sdn. Bhd.</td><td rowspan="2">4.YTL</td><td rowspan="4">5. Tasek Corporation Bhd.</td></tr>
<tr><td colspan="3">1a. Associated Pan Malaysian Cement</td></tr>
<tr><td colspan="3">1b. Malaysian Cement Industries Sdn Bhd</td><td>2a. Negeri Sembilan Cement Industries Sdn. Bhd.</td><td>5a. Perak Hanjoong Cement Sdn Bhd.</td></tr>
<tr><td colspan="3">1c. Southern Cement Industries Sdn Bhd</td><td>2b. Cement Industries(Sabah) Sdn. Bhd.</td><td>5b. Pahang Cement Sdn Bhd</td></tr>
<tr><td rowspan="2">Clinker</td><td>2003</td><td>2004</td><td>2005</td><td>2004</td><td>2004</td><td>2004</td><td>2004</td></tr>
<tr><td>4,427,230</td><td>4,504,383</td><td>4,573,108</td><td>2,770,361</td><td>585,032</td><td>3,049,121</td><td>1,218,064</td></tr>
<tr><td>Cement</td><td>5,070,189</td><td>5,216,261</td><td>5,235,858</td><td>2,969,028</td><td>633,949</td><td>3,498,161</td><td>1,311,447</td></tr>
<tr><td>% Clinker</td><td>87.32%</td><td>86.35%</td><td>87.34%</td><td>93.31%</td><td>92.28%</td><td>87.16%</td><td>92.88%</td></tr>
</table>

Table B2: Malaysian cement industry - Domestic sales & market shares for years 2003 to 2005 *(Source: Cement and Concrete Association Of Malaysia)*

To establish the baseline emissions, the methodology requires establishing the baseline benchmark share of clinker in the particular cement type produced. In this case it is the production of the general purpose cement. This is to be calculated as the lowest value among the following:

i) The average (weighted by production) mass percentage of clinker for the 5 highest blend cement brands for the relevant cement type in the region; or
ii) The production weighted average mass percentage of clinker in the top 20% (in terms of share of additives) of the total production of the blended cement type in the region; or
iii) The mass percentage of clinker in the relevant cement type produced in the proposed project activity plant before implementation of the CDM project activity.

Based on the various criteria mentioned above the benchmark clinker content is as below:

Benchmark clinker content	**2004**
Criteria (i)	88.27%
Criteria (ii)	86.35%

Benchmark clinker content	**2003**	**2004**	**2005**	**Minimum**
Criteria (iii)	87.32%	86.35%	87.34%	86.35%

Table B3: Benchmark Clinker Content (source LMCB and Cement and Concrete Association of Malaysia)

The above calculation is carried out based on the data from the Cement and Concrete Industries of Malaysia which was provided by LMCB. (It is to be noted that the Cement and Concrete Industries of Malaysia did not produce an audited statement for cement manufactured in Malaysia for 2003 & 2005) Therefore the baseline emissions will be based on criteria (iii) which is the lowest % clinker (86.35%). An increasing trend of a minimum of 2% increase in additives over the percentage of additives at the start of the project activity is incorporated as per the methodology requirement. However there is no regulatory limit on the maximum percentage of additive allowed in the country.

Baseline Emission Factor

Baseline emissions per tonne of blended cement type are given by the formula:

$BE_{BC,y} = [BE_{clinker} * B_{blend,y}] + BE_{ele\_ADD\_BC}$

Where :

$BE_{BC,y}$ = Baseline CO_2 emissions per tonne of blended cement type(BC)(tCO_2/t BC)

BE_{clinke} = CO_2 emissions per tonne of clinker in the baseline in the project activity plant (tCO_2/tonne clinker)

$B_{blend,y}$ = Baseline benchmark of share of clinker per tonne of BC updated for year (tonne clinker/tonne BC)

$BE_{ele\_ADD\_BC}$ = Baseline electricity emissions for BC grinding and preparation of

additives(tCO_2/tonne of BC)

$BE_{clinker}$ = $BE_{calcin} + BE_{fossil\_fuel} + BE_{ele\_grid\_CLNK} + BE_{ele\_sg\_CLNK}$

BE_{calcin} = Baseline emissions per tonne of clinker due to calcination of Calcium Carbonate and Magnesium Carbonate (tCO_2/tonne clinker)

BE_{fossil_fuel} = Baseline emissions per tonne of clinker due to combustion of fossil fuels for clinker production (tCO_2/tonne clinker)

$BE_{ele\_grid\_CLNK}$ = Baseline grid electricity emissions for clinker production per tonne of clinker (tCO_2/tonne clinker)

$BE_{ele\_sg\_CLNK}$ = Baseline emissions from self generated electricity for clinker production tonne of clinker (tCO_2/tonne clinker)

BE_{calcin} = $[0.785*(OutCaO – InCaO) + 1.092*(OutMgO – InMgO)]/[CLNK_{BSL}*1000]$

Where :

BE_{calcin} = Emissions from the calcinations of limestone (tCO_2/te clinker)
0.785 = Stoichiometric emission factor for CaO (tCO_2/tCaO)
1.092 = Stoichiometric emission factor for MgO (tCO_2/tMgO)

InCaO = CaO content (%) of the raw material * raw material quantity (tonnes)
OutCaO = CaO content (%) of the clinker * clinker produced (tonnes)
InMgO = MgO content (%) of the raw material * raw material quantity (tonnes)
OutMgO = MgO content(%) of the clinker * clinker produced (tonnes)

BE_{fossil_fuel} = $[\sum FF_{i\_BSL}*EFF_i]/CLNK_{BSL}*1000$

Where :

FF_{i_BSL} = Fossil fuel of type i consumed for clinker production (tonne of fuel i)
EFF_i = Emission factor for fossil fuel i (tCO2/tonne of fuel)
$CLNK_{BSL}$ = Annual production of clinker in the base year (kilotonnes of clinker)

$BE_{ele\_grid\_CLNK}$ = $[BELE_{grid\_CLNK}*EF_{grid\_BSL}]/[CLNK_{BSL}*1000]$

Where :

$BELE_{grid\_CLNK}$ = Grid electricity for clinker production (MWh)

EF_{grid_BSL} = Baseline grid emission factor (tCO_2/MWh)

$CLNK_{,BSL}$ = Annual production of clinker in the base year (kilotonnes of clinker)

There is no self generated electricity in all of LMCB's plant and all the electricity requirement comes from the National grid.

Therefore $BELE_{ele\_sg\_CLNK} = 0$

$BE_{ele\_ADD\_BC} = BE_{ele\_grid\_BC} + BE_{ele\_sg\_BC} + BE_{ele\_grid\_ADD} + BE_{ele\_sg\_ADD}$

Where :

$BE_{ele\_grid\_BC}$ = Baseline grid electricity emissions for BC grinding (tCO_2/tonneBC)

$BE_{ele\_sg\_BC}$ = Baseline self generated electricity for BC grinding (tCO_2/tonne BC)

$BE_{ele\_grid\_ADD}$ = Baseline grid electricity emissions for additive preparation (tCO_2/tonne BC)

$BE_{ele\_sg\_ADD}$ = Baseline self generated electricity emission for additive preparation (tCO_2/tonne BC)

$BE_{ele\_grid\_BC} = [BELE_{grid\_BC} * EF_{grid\_,BSL}]/[BC_{BSL} * 1000]$

$BELE_{grid\_BC}$ = Baseline grid electricity for grinding BC(MWh)

EF_{grid_BSL} = Baseline grid emission factor (tCO_2/MWh)

BC_{BSL} = Annual production of BC in the base year (kilotonnes of BC)

There is no self generated electricity in all of LMCB's plant and all the electricity requirement comes from the National grid.

Therefore $BELE_{ele\_sg\_BC} = 0$

There is no electricity consumed for preparation of additives as all additives are consumed as it is in the cement production

Therefore $BE_{ele\_grid\_ADD} = 0$

There is no self generated electricity in all of LMCB's plant and all the electricity requirement comes from the National grid.

Therefore $BE_{elec\_sg\_ADD} = 0$

The grid emission factor used is taken from Study on Grid Connected Electricity in Malaysia, by PTM, which uses ACM0002 methodology. In this case, since all LMCB's plant are situated in Peninsular Malaysia, the grid emission factor of 0.622 tCO2/MWh is used(refer to table B36)

BE_{calcin} for each project activity plant is as below:

Plant	**BE_{calcin} (tCO_2/tonne clinker)**
Kanthan	0.541
Rawang	0.529
Pasir Gudang	0.538*

Table B4 BE_{calcin} for each project activity plant

BE_{fossil_fuel} for each project activity plant is provided in the table below :

Plant	**BE_{fossil_fuel} (tCO_2/tonne clinker)**
Kanthan	0.389
Rawang	0.344
Pasir Gudang	0.383*

Table B5 BE_{fossil_fuel} for each project activity plant

$BE_{elegrid\_CLNK}$ for each project activity plant is provided in the table below :

Plant	**$BE_{ele\_grid\_CLNK}$ (tCO_2/tonne clinker)**
Kanthan	0.049
Rawang	0.059
Pasir Gudang	0.049*

Table B6 $BE_{ele\_grid\_CLNK}$ for each project activity plant

*Pasir Gudang Plant is only a cement grinding plant which receives clinker from Langkawi Plant. Therefore emissions for clinker production for Pasir Gudang Plant is taken from the Langkawi Plant emission figures

The actual figures used for calculation of the baseline emission factor, along with the sample calculations for Rawang Plant are presented below. These calculations as well as those for Kanthan and Pasir Gudang plants are also contained in the spreadsheet.

Sample Baseline Calculation for Rawang Plant

$BE_{ele\_grid\_BC}$	=	$[BELE_{grid\_BC} * EF_{grid\_,BSL}]/[BC_{BSL} * 1000]$		
	$BELE_{grid\_BC}$	=	76,997	MWh/year
	EF_{grid_BSL}	=	0.622	tCO2/MWh
	BC_{BSL}	=	1,776.941	ktonnes/year
	$BE_{ele\_grid\_BC}$	**=**	**0.027**	**tCO2/tBC**
$BE_{ele\_ADD\_BC}$	=	$BE_{ele\_grid\_BC} + BE_{ele\_sg\_BC} + BE_{ele\_grid\_ADD} + BE_{ele\_sg\_ADD}$		
	$BE_{ele\_grid\_BC}$	=	0.027	tCO2/tBC
	$BE_{ele\_sg\_BC}$	=	0	
	$BE_{ele\_grid\_ADD}$	=	0	
	$BE_{ele\_sg\_ADD}$	=	0	
	$BE_{ele\_ADD\_BC}$	**=**	**0.027**	**tCO2/tBC**
$BE_{ele\_grid\_CLNK}$	=	$[BELE_{grid\_CLNK} * EF_{grid\_BSL}]/[CLNK_{BSL} * 1000]$		
	$BELE_{grid\_CLNK}$	=	148,156	MWh/year
	EF_{grid_BSL}	=	0.622	tCO2/MWh
	$CLNK_{,BSL}$	=	1,550.097	ktonnes/year

	$BE_{ele\_grid\_CLNK}$	**=**	**0.059**	**tCO2/tClinker**

BE_{fossil_fuel} = $[\sum FF_{i\_BSL} * EFF_i] / CLNK_{BSL} * 1000$

Petrol Coke	FF_{PC_BSL}	=	1,703	t/year
	EFF_{PC}		3.170	tCO2/tfuel
Heavy fuel oil	FF_{HO_BSL}	=	3,584	t/year
	EFF_{HO}		3.126	tCO2/tfuel
Diesoline	FF_{D_BSL}	=	70	t/year
	EFF_{D}		3.185	tCO2/tfuel
Coal	FF_{C_BSL}	=	193,375	t/year
	EFF_{C}		2.668	tCO2/tfuel
Palm Kernal Shell	FF_{PKS_BSL}	=	34,875	t/year
	EFF_{PKS}	=	0	tCO2/tfuel
	$CLNK_{BSL}$	=	1,550.097	ktonnes/year

BE_{fossil_fuel}	**=**	**0.344**	**tCO2/tClinker**

BE_{calcin} = $[0.785*(OutCaO - InCaO) + 1.092*(OutMgO - InMgO)]/[CLNK_{BSL}*1000]$

%InCaO	=	0	
%OutCaO	=	66.42	
%InMgO	=	0	
%OutMgO	=	0.66	
InCaO	=	0	
OutCaO	=	1,029,618	
InMgO	=	0	
OutMgO	=	10,263	
$CLNK_{BSL}$	=	1,550.097	ktonnes/year
Raw material for clinker	=	2,576.893	ktonnes/year

BE_{calcin}	**=**	**0.529**	**tCO2/tclinker**

$BE_{clinker}$ = $BE_{calcin} + BE_{fossil\_fuel} + BE_{ele\_grid\_CLNK} + BE_{ele\_sg\_CLNK}$

$BE_{clinker}$	**=**	**0.932**	**tCO2/tclinker**

$BE_{BC,y} = [BE_{clinker} * B_{blend,y}] + BE_{ele\_ADD\_BC}$

$B_{blend,y}$	=	86.35%	
$BE_{ele\_ADD\_BC}$	=	0.027	tCO2/tBC
$BE_{clinker}$	=	0.932	tCO2/tclinker
$BE_{BC,y}$	**=**	**0.831**	**tCO2/tBC**

An annual increase of 2% in share of additive is included in calculating the $BE_{BC,y}$

For 2007

Initial baseline additive	=	13.65%	
Adjusted baseline additive	=	13.92%	
$B_{blend,y}$	=	86.08	
$BE_{BC,y}$	**=**	**0.829**	**tCO2/tBC**

$BE_{ele\_grid\_BC}$ for each project activity plant is provided in the table below:

Plant	**$BE_{ele\_grid\_BC}$ (tCO_2/tonne BC)**
Kanthan	0.031
Rawang	0.027
Pasir Gudang	0.028

Table B7 $BE_{ele\_grid\_BC}$ for each project activity plant

There is no self generated electricity used for the grinding of blended cement or for the additive preparation.

Therefore $BE_{ele\_sg\_BC} = 0$ and $BE_{ele\_sg\_ADD} = 0$.

There is no electricity consumed for the preparation of additive. However there is a coarse screening system which is part of the additive conveying system in to the plant. As a conservative approach has been adopted this equipment has been included in the leakage calculations.

Therefore $BE_{ele\_ADD\_BC} = BE_{ele\_grid\_BC}$ and is provided in the table below

Plant	$BE_{ele\_ADD\_BC}$ **(tCO_2/tonne BC)**
Kanthan	0.031
Rawang	0.027
Pasir Gudang	0.028

Table B8: $BE_{ele\_grid\_BC}$ for each project activity plant

The summary of the total Baseline emissions for clinker production are provided in the table below:

Plant	**$BE_{clinker}$ (tCO_2/tonne clinker)**
Kanthan	0.979
Rawang	0.932
Pasir Gudang	0.971

Table B9: Total Baseline emissions for clinker production

The Total baseline emissions per tonne of cement are provided in the table below:

Plant	**$BE_{BC,y}$ (tCO_2/tonne BC)**

Kanthan	0.874
Rawang	0.829
Pasir Gudang	0.864

Table B10: The total baseline emissions of the plants included in the project.

There is no electricity consumption for the preparation of additive as the PFA brought in from the various power plants are used as it is. In addition there is no self generated electricity for the grinding of BC and for the additive preparation.

The raw data for the emissions related to the clinker production from the Langkawi plant will be transferred as the emissions for the Pasir Gudang Plant in calculating the total emissions from the Pasir Gudang Plant. This is acceptable because the clinker for cement production in Pasir Gudang plant comes from Langkawi Plant.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

The latest tool for the demonstration and assessment of additionality which is available on the UNFCCC website(version 4) is used to identify the barriers which prevent LMCB from carrying out the proposed project activity.

Step 1. Identification of alternatives to the project activity consistent with the current laws and regulations

Sub-step 1a. Define alternatives to the project activity:

1. The realistic and credible alternatives available for LMCB which provides a conservative approach are (see section B.4):
   - **a.** The proposed project activity of increasing the share of additives (PFA, granulated blast furnace slag(GBFS) and limestone) in the production of the general purpose cement type as a non CDM project activity
   - **b.** The continuation of the current production of general purpose cement type for the specific usage type as it is.

Sub-step 1b. Enforcement of applicable laws and regulations:

There is no regulation or law in the region which mandatory requires the use of PFA, granulated blast furnace slag(GBFS) or limestone additives in the cement production for any type of specific usage, neither are there any regulations or law which controls the level of these additives that can be used in the production of cement. There is also no written policy by any authorities in the region which encourages the usage of these additives in the production of cement. However the level of additives is very much quality compliance driven which limits the level of PFA, granulated blast furnace slag(GBFS) or limestone additive which could be incorporated in the production of general purpose cement type. The fact that there is only one other general purpose cement type producer in Malaysia whom is producing

PPC using PFA additive (however this is only limited to producing a specific type of PPC for a specific application only and in a very low dosage of less than 5%) clearly demonstrates that there is a market acceptance barrier in the region. There are no other cement producers using granulated blast furnace slag(GBFS) as an additive in the production of general purpose cement.

There is no regulation or applicable laws which prohibits the production of general purpose cement without these additives for any specific usage in the region. Moreover the general purpose cement type without PFA, granulated blast furnace slag(GBFS) or limestone is commonly available in the region(OPC subtype cement) and the majority of the producers have been and are currently producing such cement.

Step 2. Investment analysis or

Step 3. Barrier analysis

For this project it has been chosen to demonstrate additionality by the use of Barrier Analysis.

Sub-step 3a. Identify barriers that would prevent the implementation of the proposed project activity:

LMCB have been producing general purpose cement type, however share of additives are much lower than what LMCB intends to do in the project acticity. The PPC subtype cement has been used in large scale projects for example the foundations of high rise buildings (such as Petronas Twin Tower ,KLIA and KL Tower), bridges, dams and other big pour projects . However having said that the use of this cement type in this particular application required approval from the Public Works Department and there is a risk of the product being rejected due to inability to meet the quality as per OPC which is previously used in this particular application and LMCB has to carry out extensive R&D to ensure the product meets such stringent requirements. Therefore LMCB is taking a bigger risk in further increasing the share of additives used in the general purpose cement type which eventually decreases the OPC subtype cement produced.

Various barriers are faced by LMCB in increasing the share of additive in the production of general purpose cement through production of various PPC subtype general purpose cement and phasing out the OPC subtype general purpose cement. This project aims at substitution of OPC with PPC which introduces various barriers which LMCB needs to overcome and is mentioned below:

1. **Operational barriers**

   a. The operation of the grinding mill for the production of the final cement has to take into account the possibility of the contamination of additive beyond the level that it suppose to be in the various PPC subtypes . This becomes very critical in the production of various types of PPC's which is used to replace OPC as a general purpose cement as any variation beyond the stringent additive dosage tolerance level could cause the early strength of the specific PPC subtype to be effected. Variation in the speciality materials used (e.g grinding aid and other specialized hardening materials) could also cause a

similar problem. Therefore careful production planning has to be carried out and the frequency of fully de-burdening existing material in the mill prior to changeover to a different cement subtype has to be carried out to ensure cross contamination of different material does not occur. This is a barrier which LMCB faces in executing this project of increasing the share of additive used in the production of general purpose cement as the PPC's quality of being similar if not better than OPC could be compromised if the plant operators do not execute properly the new operating procedures to prevent cross-contamination of material which could compromise the quality of PPC as a general purpose cement type, hence affecting LMCB's reputation in the market as the first company in Malaysia to produce PPC's which could replace OPC as a general purpose cement.

There is a possibility of a particular PPC subtype being mixed into another PPC subtype cement due to leakage through the valve which isolates between the various PPC subtype silos as the cement is constantly being blown by compressed air from the mill into the silos which will cause serious quality problems. New Standard Operating procedures for product changeover had to be developed and adhered to strictly to ensure no product contamination.

b. The existing cement mill feeding system in Kanthan Plant has to be modified to enable dosage of the additional component due to the project activity. The existing system has a common feeding system which transports the OPC subtype cement into two feeding hoppers of the packing section. With the project activity in place to produce various PPC subtype cement to replace OPC subtype cement as a general purpose cement type, situation where two different PPC will need to be packed at the same time will occur. Therefore individual dedicated feeding system has to be installed for each packing hopper to ensure different PPC's could be packed at the same time. This involves an additional investment cost RM2.94 Million which LMCB needs to incur to proceed with the project at its Kanthan facility.

2. Technological Barrier

a. The current quality of the PPC general purpose subtype cement available in the country (including the one produced by LMCB) does not permit it to cover for all the current various uses of OPC subtype as a general purpose cement. A lot of research and development work had to be carried out and is still being carried out in order for the additives to be used in the production of this cement type. Currently LMCB has identified a range of applications for the PFA, granulated blast furnace slag (GBFS) or limestone blended cement as a substitute for the existing general purpose cement. A team of 10-12 people headed by the Senior Vice President of Marketing are specifically dedicated to carry out R&D in this area which includes carrying out actual blend tests and analysing the effect on the market on the replacement product. Furthermore, quality control of the blended cement presents a considerable challenge given that there are more components in the cement and due to the variable and uncontrollable quality of the fly ash and becomes more complex with the introduction of various PPC subtype cements with various additive content to cover for the OPC subtype cement as a general purpose cement. The R&D work carried out involves improvement of the early strength of the

PPC to be similar if not better than OPC. Regardless on the area of application the current OPC subtype cement users are already accustomed with the existing OPC's early strength and LMCB's approach is to produce PPC's which are comparable with OPC. In certain cases such as for Avancrete a considerable amount of effort has been put in to develop an early strength which is much higher than OPC in order to penetrate the general purpose market for brick laying purposes where there is a need to have a cement which has a higher early strength than the normal OPC subtype.(Having said that the market views PPC as a low quality cement, therefore market will not easily accept such cement as a substitute for the various use of OPC and this is a risk which LMCB is taking in developing such products).In the case of OPC usage for thick foundation and big concrete pour, the requirement to generate low amount of heat of hydration is imperative and LMCB has been able to create Mascrete LH which is a low heat cement. Table B11 shows the early strength of the OPC and the achieved early strength of the PPC which is currently developed by LMCB through extensive R&D work that has been carried out. It is important to note that this R&D work will be on going to further improve the early strength and also to develop good early strength of other PPC such as Phoenix E-Tem and Mascrete E-Tem as well as to ensure overall consistency in product quality.

Strength(mPa)	**1 DayC**	**3 DaysC**	**7 DaysC**	**28 DaysC**
OPC	13.04	20.51	27.11	36.11
Phoneix	13.38	19.78	25.30	35.18
Mascrete	13.75	19.17	24.80	35.24
Mas E	16.05	22.84	29.37	39.69
Mas LH	10.15	14.20	22.20	33.86
Avancrete	24.06	27.55	42.72	56.53

Table B11 Early Strength of PPC subtype cement developed by LMCB

b. In order to increase the general market customer confidence in the PPC general purpose subtype cement, a specially formulated grinding aid was developed which enhances the performance of the various PPC subtype cements to be of equivalent quality as OPC subtype cement. For Mascrete Pro and Avancrete the grinding aids were developed jointly in collaboration with BASF and Fosroc and considerable investment was required by LMCB in development of these grinding aids. Furthermore, these products have been developed exclusively for LMCB and the terms of the contract between these organisations reflect this. As such and due to the investment required, LMCB assumes a substantial risk should the product fail in the market.

c. Given that the increase of share of additive in the production of general purpose cement was facing various barriers, LMCB felt it was necessary to develop a new method to ensure that it met the high standards demanded by the customers. The technique called 'microconcrete' was used in the product development stage and subsequently this technique has to be transferred to the cement plants for quality control of the various PPC subtype cement produced in a much larger quantities. The PPC's produced by LMCB is of high fineness in developing cement of high early strength to be comparable with OPC and this increases the water demand of PPC's on the customer site which can affect the

cement strength. However if LMCB is to carry out the normal standard test in determining the quality of cement as per standard compression test(based on European Norm Standard) with a fixed water content, the actual strength developed in the customers end will not be exactly the same and hence results in the customers raising complaints and rejecting the cement. Therefore it is of importance to monitor the water demand of the cement produced which is often a challenge for PPC's due to its high fineness. Hence the micronconcrete technique had to be introduced which is a better but tedious method in simulating concrete in applications as it based on fix slump(workability test) and incorporated with common concrete admixture in order to give a good indication of the actual performance test of the cement during application by the customers. This additional step of testing if not done properly could result in the cement being rejected by the customers and this a barrier which LMCB had to face in this project actvity. Prior to the project activity the PPC's were not produced as a general purpose subtype cement to replace the OPC cement, hence such quality issues did not arise. This microconcrete technique allows monitoring and measurement of the quality of the cements as perceived by LMCB's customers and users. LMCB is the first company in Malaysia and perhaps in South East Asia to adopt this modern approach in using the microconcrete technique. Having said that, the use of the new technique also requires continuous training to be given to the staff to ensure that they apply these techniques appropriately and it is an additional step which could go wrong easily if the testing is not done properly. All LMCB's quality control staff are being trained on the new method of micro concrete "Testing and Analysis" and refresher training has to be conducted on a regular basis.

3. Infrastructure barriers

a. There is also an infrastructure barrier to bring in the additional amount of additives especially PFA and granulated blast furnace slag(GBFS) additive from the identified coal fired power plant and steel mills to the respective cement production facilities. A considerable amount of effort needs to be put in place to ensure supply chain planning of these additives is well managed. As the PFA supply from the coal fired power plants are always fluctuating depending on the domestic power consumption , it is a constant challenge to manage extreme situations when there is surplus PFA supply .LMCB is obliged to pay for the entire fly ash production of the power plants, hence the planning has to optimize the usage of the fly ash in the cement production but yet having to absorb the significant swing in supply There is a dedicated person within the client's organisation whose responsibility is to ensure that this is managed in the most efficient manner and co-ordination between LMCB and the additive supplier is crucial in ensuring prompt delivery of these additives. Additional PFA storage facilities are also being invested in the Northport terminal and in Kanthan Plant, in order to increase the buffer storage for the additional amount of PFA to be consumed.

b. In order to ensure an adequate supply of fly ash, a long term contract has been signed with Tanjung Bin and Kapar power plant. For the Tanjung Bin power plant a considerable amount of capital expenditure has to be incurred in the fly ash handling system both at the power station and at LMCB's cement plant in the South of Malaysia. The power station placed a constraint on the amount of fly ash which can be transported

by road, which has resulted in LMCB having to transport almost 70% fly ash consumed by ship. For this reason LMCB have, at their own expense of RM 47.8 million, had to build an auxiliary jetty and pumping system at the power station to enable the flyash to be transported to the plant. Moreover a dedicated ship transporting an amount of 3000 tonnes per shipment has to be chartered specifically for this purpose by LMCB. Technical modifications are required to be made to the vessel to be able to carry the fly ash, incurring additional investment and also obliging LMCB to charter the vessel over a long term period. Technological barriers have also been faced at the cement plant side in that large silos and fly ash receiving systems have had to be installed to receive the fly ash from the ships. The investment incurred at the power station will only last for 15 years during the duration of the first part of the contract with them. The power plant will take possession of the additional facility which has been installed once the contract has expired. Therefore this cost has to be amortized over 15 years and has to be built up into the PFA cost.

4. Market barriers

a. The price of cement in Malaysia is controlled by the government, through the Ministry of Domestic Trade. There is no minimum price capped by the government; however there is a maximum price ceiling set by the government. This has created a barrier for Lafarge in carrying out the project of replacing the OPC subtype cement with PPC subtype as other OPC producers could lower their prices in order to compete with Lafarge’s PPC subtype of cement. Lafarge has carried out substantial Research and substantial cost is involved in developing the PPC subtype cement to allow it to replace OPC as a general purpose cement type. Therefore the price could not be lowered to compete with the competitor’s OPC and the situation worsens as the Malaysian market’s perception is that PPC is a lower quality cement compared to OPC and could not be used to replace OPC as a general purpose cement type. The situation worsens for Avancrete and Phoenix PPC cements as it has to be sold as a premium cement due to the cost of production being higher than for OPC(due to additional step in the incorporation of special chemicals as a grinding aid and development of shortest early strength and stringent quality control in dosing of additives).However in the Malaysian general purpose market PPC is clearly differentiated as a lower grade cement compared to OPC and this differentiation creates a substantial risk for LMCB to market it as a premium cement. The situation worsens when there is no minimum floor price for the price of cement as OPC could be sold at a much lower price to create a huge price gap between these “premium PPC” and OPC cements, hence making it difficult for customers from even trying the product in the first place.

b. The Malaysian cement market is still developing and is still very much an OPC subtype cement market. Most of the cement manufactures are selling mainly OPC (with the exception of LMCB and YTL where the PPC subtype cement is produced for a specific purpose where OPC is used in the construction industry and does not cover all the uses of OPC subtype cement as a substitute for general purpose cement type). PPC subtype cement is seen to be inferior to OPC and hence customers need to be convinced to switch to PPC through rebates, promotions etc. However, given the fragility of the market if any quality issues are faced with the PPC subtype, the customers immediately switch back to

OPC subtype and this will be a costly affair for LMCB in this project activity since a substantial R&D and investment on the additive supply chain management had to be incurred(as mentioned above). It should be noted that the switching cost is almost nil in the cement industry.

c. Given the inferior market perception which PPC subtype cement faces in Malaysia, higher marketing costs are incurred overcoming this barrier such as in holding product launches, promotions, marketing demonstrations and sales team efforts. Furthermore, it is often the case that large samples, sometimes stretching into tonnes of the PPC subtype cement are provided to the end users free of charge by LMCB in order to convince the clients that LMCB has various PPC subtypes which forms a general purpose cement family which is able to substitute OPC general purpose cement for any desired purpose. Clearly, this represents a substantial cost to LMCB and is combined with the higher technical support costs in the education of customers in converting to PPC subtype general purpose cement..

d. Due to the increased quantity of fly ash required in the project activity, LMCB has signed long term contracts with the power stations which will enable them to purchase the fly ash for the next 25 years (renewable for a 10 period after the first 15 years). The terms of the contract are on a "take or pay" basis which means that LMCB must pay for all of the fly ash which the power plants generate regardless of whether LMCB uses it or not. Any unconsumed fly ash will be dumped by the power plant into their waste lagoons and the cost of this will be borne by LMCB.
LMCB has to increase it's headcount at both the power stations in Tanjung Bin and Kapar and also at the head office to manage the additional fly ash volumes which have been secured along with managing the contract between the power company and LMCB with regards to the additional fly ash required.
It is clear that the terms of the contract which LMCB has entered into and also the additional personnel which they have recruited places considerable risk and financial burden on their side if the market does not accept the various PPC's as a general purpose cement type..

e. Strong market rejection and resistance was faced during the initial launch of the blended cement. It is well known that the Malaysian cement market has been accustomed to the use of OPC for some 50 years and there is strong resistance to change, in particular, fly ash and limestone are viewed as cheap substitutes for clinker. In 2006 LMCB received 26 customer complaints regarding the quality of the blended cement, from key customers who purchase substantial quantities of cement. Complaints were received concerning all of the blended cement types which they produce. However, major complaints were received concerning two particular sub-types. To put the magnitude of these particular complaints into context, LMCB sold 190,897 MT of Avancrete in 2006 of which they received complaints relating to 100,521 MT representing a complaint rate of 53%. Similarly, they sold 108,708 MT of Mascrete Pro and received complaints relating to 63,424 MT, providing a complaint rate of 59%. Clearly, this data shows the damage which LMCB have suffered by the production of blended cement. All these complaints were captured using the in house ECCR (Electronic Customer Complaint Report) system and all the complaints were reviewed and discussed at the monthly Product Quality

meeting chaired by the LMCB's President & CEO. Actions have been taken to resolve the complaints regarding both product quality as well as services on a one to one basis which is very time consuming. More importantly LMCB has suffered some damage to their reputation, which is potentially irrecoverable. Furthermore, in order to overcome the market barriers, LMCB has been continuously conducting seminars, workshops and other briefings to the construction fraternity. In addition to that, LMCB has also engaged, at some cost, the Malaysian Standards Institute (SIRIM) to certify all the products in order to gain market confidence.

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f. Barrier due to prevailing practice, inter alia :

The project activity of producing various types of PFA, granulated blast furnace slag (GBFS) or limestone blended cement of a similar quality as the current general purpose cement for various uses through extensive R&D is the first of it kind in the country. The Pozzolanic material and/or limestone blended cement which has been produced by Lafarge's competitor is meant for certain applications such as the construction of dams for hydro power plants and does not cover for general purpose use, therefore cannot be considered as a general purpose cement type. Therefore it can be concluded that there is no such project type, which is operational in the host country or region.

Sub-step 3b.The identified barriers would not prevent the implementation of the project alternatives:

As mentioned above, the project alternative is the continuation of the production of general-purpose cement production with the current (low) proportion of additives. This is the business as usual scenario and therefore does not face any of the barriers mentioned above. In terms of future law or regulations prohibiting the use of the non Pozzolane and/or limestone additive based general-purpose cement, it is unlikely to happen as it is widely accepted and proven in the construction industry in the country.

Step 4. Common practice analysis

The project activity, which increases the share of additives and reduces the share of clinker, is the first of its kind in the country. This is because the Pozzolane and/or limestone additive blended cement produced can be categorized as a general purpose cement because of the extensive R&D carried out by LMCB and results in the overall reduction of clinker in this category of cement. Therefore the project exceeds the common practice in the country.

Early CDM Consideration

LMCB decided to take up this project as a CDM project and requested for proposals from 4 consultants in March 2006. The proposals were evaluated and the selection of the CDM consultant was made during a Monthly Meeting on 18th May 2006 which demonstrates CDM was considered before project implementation.

The EPCC contractor selection for Tanjung Bin PFA handling facility tender sign was done on 14 June 2006 which is considered as the start date of the project.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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The procedures for calculation of the baseline emissions, project emissions, leakage and emission reductions are as per the formulas stated in ACM0005. The only difference is that there are no emissions related to the self generated electricity as the project entity does not self generate any electricity in its production process neither does it have any plans to self generate electricity in the future.

The following approach and deductions are used in line with the choices given in the methodology:

a) Baseline emissions

   i) As mentioned in section B.4 the benchmark baseline emissions were taken as the lowest value among the 3 criteria stated, which is the mass percentage of clinker in the general purpose cement type produced in the proposed project activity plant before the implementation of the CDM project activity. The benchmark baseline before the implementation of the project activity is calculated as a cumulative calculation for all the 3 project activity plants.

   ii) The highest percentage of additives used over the 3 most recent years is selected and an increase of 2% in additive, over the percentage of additive at the start of the project activity, is incorporated until year 2012 for the calculation of the adjusted baseline emission for each project activity year. There is no capping on the amount of additive that can be incorporated into the cement. In terms of the maximum amount that is considered normal in the cement industry in Malaysia, it's very much dependant on LMCB itself as they are the market leaders in the Malaysian cement industry. Furthermore, through extensive on going research and development the maximum amount of additive that can be incorporated is still being determined. Based on the current additive usage in the cement industry this figure will not be approached in the benchmark baseline percentage of additive.

   iii) To calculate the baseline emissions per tonne of general purpose cement, consumption of fuel and electricity in the production of clinker and the general purpose cement are monitored from year 2003 till 2005 (prior to start of project activity) and the average figure is taken in determining the baseline emissions.

b) Project emissions

   Project emissions per tonne of general purpose cement is calculated for each project activity (Rawang, Kanthan and Pasir Gudang Plants), as per section B.6.3 which consists of:

   a. Emissions from calcinations of limestone
   b. Emissions from combustion of fossil fuel
   c. Emissions from electricity used for additives and grinding of cement

c) Leakage emissions

   Leakage emissions per tonne of general purpose cement due to additional additives are calculated for each project activity plant as per section B.6.3. The following procedures shall apply to calculate leakage emissions during project activity year for each project activity plant:

i) The leakage is calculated on the basis of PFA transportation from the power plant to the project site as well as the GBFS transportation via ship to the Pasir Gudang port and the transportation via road from the Pasir Gudang port to the Pasir Gudang plant. For GBFS transportation via road, the distance travelled from the port to the plant is much lower (120km roundtrip) compared to the distance travelled to bring in the PFA (600km roundtrip from Kapar to Kanthan Plant).(The blended cement using GBFS will only be produced in Pasir Gudang works due to logistics reason as GBFS will be brought in via ship through Pasir Gudang Port). As a conservative approach has been taken, the leakage for transportation of GBFS by lorries to the port is included as part of the leakage calculation for PFA transportation which has a much longer distance of transportation (600km).However during the project activity the actual distance will be recorded for each additive consignment received in each plant and the actual leakage will be calculated accordingly . This is because the PFA could come from various sources in the country, even though for economic reasons the following sources are dedicated for each project activity plant:

a. Kapar Power Station for Rawang Plant and Kanthan Plant
b. Tanjung Bin Station for Pasir Gudang Plant.

For the Pasir Gudang Plant, 70% of the PFA is transported via ship due to the requirement by the power plant to offtake the PFA via ship to reduce traffic congestion. The travelling time is approximately one day and 3,000 tonnes is shipped per consignment via ship. The balance 30% of the requirement is transported via road using truck which carries 25 tonnes of PFA/truck. This has been taken into account in the calculation of emission reduction during the project activity and is included in the monitoring plan under section B.7.

For Rawang and Kanthan Plant the limestone which is required in small quantities compared to PFA in both plants is transported via trucks from the limestone storage area to the hopper which is then conveyed to the mill (the limestone is obtained from the quarry located within the two plants).The distance travelled is minimal (approximately 500m with 25tonne capacity/truck) and therefore this is included as part of the leakage calculation for PFA as a conservative approach as the PFA transportation distance is much higher and the power consumption for the additive conveying system for PFA is much higher as well. For Pasir Gudang Plant, the limestone is transported via trucks from quarries on Ipoh which is approximately 1,300km roundtrip to and from the Pasir Gudang Plant and this leakage is calculated separately for estimation of emission reductions.

It is also important to note that for the emission reduction estimation the leakage due to electricity consumption by the additive conveying system is based on the power rating of the drives for the Rawang plant as the system in Rawang has the highest power rating of the total drives for the additive conveying system(503.64KWh) compared to Kanthan (254.2KWh) and Pasir Gudang plant(83.5KWh).However during the project activity period LMCB will install a meter to measure the actual power consumption of the additive handling system in each project plant and this will be used in the actual leakage calculation as the methodology requires the power consumption to be measured.

ii) The possibility of a diversion of the additive from existing uses during the project activity has to be looked into as per the methodology. If LMCB could not substantiate x tonnes of

additives used during the project activity year are surplus, then the project emission reductions will be multiplied by the factor(1-α) where :

α = (x tonnes of additives in year y/total additional additives used in year y)

However LMCB has signed long term contracts (15years + 10 years renewable) contract with the Tanjung Bin Power Plant and for Kapar is on a renewable contract basis every 10 years..Prior to signing these contracts the power plants were disposing off the PFA into their waste lagoons. Through this contracts Lafarge has also secured the PFA that will be produced in the future by these both power plants as well as all the additional PFA produced due to any increase in the capacity of these coal fired power plants. Since there is no other use for the PFA produced by these two power plants and contracts has be signed to secure the PFA by Lafarge with these two coal power plants, there is no possibility of diversion of the additives from any other use from these two coal power plants.

For additives which is imported (GBFS), even though the consumption is very low compared to other additives, the actual world production of iron slag and the GBFS traded worldwide has to be monitored. against the GBFS consumption by Lafarge(as iron slag which is a waste material from the steel industry is converted to GBFS). Any excess in iron slag production demonstrates that there is no diversion of the GBFS from any other existing use.

d) Emission reductions
As mentioned above the emission reductions will be discounted for the percentage of additives for which surplus availability is not substantiated. The factor (1-α) will be multiplied with the emission reductions ER_y for the project activity year y. However in the estimation of emission reductions it is assumed that the availability additives are surplus.
There is also no self generated electricity calculated as according to LMCB there are no plans to produce electricity in any of the project activity plants as well as in Langkawi works where the clinker for the Pasir Gudang works originates from.

B.6.2. Data and parameters that are available at validation:

The data and parameters that are not monitored throughout the crediting period and only determined once and thus remains the same throughout the crediting period that are available during the validation are as below:

Data / Parameter:	EFF_{HFO}
Data unit:	CO_2/te
Description:	CO_2 emission factor per tonne of Heavy Fuel Oil
Source of data used:	IPCC 2006
Value applied:	3.126
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is the value established through the study conducted by the Intergovernmental Panel On Climate Change(IPCC)

Any comment:	

Table B12

Data / Parameter:	EFF_{PC}
Data unit:	CO_2/te
Description:	CO_2 emission factor per tonne of Petrol Coke
Source of data used:	IPCC 2006
Value applied:	3.170
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is the value established through the study conducted by the Intergovernmental Panel On Climate Change(IPCC)
Any comment:	

Table B13

Data / Parameter:	EFF_D
Data unit:	CO_2/te
Description:	CO_2 emission factor per tonne of Diesoline
Source of data used:	IPCC 2006
Value applied:	3.185
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is the value established through the study conducted by the Intergovernmental Panel On Climate Change(IPCC)
Any comment:	

Table B14

Data / Parameter:	EFF_C
Data unit:	CO_2/te
Description:	CO_2 emission factor per tonne of Coal
Source of data used:	IPCC 2006
Value applied:	2.668
Justification of the choice of data or description of measurement methods and procedures actually applied :	This data is the value established through the study conducted by the Intergovernmental Panel On Climate Change(IPCC)
Any comment:	

Table B15

Data / Parameter:	EFF_{PKS}

Data unit:	CO_2/te
Description:	CO_2 emission factor per tonne of Palm Kernel Shell
Source of data used:	IPCC
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value is fixed at zero as the Palm Kernel Shell is a carbon neutral biomass and the IPCC study states that the emission factor for such fuels is zero.
Any comment:	

Table B16

Data / Parameter:	EF_{grid}
Data unit:	CO_2/MWh
Description:	Grid Electricity Emission Factor
Source of data used:	Study on Grid Connected Electricity (PTM) report
Value applied:	0.622
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value is fixed and is based on the Study on the Grid Connected Electricity report carried out by the the National Energy Centre(PTM) January 2008.The original figure in the report is calculated using the 1996 IPCC default factors for the fuel data and has been corrected using the 2006 IPCC default factors as required by the validator.
Any comment:	

Table B17

Data / Parameter:	Fuel consumption of vehicle
Data unit:	kg fuel/km
Description:	The fuel consumption of the vehicle transporting the additive to all the project plants
Source of data used:	LMCB information
Value applied:	0.213
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value is fixed for all project plants as the vehicle transporting the additives are diesel lorries. This is equivalent to 4km/litre of diesel which is typical for lorries/trucks using diesel fuel.
Any comment:	

Table B18

Data / Parameter:	Fuel consumption of ship
Data unit:	Tons/day
Description:	Quantity of fuel used per day of sailing by ship transporting GBFS to the Pasir

	Gudang Port
Source of data used:	Statistics from the Food and Agricultural Organization of The United Nations
Value applied:	0.546tons/day
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data taken from the statistics from the Food and Agricultural Organization of The United Nations
Any comment:	

Table B19

Data / Parameter:	Quantity of additives transported per trip of vehicle
Data unit:	Tonnes
Description:	The quantity of additives that is transported per vehicle per trip
Source of data used:	LMCB information
Value applied:	25 tonnes
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is the standard size of vehicle which is used by LMCB to transport the additives
Any comment:	

Table B20

B.6.3 Ex-ante calculation of emission reductions:

Baseline emissions

Baseline emissions are calculated as specified in section B4.

Project emissions

Project emissions are calculated as below :

$PE_{BC,y}$ are determined as below :

$$PE_{BC,y} = [PE_{clinker,y} * P_{blend,y}] + PE_{ele\_ADD\_BC,y}$$

Where

$PE_{BC,y}$ = CO_2 emissions per tonne of BC in the project activity plant in year y (tCO_2/te BC)

$PE_{clinker,y}$ = CO_2 emissions per tonne of clinker in the project activity plant in year y (tCO_2/te clinker) and defined below

$P_{blend,y}$ = Share of clinker per tonne of BC in year y (tonne of clinker/tonne of BC)

$PE_{ele\_ADD\_BC,y}$ = Electricity emissions for BC grinding and preparation of additives in year y (tonneCO_2/tonneBC)

$PE_{clinker,}$ is calculated as below :

$PE_{clinker}$ = $PE_{calcin,y} + PE_{fossil\_fuel,y} + PE_{ele\_grid\_CLNK,y} + PE_{ele\_sg\_CLNK,y}$

$PE_{calcin,y}$ = Emissions per tonne of clinker due to calcination of Calcium Carbonate and Magnesium Carbonate in year y (tCO_2/tonne clinker)

$PE_{fossil\_fuel,y}$ = Emissions per tonne of clinker due to combustion of fossil fuels for clinker production in year y (tCO_2/tonne clinker)

$PE_{ele\_grid\_CLNK,y}$ = Grid electricity emissions for clinker production per tonne of clinker in year y (tCO_2/tonne clinker)

$PE_{ele\_sg\_CLNK,y}$ = Emissions from self generated electricity for clinker production in year y (tCO_2/tonne clinker)

$PE_{calcin,y}$ = $0.785*(OutCaO_y – InCaO_y) + 1.092 * (OutMgO_y –InMgOy)/[CLNK_y *1000]$

Where :

$PE_{calcin,y}$ = Emissions from the calcinations of limestone(tCO_2/te clinker)

0.785 = Stoichiometric emission factor for CaO(tCO_2/tCaO)

1.092 = Stoichiometric emission factor for MgO(tCO_2/tMgO)

$InCaO,_y$ = CaO content (%) of the raw material * raw material quantity(tonnes)

$OutCaO,_y$ = CaO content(%) of the clinker * clinker produced(tonnes)

$InMgO,_y$ = MgO content (%) of the raw material * raw material quantity(tonnes)

$OutMgO,_y$ = MgO content(%) of the clinker * clinker produced(tonnes)

$PE_{fossil\_fuel,y}$ = $[\sum FF_{i\_,y}*EFF_i]/CLNK_{,y}*1000$

Where :

$FF_{i\_,y}$ = Fossil fuel of type i consumed for clinker production in year y (tonne of fuel i)

EFF_i = Emission factor for fossil fuel i (tCO2/tonne of fuel)

$CLNK_{,y}$ = Annual production of clinker in year y (kilotonnes of clinker)

$PE_{ele\_grid\_CLNK,y}$ = $[PELE_{grid\_CLNK,y}*EF_{grid\_y}]/[CLNK_{,y}*1000]$

Where :

$PELE_{grid\_CLNK,y}$ = Grid electricity for clinker production in year y (MWh)

EF_{grid_y} = Grid emission factor in year y (tCO_2/MWh)

$CLNK_{,y}$ = Annual production of clinker in year y (kilotonnes of clinker)

$PE_{ele\_sg\_CLNK,y}$ = $[PELE_{sg\_CLNK,y}*EF_{sg\_y}]/[CLNK_{,y}*1000]$

Where

$PELE_{sg\_CLNK,y}$ = Self generation of electricity for clinker production in year y (MWh)

EF_{sg_y} = Emission factor for self generated electricity in year y (tCO_2/MWh)

$CLNK_{,y}$ = Annual production of clinker in year y (kilotonnes of clinker)

$PE_{ele\_ADD\_BC,y}$ = $PE_{ele\_grid\_BC,y} + PE_{ele\_sg\_BC,y} + PE_{ele\_grid\_ADD,y} + PE_{ele\_sg\_ADD,y}$

Where :

$PE_{ele\_grid\_BC,y}$ = Grid electricity emissions for BC grinding in year y (tCO_2/tonneBC)

$PE_{ele\_sg\_BC,y}$ = Emissions from self generated electricity for BC grinding in year y (tCO_2/tonneBC)

$PE_{ele\_grid\_ADD,y}$ = Grid electricity emissions for additive preparation in year y (tCO_2/tonneBC)

$PE_{ele\_sg\_ADD,y}$ = Emissions from self generated electricity additive preparation in year y (tCO_2/tonneBC)

$PE_{ele\_grid\_BC,y}$ = $[PELE_{grid\_BC,y}*EF_{grid\_,y}]/[BC_{,y}*1000]$

$PELE_{grid\_BC,y}$ = Baseline grid electricity for grinding BC (MWh)

$EF_{grid\_,y}$ = Grid emission factor in year y(tCO_2/MWh)

$BC_{,y}$ = Annual production of BC in year y (kilotonnes of BC)

$PE_{ele\_sg\_BC,y}$ = $[PELE_{sg\_BC,y}*EF_{sg\_y}]/[BC_{,y}*1000]$

Where

$PELE_{sg\_BC,y}$ = Self generation of electricity for grinding BC in year y (MWh)

EF_{sg_y} = Emission factor for self generated electricity in year y (tCO_2/MWh)

$BC_{,y}$ = Annual production of BC in year y (kilotonnes of clinker)

$PE_{ele\_grid\_ADD,}$ = $[PELE_{grid\_ADD}*EF_{grid\_,y}]/[BC_{,y}*1000]$

$PELE_{grid\_ADD}$ = Baseline grid electricity for grinding additives (MWh)

$EF_{grid\_,y}$ = Grid emission factor in year y (tCO_2/MWh)

$PE_{ele\_sg\_ADD,y}$ = $[PELE_{sg\_ADD,y}*EF_{sg\_,y}]/[BC_{,y}*1000]$

$PELE_{sg\_ADD,y}$ = Baseline self generation electricity for grinding additives (MWh)

$EF_{sg\_,y}$ = Emission factor for self generated electricity in year y (tCO_2/MWh)

In determining the emission coefficients, the 2006 IPCC Good Practice Guidance default values and also the Study on Grid Connected Electricity (PTM) report are used which are country specific. In this case since all the LMCB's plants are situated in Peninsular Malaysia the grid emission factor of 0.622 is used.

Leakage

The estimated leakage is calculated below :

L_{add_trans} = $[(TF_{cons}*D_{add\_source}*TEF)\ 1/Q_{add}*1/1000 + (ELE_{conveyor\_ADD}*EF_{grid})*1/ADD_y]$

Where:

L_{add_trans} = Transport related emission per tonne of additives (tCO_2/tonne of additive)
TF_{cons} = Fuel consumption for the vehicle per kilometre (kg of fuel/kilometre)
D_{add_source} = Distance between the source of additive and the project activity (km)
TEF = Emission factor for transport fuel (kg CO_2/kg of fuel)
Q_{add} = Quantity of additive carried in one trip per vehicle (tonnes of additive)
$ELE_{conveyor\_ADD}$ = Electricity consumption for conveyor system for additives (MWh)
EF_{grid} = Grid electricity emission factor (tonnes CO_2/MWh)
ADD_y = Annual consumption of additives in year y (tonnes of additive)

Leakage emissions per tonne of BC due to additional additives are determined as below:

L_y = $L_{add\_trans}*[A_{blend,y}-P_{blend,y}]*BC_y$

Where :

L_y = Leakage emissions for transport of additives (kilotonnes of CO2)
BCy = Production of BC in year y (kilotonnes of BC)
Ablend,y = Baseline benchmark share of additive per tonne of BC updated for year y (tonne of additive/tonne of BC)
$P_{blend,y}$ = Share of additives per tonne of BC in year y(tonne of additives/tonne of BC)

There are two types of conveying system in place in LMCB's plants for transportation of the additives, these being:

i) A screw conveying system with a blower system
ii) A direct pneumatic conveying system

One or other of the systems will be operational at any one time. The screw conveying system consumes much higher electricity. Therefore as a conservative approach this system is assumed to be in operation for all the additive handled in all of LMCB's plants.

The actual figures used for calculation of the project emission factor, along with the sample calculations for Rawang plant are presented below. These calculations as well as those for Kanthan and Pasir Gudang plants are also contained in the spreadsheet.

Sample Project Emission Calculation for Rawang Plant

2007

$PE_{ele\_grid\_BC,y}$ = $[PELE_{grid\_BC,y} * EF_{grid\_,y}]/[BC_{,y} * 1000]$

$PELE_{grid\_BC,y}$	=	93,586	MWh/year
$EF_{grid\_,y}$	=	0.622	tCO2/MWh
$BC_{,y}$	=	2,147.65	ktonnes
$PE_{ele\_grid\_BC,y}$	=	**0.027**	**tCO2/tBC**

$PE_{ele\_ADD\_BC,y}$ = $PE_{ele\_grid\_BC,y} + PE_{ele\_sg\_BC,y} + PE_{ele\_grid\_ADD,y} + PE_{ele\_sg\_ADD,y}$

$PE_{ele\_grid\_BC,y}$	=	0.027	tCO2/tBC
$PE_{ele\_sg\_BC,y}$	=	0	
$PE_{ele\_grid\_ADD,y}$	=	0	
$PE_{ele\_sg\_ADD,y}$	=	0	
$PE_{ele\_ADD\_BC,y}$	=	**0.027**	**tCO2/tBC**

$PE_{ele\_grid\_CLNK,y}$ = $[PELE_{grid\_CLNK,y} * EF_{grid\_y}]/[CLNK_{,y} * 1000]$

$PELE_{grid\_CLNK,y}$	=	162,687	MWh/year
EF_{grid_y}	=	0.622	tCO2/MWh
$CLNK_{,y}$	=	1,700.973	ktonnes
$PE_{ele\_grid\_CLNK,y}$	**=**	**0.059**	**tCO2/tClinker**

$PE_{fossil\_fuel,y}$ = $[\sum FF_{i\_,y} * EFF_i]/CLNK_{,y}*1000$

It is assumed for the calculation of the project emission the type of fuels and its proportion in the production of clinker is not varied, hence the emissions per te of clinker has not changed.

$PE_{fossil\_fuel,y}$	**=**	**0.344**	**tCO2/tClinker**

$PE_{calcin,y}$ = $[0.785*(OutCaO - InCaO) + 1.092*(OutMgO - InMgO)]/[CLNK_{,y}*1000]$

%InCaO	=	0	
%OutCaO	=	66.42	
%InMgO	=	0	
%OutMgO	=	0.66	
InCaO	=	0	
OutCaO	=	1,129,843	
InMgO	=	0	
OutMgO	=	11,283	
$CLNK_{,y}$	=	1,700.973	ktonnes/year
Raw material	=	2,828.324	ktonnes/year
$PE_{calcin,y}$	**=**	**0.529**	**tCO2/tclinker**

$PE_{clinker}$ = $PE_{calcin,y} + PE_{fossil\_fuel,y} + PE_{ele\_grid\_CLNK,y} + PE_{ele\_sg\_CLNK,y}$

$PE_{calcin,y}$	=	0.529	tCO2/tclinker
$PE_{fossil\_fuel,y}$	=	0.343	tCO2/tClinker
$PE_{ele\_grid\_CLNK,y}$	=	0.059	tCO2/tClinker
$PE_{ele\_sg\_CLNK,y}$	=	0	tCO2/tclinker
$PE_{clinker}$	**=**	**0.931**	**tCO2/tclinker**

$PE_{BC,y}$ = $[PE_{clinker,y} * P_{blend,y}] + PE_{ele\_ADD\_BC,y}$

$P_{blend,y}$	=	79.2	%
$PE_{ele\_ADD\_BC,y}$	=	0.027	tCO2/tBC
$PE_{clinker}$	=	0.932	tCO2/tclinker
$PE_{BC,y}$	**=**	**0.765**	**tCO2/tBC**

BC	=	2,147.65	Ktonnes
ER	**=**	**137,450**	**tCO2**

Leakage

L_{add_trans} = $[(TF_{cons}*D_{add\_source}*TEF)\ 1/Q_{add}*1/1000 + (ELE_{conveyor\_ADD}*EF_{grid})*1/ADD_y]$

TF_{cons}	=	0.213	kg/km
D_{add_source}	=	600	Km
TEF	=	3.185	kgCO2/kg fuel
Q_{add}	=	25	tonnes/trip
$ELE_{conveyor\_ADD}$	=	4,412	MWh/year
EF_{grid}	=	0.622	tCO2/MWh
ADD_y	=	446,677	tonnes/year

L_{add_trans} = 0.022 tCO2/tadditive

L_y = L_{add_trans}*[$A_{blend,y}$-$P_{blend,y}$]*BC_y

L_{add_trans} = 0.022 tCO2/tadditive
BC_y = 2,147.65 ktonnes/year
$P_{blend,y}$ = 13.92%
$A_{blend,y}$ = 20.80%

L_y = -3251 ktCO2/year

ER = 134,199 tCO2/year

* Sample calculations are done based on 2007 projected figure although the project is expected to start generating CERs in 2008.

B.6.4 Summary of the ex-ante estimation of emission reductions:

The following table presents a summary of the decrease in the clinker usage in all the LMCB's plant :

	2008	2009	2010	2011	2012*	2013*	2014*	2015*
Kanthan	78.94	78.99	77.82	77.65	77.65	77.65	77.65	77.65
Rawang	73.84	75.48	75.44	75.42	75.42	75.42	75.42	75.42
Pasir Gudang	62.95	63.06	63.11	63.12	63.12	63.12	63.12	63.12

Table B21- Summary of the decrease in the clinker usage in all the LMCB's plant (*Source: (LMCB Marketing Key Performance Data)*

Based on the proportionate amount of increased additive usage, the forecasted CO_2 emissions per tonne of BC in the project activity plant , $PE_{BC,y}$ are as below :

	2008	2009	2010	2011	2012*	2013*	2014*	2015*
Kanthan	0.804	0.804	0.793	0.791	0.791	0.791	0.791	0.791

Rawang	0.715	0.730	0.730	0.730	0.730	0.730	0.730	0.730
Pasir Gudang	0.640	0.641	0.641	0.641	0.641	0.641	0.641	0.641

Table B22- The forecasted CO_2 emissions per tonne of BC in the project activity plant , $PE_{BC,}$

The estimated leakage over the crediting period at each project activity is estimated as below (tCO2e/te additive):

		2008	**2009**	**2010**	**2011**	**2012***	**2013***	**2014***	**2015***
Kanthan(PFA/Limestone)		-0.021	-0.021	-0.021	-0.020	-0.020	-0.020	-0.020	-0.020
Rawang(PFA/Limestone)		-0.022	-0.021	-0.021	-0.021	-0.021	-0.021	-0.021	-0.021
Pasir Gudang	**(Limestone)**	-0.093	-0.092	-0.090	-0.089	-0.089	-0.089	-0.089	-0.089
	(PFA)	-0.075	-0.073	-0.072	-0.070	-0.070	-0.070	-0.070	-0.070
	GBFS	-0.099	-0.097	-0.096	-0.094	-0.094	-0.094	-0.094	-0.094

Table B23- The estimated leakage over the crediting period at each project activity

The total emission reductions per year are as below:

Year	**Estimation of project activity emissions (tonnes of CO_2e)**	**Estimation of baseline emissions (tonnes of CO_2e)**	**Estimation of leakage (tonnes of CO_2e)**	**Estimation of overall emissions reductions (tonnes of CO_2e)**
2008(Sept-Dec)	412,526	476,818	-1,539	62,754
2009	1,685,067	1,901,185	-4,892	211,226
2010	1,724,553	1,940,717	-4,865	211,298
2011	1,756,502	1,970,965	-4,806	209,657
2012*	1,756,502	1,964,842	-4,806	203,534
2013*	1,756,502	1,958,719	-4,806	197,411
2014*	1,756,502	1,952,596	-4,806	191,288
2015*(Jan-Aug)	1,171,001	1,297,649	-3,204	123,443
Total (tonnes of CO_2e)	12,019,155	13,463,490	-33,725	1,410,610

Table B24: Total Emission Reduction For Rawang Plant

Year	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emissions reductions (tonnes of CO_2e)
2008(Sept-Dec)	720,038	779,992	-1,297	58,657
2009	2,220,321	2,396,276	-3,787	172,168
2010	2,267,626	2,475,021	-4,375	203,020
2011	2,338,346	2,549,578	-4,419	206,813
2012*	2,338,346	2,541,684	-4,419	198,919
2013*	2,338,346	2,533,791	-4,419	191,026
2014*	2,338,346	2,525,897	-4,419	183,132
2015*(Jan-Aug)	1,558,897	1,678,669	-2,946	116,825
Total (tonnes of CO_2e)	16,120,266	17,480,907	-30,080	1,330,561

Table B25: Total Emission Reduction For Kanthan Plant

Year	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emissions reductions (tonnes of CO_2e)
2008(Sept-Dec)	155,517	209,512	-7,608	46,387
2009	480,483	644,199	-22,974	140,742
2010	494,287	660,211	-23,160	142,764
2011	508,258	676,575	-23,363	144,953
2012*	508,258	674,473	-23,363	142,852
2013*	508,258	672,371	-23,363	140,750
2014*	508,258	670,270	-23,363	138,649
2015*(Jan-Aug)	338,839	445,446	-15,575	91,032
Total (tonnes of CO_2e)	3,502,158	4,653,057	--162,769	988,130

Table B26: Total Emission Reduction For Pasir Gudang Plant

***The emission reductions from 2012-2015 is based on the production data for 2011 as LMCB have only forecasted their cement production data up to year 2011.**

B.7 Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:	
Data / Parameter:	In CaO_y
Data unit:	%

Description:	Calcium Oxide content of the raw material (%) * quantity of raw material
Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0% for the inlet raw material mix for all the project activity plants.
Description of measurement methods and procedures to be applied:	Measurement method: X-ray fluorescence spectrometry Measurement equipment: X Ray Fluorescence Standards used: BS EN 196-2 : 1995 Calibration procedures: According to manufacturers recommendations Accuracy: +/- 0.5% Person responsible: Plant Quality Manager Measurement interval: Every 8 Hours
QA/QC procedures to be applied:	ISO 17025
Any comment:	Data will be archived and retained for 2 years beyond the end of the crediting period.

Table B27

Data / Parameter:	Out CaO_y
Data unit:	%
Description:	Calcium Oxide content of the clinker * the clinker production
Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Rawang Plant : 66.42% Kanthan Plant : 65.53% Pasir Gudang Plant : 66.28%
Description of measurement methods and procedures to be applied:	Measurement method: X-ray fluorescence spectrometry Measurement equipment: X Ray Fluorescence Standards used: BS EN 196-2 : 1995 Calibration procedures: According to manufacturers recommendations Accuracy: +/-0.5% Person responsible: Plant Quality Manager Measurement interval : Every 2 Hours
QA/QC procedures to be applied:	ISO 17025 Laboratory accreditation
Any comment:	Data will be archived and retained for 2 years beyond the end of the crediting period.

Table B28

Data / Parameter:	InMgO_y
Data unit:	%
Description:	Magnesium Oxide content of the raw material (%) * quantity of raw material

Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0% for all the project activity plants
Description of measurement methods and procedures to be applied:	Measurement method: X-ray fluorescence spectrometry Measurement equipment: X Ray Fluorescence Standards used: BS EN 196-2 : 1995 Calibration procedures: According to manufacturers recommendations Accuracy: +/- 0.15% Person responsible: Plant Quality Manager Measurement interval : Every 8 Hourly
QA/QC procedures to be applied:	ISO17025 Laboratory accreditation
Any comment:	Data will be archived and retained for 2 years beyond the end of the crediting period.

Table B29

Data / Parameter:	$OutMgO_y$
Data unit:	%
Description:	Magnesium Oxide content of the clinker * the clinker production
Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Rawang Plant : 0.66% Kanthan Plant : 2.48% Pasir Gudang Plant : 1.71%
Description of measurement methods and procedures to be applied:	Measurement method: X-ray fluorescence spectrometry Measurement equipment: X Ray Fluorescence Standards used: BS EN 196-2 : 1995 Calibration procedures: According to manufacturers recommendations Accuracy: +/-0.15% Person responsible: Plant Quality Manager Measurement interval: Every 2 Hourly
QA/QC procedures to be applied:	ISO 17025 Laboratory accreditation
Any comment:	Data will be archived and retained for 2 years beyond the end of the crediting period.

Table B30

Data / Parameter:	Quantity of clinker raw material
Data unit:	Kilo Tonnes
Description:	Quantity of clinker raw material

<table>
<tr><td>Source of data to be used:</td><td>Plant records</td></tr>
<tr><td>Value of data applied for the purpose of calculating expected emission reductions in section B.5</td><td>
<table>
<tr><th></th><th>2008</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th></tr>
<tr><td>Rawang</td><td>2,125,072</td><td>2,895,832</td><td>2,963,633</td><td>3,018,513</td><td>3,018,513</td><td>3,018,513</td><td>3,018,513</td><td>3,018,513</td></tr>
<tr><td>Kanthan</td><td>3,405,141</td><td>3,500,141</td><td>3,572,628</td><td>3,683,736</td><td>3,683,736</td><td>3,683,736</td><td>3,683,736</td><td>3,683,736</td></tr>
<tr><td>Pasir Gudang</td><td>732,343</td><td>754,270</td><td>775,964</td><td>797,907</td><td>797,907</td><td>797,907</td><td>797,907</td><td>797,907</td></tr>
</table>
</td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td>Measurement method: Load Cell
Measurement equipment: Pfister rotor scale
Standards used: ISO9001: 2000
Calibration procedures: According to manufacturers recommendations
Accuracy: +/-1%
Person responsible: Manager- electrical and instrument
Measurement interval: Continuous</td></tr>
<tr><td>QA/QC procedures to be applied:</td><td>LMCB’s ISO 9001:2000 procedure</td></tr>
<tr><td>Any comment:</td><td>i) Data will be archived and retained for 2 years beyond the end of the crediting period.
ii) The figures are based on the multiplication of the clinker in the cement with the average clinker raw material to clinker ratio between 2003-2005 which also includes raw material used to produce clinker for other manufacturers.In the case of Pasir Gudang works, this ratio is taken from the Langkawi works ratio which Pasir Gudang works receives the clinker from. Figures for 2012 -2015 are based on 2011 figures as LMCB cement marketing forecast is not available beyond year 2011</td></tr>
</table>

Table B31

<table>
<tr><td>Data / Parameter:</td><td>$CLNK_y$</td></tr>
<tr><td>Data unit:</td><td>Kilo Tonnes of Clinker</td></tr>
<tr><td>Description:</td><td>Annual production of clinker in year, y used for production by LMCB</td></tr>
<tr><td>Source of data to be used:</td><td>Plant records</td></tr>
<tr><td>Value of data applied for the purpose of calculating expected emission reductions in section B.5</td><td>
<table>
<tr><th></th><th>2008</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th></tr>
<tr><td>Rawang</td><td>1,278,033</td><td>1,741,573</td><td>1,782,349</td><td>1,815,353</td><td>1,815,353</td><td>1,815,353</td><td>1,815,353</td><td>1,815,353</td></tr>
<tr><td>Kanthan</td><td>2,120,982</td><td>2,180,156</td><td>2,225,306</td><td>2,294,513</td><td>2,294,513</td><td>2,294,513</td><td>2,294,513</td><td>2,294,513</td></tr>
<tr><td>Pasir Gudang</td><td>459,117</td><td>472,863</td><td>486,464</td><td>50,220</td><td>500,220</td><td>500,220</td><td>500220</td><td>500220</td></tr>
</table>
</td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td>Measurement method: By calculation
Measurement equipment: Based on clinker raw material totalizers
Standards used: ISO9001: 2000
Calibration procedures: According to manufacturers recommendations
Accuracy: +/-3%
Person responsible: Manager- electrical and instrument
Measurement interval: Continuous</td></tr>
<tr><td>QA/QC procedures to</td><td>LMCB’s ISO 9001:2000 procedure</td></tr>
</table>

be applied:	
Any comment:	i) Data will be archived and retained for 2 years beyond the end of the crediting period.The quantity of clinker is the actual quantity produced for Rawang and Kanthan Plants which differs with the actual total clinker in the cement due to the fact that the excess clinker is sold to other cement producers in the country. Therefore the actual clinker used for cement production will be obtained by subtracting the clinker raw material totalizer reading with the clinker sold. ii) Figures for 2012 -2015 are based on 2011 figures as LMCB cement marketing forecast is not available beyond year 2011.

Table B32

Data / Parameter:	$FF_{i\_,y}$
Data unit:	Tonnes of fuel i
Description:	Quantity of each type of fossil fuel used in the production of clinker
Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The values are taken as per the average baseline figure for 2003-2005 and the fuel per tonne of clinker is calculated using the average baseline figure from 2003-2005
Description of measurement methods and procedures to be applied:	Measurement method: Load Cell Measurement equipment: Pfister rotor scale Standards used: ISO9001: 2000 Calibration procedures: According to manufacturers recommendations Accuracy: +/-1% Person responsible: Manager- electrical and instrument Measurement interval: Continuous
QA/QC procedures to be applied:	LMCB's ISO 9001:2000 procedure
Any comment:	Data will be archived and retained for 2 years beyond the end of the crediting period.

Table B33

Data / Parameter:	EFF_i
Data unit:	tCO_2/tonne of fuel i
Description:	Emission factor for fossil fuel i
Source of data to be used:	IPCC 2006
Value of data applied for the purpose of calculating expected emission reductions in	The following values are used for all the project activity plants for each project year: Heavy fuel oil : 3.126 Petrol coke : 3.170

section B.5	Coal : 2.668 Diesel : 3.185 Palm kernel shell : 0
Description of measurement methods and procedures to be applied:	As per IPCC 2006 default values
QA/QC procedures to be applied:	Not applicable
Any comment:	i) Data will be archived and retained for 2 years beyond the end of the crediting period. ii) This data is the value established through the study conducted by the Intergovernmental Panel On Climate Change(IPCC)

Table B34

Data / Parameter:	$PELE_{grid\ CLNK,y}$
Data unit:	MWh
Description:	Baseline grid electricity for clinker production
Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	(see table below)
Description of measurement methods and procedures to be applied:	Measurement method: Current and voltage transformer Measurement equipment: KWh meter Standards used: TNB standard Calibration procedures: According to manufacturers recommendations Accuracy: +/-0.5% Person responsible: Manager- electrical and instrument Measurement interval: Continuous
QA/QC procedures to be applied:	As per the National Electricity Board Standard (TNB Standard)
Any comment:	i) Data will be archived and retained for 2 years beyond the end of the crediting period ii) The values are calculated based on the average baseline grid electricity per tonne of clinker and multiplied by the clinker production estimated for year 2008-2015.The values for Pasir Gudang are based on the electricity per tonne clinker of the Langkawi plant where the clinker originates from. Figures for 2012 -2015 are based on 2011 figures as LMCB cement marketing forecast is not available beyond year 2011.

	2008	2009	2010	2011	2012	2013	2014	2015
Rawang	122,235	166,570	170,470	173,626	173,626	173,626	173626	173626
Kanthan	165,635	170,256	173,782	179,187	179,187 7	179,187	179187	179187
Pasir Gudang	36,267	37,353	38,427	39,514	39,514	39,514	39514	39514

Table B35

Data / Parameter:	EF_{grid_BSL}
Data unit:	tCO_2/MWh
Description:	Baseline grid emissions factor
Source of data to be used:	Study on Grid Connected Electricity(PTM) report, Jan 2008 .
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.622
Description of measurement methods and procedures to be applied:	This value is fixed and is based on the Study on the Grid Connected Electricity report carried out by the Malaysian National Energy Centre(PTM)(corrected using the IPCC 2006 default factors for the fuel data)
QA/QC procedures to be applied:	Not applicable
Any comment:	

Table B36

Data / Parameter:	EF_{sg_y}
Data unit:	tCO_2/MWh
Description:	Emission factor for self generated electricity in year y
Source of data to be used:	Plant records/IPCC
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.00
Description of measurement methods and procedures to be applied:	There is no self generated electricity accounted for during the project activity year as LMCB does not have any plans to self generate electricity during the project activity years 2008-2015(the first crediting period).
QA/QC procedures to be applied:	Not applicable
Any comment:	

Table B37

Data / Parameter:	ADD_y Quantity of additives
Data unit:	Kilo tonnes
Description:	Annual Consumption of additive in year y
Source of data to be used:	Plant records

Value of data applied for the purpose of calculating expected emission reductions in section B.5

Rawang Works

	2008	2009	2010	2011	2012*	2013*	2014*	2015*
PFA	137,963	178,417	182,639	1838,87	183,887	183,887	183,887	183,887
Limestone	228,178	271,989	279,499	287,311	287,311	287,311	287,311	287,311
GBFS	0	0	0	0	0	0	0	0

Kanthan Works

	2008	2009	2010	2011	2012*	2013*	2014*	2015*
PFA	205,791	210,657	234,997	245,248	245,248	245,248	245,248	245,248
Limestone	225,799	231,217	256,249	267,289	267,289	267,289	267,289	267,289
GBFS	0	0	0	0	0	0	0	0

Pasir Gudang Works

	2008	2009	2010	2011	2012*	2013*	2014*	2015*
PFA	121,129	124,257	127,616	131,120	131,120	131,120	131,120	131,120
Limestone	15,565	16,032	16,513	17,008	17,008	17,008	17,008	17,008
GBFS	97,091	99,209	101,734	104,461	104,461	104,461	104,461	104,461

Description of measurement methods and procedures to be applied:	Measurement method: Load cell Measurement equipment: Impact flow meter (PFA/GBFS) and belt weigher (limestone) Standards used: ISO 9001:2000 Calibration procedures: According to manufacturers recommendations Accuracy: +/-5% Person responsible: Manager – electrical and instrument Measurement interval: Continuous
QA/QC procedures to be applied:	LMCB's ISO 9001:2000 procedure
Any comment:	i) Data will be archived and retained for 2 years beyond the end of the crediting period ii)Figures for 2012-2015 are based on 2011 figures as LMCB cement marketing forecast is not available beyond year 2011.

Table 38

Data / Parameter:	$PELE_{grid\_BC,y}$
Data unit:	MWh
Description:	Baseline grid electricity for grinding BC
Source of data to be used:	Plant records

Value of data applied for the purpose of calculating expected emission reductions in section B.5

	2008	2009	2010	2011	2012 *	2013 *	2014*	2015*
Rawang	75,418	100,545	102,954	104,883	104,883	104,883	104,883	104,883
Kanthan	135,213	138,892	143,899	148,693	148,693	148,693	148,693	148,693

	Pasir Gudang	33,285	34,220	35,179	36,163	36,163	36,163	36,163	36,163
Description of measurement methods and procedures to be applied:	Measurement method: Current and voltage transformer Measurement equipment: KWh meter Standards used: TNB standard Calibration procedures: According to manufacturers recommendations Accuracy: +/-0.5% Person responsible: Manager- electrical and instrument Measurement interval: Continuous								
QA/QC procedures to be applied:	As per the National Electricity Board Standard (TNB Standard)								
Any comment:	i) Data will be archived and retained for 2 years beyond the end of the crediting period ii) The values are calculated based on the average baseline grid electricity per tonne of cement and multiplied by the cement production estimated for year 2008-2015. Figures for 2012 -2015 are based on 2011 figures as LMCB cement marketing forecast is not available beyond year 2011.								

Table B39

Data / Parameter:	$PELE_{grid\_ADD,y}$
Data unit:	MWh
Description:	Baseline grid electricity for grinding additives
Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.00
Description of measurement methods and procedures to be applied:	Measurement method: Current and voltage transformer Measurement equipment: KWh meter Standards used: TNB standard Calibration procedures: According to manufacturers recommendations Accuracy: +/-0.5% Person responsible: Manager- electrical and instrument Measurement interval: Continuous
QA/QC procedures to be applied:	Not applicable
Any comment:	There is no electricity consumed for grinding of additives in all the project activity plants.

Table B40

Data / Parameter:	$F_{i,j,y}$
Data unit:	Tonnes of Fuel i
Description:	Amount of fuel I consumed by relevant power sources j in year(s) y

Source of data to be used:	Not applicable
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable
Description of measurement methods and procedures to be applied:	Not applicable
QA/QC procedures to be applied:	Not applicable
Any comment:	These values are not calculated as the baseline grid emission factor is taken from “Study on Grid connected Electricity Baselines in Malaysia”, a study prepared by Pusat Tenaga Malaysia(Malaysian Energy Centre) . See table B36

Table B41

Data / Parameter:	$COEF_{i,j,y}$
Data unit:	tCO_2/tonne of fuel i
Description:	CO_2 emission coefficient of fuel i, taking into account the carbon content of the fuels used by relevant power sources j and the percent oxidation of the fuel in year(s) y
Source of data to be used:	Not applicable
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable
Description of measurement methods and procedures to be applied:	Not applicable
QA/QC procedures to be applied:	Not applicable
Any comment:	These values are not calculated as the baseline grid emission factor is taken from “Study on Grid connected Electricity Baselines in Malaysia”, a study prepared by Pusat Tenaga Malaysia(Malaysian Energy Centre). See table B36

Table B42

Data / Parameter:	$GEN_{i.y}$
Data unit:	MWh
Description:	Electricity generated by the source j
Source of data to be used:	IPCC
Value of data applied for	IPCC

the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Not applicable
QA/QC procedures to be applied:	Not applicable
Any comment:	Not applicable
	These values are not calculated as the baseline grid emission factor is taken from “Study on Grid connected Electricity Baselines in Malaysia”, a study prepared by Pusat Tenaga Malaysia(Malaysian Energy Centre) . See table B36

Table B43

Data / Parameter:	$PE_{calcin,y}$
Data unit:	tCO_2/tonne clinker
Description:	Emissions per tonne of clinker due to calcination of limestone
Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Rawang : 0.529 Kanthan : 0.541 Pasir Gudang : 0.539
Description of measurement methods and procedures to be applied:	The value calculated for the emission reduction is assuming that the Calcium Oxide levels in the raw materials are as per the average 2003-2005 baseline figures. The actual values will be calculated based on the plant records during the project activity period.
QA/QC procedures to be applied:	Not applicable
Any comment:	Data will be archived and retained for 2 years beyond the end of the crediting period

Table B44

Data / Parameter:	$PE_{fossil\ fuel,y}$
Data unit:	tCO_2/tonne clinker
Description:	Emissions per tonne of clinker due to combustion of fossil fuels for clinker production in year, y
Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in	Rawang : 0.344 Kanthan : 0.389 Pasir Gudang : 0.383

section B.5	
Description of measurement methods and procedures to be applied:	This is assuming that the proportions of the various fuels used are maintained in the calcination process as per the baseline average figure. The actual fuel usage has to be monitored during the project activity year to confirm these figures.
QA/QC procedures to be applied:	Not applicable
Any comment:	i) Data will be archived and retained for 2 years beyond the end of the crediting period ii) The value for the Pasir Gudang plant is from the fossil fuel emissions for clinker production in Langkawi, which is where the clinker is received from.

Table B45

Data / Parameter:	$PE_{ele\_grid\_CLNK,y}$
Data unit:	tCO_2/tonne clinker
Description:	Grid electricity emissions for clinker production per tonne of clinker in year, y
Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Rawang : 0.059 Kanthan : 0.049 Pasir Gudang : 0.049
Description of measurement methods and procedures to be applied:	This values are calculated based on the projected amount of clinker required for the project activity year and the grid emission factor based on the PTM study report.
QA/QC procedures to be applied:	Not applicable
Any comment:	i) Data will be archived and retained for 2 years beyond the end of the crediting period ii) The value for the Pasir Gudang plant is from the fossil fuel emissions for clinker production in Langkawi which is where the clinker is received from.

Table B46

Data / Parameter:	$PE_{ele\_grid\_BC,y}$
Data unit:	tCO_2/tonne BC
Description:	Grid electricity emissions for blended cement grinding in year, y
Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in	Rawang : 0.027 Kanthan : 0.031 Pasir Gudang : 0.028

section B.5	
Description of measurement methods and procedures to be applied:	This values are calculated based on the projected amount of cement produced for the project activity year and the grid emission factor based on the PTM study report.
QA/QC procedures to be applied:	Not applicable
Any comment:	Data will be archived and retained for 2 years beyond the end of the crediting period

Table B47

Data / Parameter:	$PE_{ele\_grid\_ADD,y}$
Data unit:	tCO_2/tonne BC
Description:	Grid electricity emissions for additive preparation in year, y
Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.00
Description of measurement methods and procedures to be applied:	Not applicable
QA/QC procedures to be applied:	Not applicable
Any comment:	There is no electricity consumed for additive preparation as it could be used directly into the process as it is.

Table B48

Data / Parameter:	$P_{blend,y}$
Data unit:	Tonnes of clinker / tonne of BC
Description:	Share of clinker per tonne of blended cement of blended cement in year, y
Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	(see table below)
Description of measurement methods and procedures to be applied:	These values are based on the various clinker contents of all general purpose cement types as projected and contained within the LMCB's Marketing Dept. report.

	2008	2009	2010	2011	2012	2013	2014	2015
Rawang	73.84%	75.48%	75.44%	75.42%	75.42%	75.42%	75.42%	75.42%
Kanthan	78.94%	78.99%	77.82%	77.65%	77.65%	77.65%	77.65%	77.65%
Pasir Gudang	62.95%	63.06%	63.11%	63.12%	63.12%	63.12%	63.12%	63.12%

QA/QC procedures to be applied:	Determination of the actual clinker content will be carried by the laboratory as per 1SO 17025
Any comment:	i) Data will be archived and retained for 2 years beyond the end of the crediting period ii) Figures for 2012-2015 are based on 2011 figures as LMCB cement marketing forecast is not available beyond year 2011.

Table B49

Data / Parameter:	Electricity consumption of the additive conveying system
Data unit:	MWh/year
Description:	Electricity consumption of all the additive conveying system(PFA, limestone and GBFS)
Source of data to be used:	Plant Records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	503.64KWh for Rawang, Kanthan and Pasir Gudang Plant.
Description of measurement methods and procedures to be applied:	The actual measurement of electricity consumed by the additive conveying system in all the plants will be measured through a KWh meter which will be installed by Lafarge during the project activity period.
QA/QC procedures to be applied:	Measurement method: Current and voltage transformer Measurement equipment: KWh meter Standards used: TNB standard Calibration procedures: According to manufacturers recommendations Accuracy: +/-0.5% Person responsible: Manager- electrical and instrument Measurement interval: Continuous
Any comment:	Data will be archived and retained for 2 years beyond the end of the crediting period

Table B50

Data unit:	Additive transport distance
Description:	Distance travelled to transport the additive from the additive source to the project activity plant
Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	600 km based on the longest roundtrip distance of transportation between the Kapar Power Plant and Kanthan Plant. This value is also applied for the transportation of limestone as a conservative approach for leakage calculation for the Rawang and Kanthan Plant. For Pasir Gudang Plant a distance of 1,300km roundtrip from the Ipoh Quarry to and from Pasir Gudang is used for leakage calculation for limestone

	transportation.
Description of measurement methods and procedures to be applied:	Not applicable
QA/QC procedures to be applied:	Not applicable
Any comment:	During the project activity the actual distance will be recorded for each additive consignment received in each plant and the actual leakage will be calculated accordingly.

Table B51

Data / Parameter:	No of sailing days for GBFS transportation via ship to Pasir Gudang Port
Data unit:	Days
Description:	No of days travelled by ship delivering the GBFS additive to the Pasir Gudang Port
Source of data to be used:	Shipping documentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	14 days based on the no of sailing days of GBFS shipment from Japan to Pasir Gudang port where GBFS is only used in the Pasir Gudang project activity plant
Description of measurement methods and procedures to be applied:	Not applicable
QA/QC procedures to be applied:	Not applicable
Any comment:	Data will be archived and retained for 2 years beyond the end of the crediting period

Table B52

Data / Parameter:	Quantity of GBFS transported per each shipment
Data unit:	Tonnes
Description:	Quantity of GBFS transported via ship for each shipment arriving port
Source of data to be used:	Shipping documentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1000 tonnes/shipment
Description of measurement methods and procedures to be applied:	Based on the shipment documents received for each shipment of GBFS

QA/QC procedures to be applied:	As per ISO 9001:2001 documentation
Any comment:	Data will be archived and retained for 2 years beyond the end of the crediting period

Table B53

Data / Parameter:	No of sailing days for PFA transportation via ship to Pasir Gudang Plant
Data unit:	Days
Description:	No of days travelled by ship delivering the PFA to the Pasir Gudang Plant
Source of data to be used:	Shipping documentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1 day based on the no of sailing days of PFA shipment from Tanjung Bin Power Plant to Pasir Gudang Plant where 70% of the PFA offtake from Tanjung Bin Power Plant will be transported via ship.
Description of measurement methods and procedures to be applied:	Not applicable
QA/QC procedures to be applied:	Not applicable
Any comment:	Data will be archived and retained for 2 years beyond the end of the crediting period

Table B54

Data / Parameter:	Quantity of PFA transported per each shipment via ship
Data unit:	Tonnes
Description:	Quantity of PFA transported via ship for each shipment arriving Pasir Gudang Plant
Source of data to be used:	Shipping documentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	3000tonnes/shipment
Description of measurement methods and procedures to be applied:	Based on the shipment documents received for each shipment of PFA
QA/QC procedures to be applied:	As per ISO 9001:2001 documentation
Any comment:	Data will be archived and retained for 2 years beyond the end of the crediting period

Table B55

Data / Parameter:	Quantity of PFA brought in via ship to Pasir Gudang Plant
Data unit:	Tonnes
Description:	Quantity of PFA brought in via ship to Pasir Gudang Plant from the Tanjung Bin Power Plant
Source of data to be used:	Shipping documentation/Plant Records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	70% of the total PFA supplied by the Tanjung Bin Power Plant to Pasir Gudang Plant based on the requirement stated by the Tanjung Bin Power Plant
Description of measurement methods and procedures to be applied:	Not applicable
QA/QC procedures to be applied:	Not applicable
Any comment:	Data will be archived and retained for 2 years beyond the end of the crediting period

Table B56

Data / Parameter:	Quantity of PFA brought in via road transportation to Pasir Gudang Plant
Data unit:	Tonnes
Description:	Quantity of PFA brought in via road transportation to Pasir Gudang Plant from the Tanjung Bin Power Plant
Source of data to be used:	Consignment note/Plant Records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	30% of the total PFA supplied by the Tanjung Bin Power Plant to Pasir Gudang Plant based on the requirement stated by the Tanjung Bin Power Plant
Description of measurement methods and procedures to be applied:	Not applicable
QA/QC procedures to be applied:	Not applicable
Any comment:	Data will be archived and retained for 2 years beyond the end of the crediting period

Table B57

Data / Parameter:	α_{GBFS}
Data unit:	Dimensionless
Description:	X tonnes of GBFS that is not surplus/total quantity of GBFS consumed
Source of data to be used:	World GBFS and Iron Slag Statistics from Onestone and IISI

Value of data applied for the purpose of calculating expected emission reductions in section B.5	1 as it is assumed that there is no diversion of the GBFS from any existing use.
Description of measurement methods and procedures to be applied:	Not applicable
QA/QC procedures to be applied:	Not applicable
Any comment:	Data will be archived and retained for 2 years beyond the end of the crediting period

Table B58

The leakage calculation is assumed on a worst case scenario as LMCB does not have a separate meter to monitor the electricity consumption for the additive conveying system. This approach calculates the electricity consumption based on the operating hours which are recorded by LMCB multiplied by the total power rating of the various equipment in the additive conveying system. This will produce a figure for the electricity consumption which is conservatively higher than if the electricity is directly measured as it assumes that all of the equipment is operating at maximum power all of the time- which is not the case. The total power rating of equipment in the additive conveying system is included in the monitoring plan which is recorded from the nameplate rating on the equipment itself.

However during the project activity period LMCB will ensure that a meter is installed to accurately measure the electricity consumption of the additive handling system to ensure that above values will be calculated as per the methodology.

B.7.2 Description of the monitoring plan:

This section details the steps to be taken to monitor on a regular basis the necessary parameters to monitor the GHG emissions reductions of this project. The main components covered within this section are:

1. Operational procedures and quality assurance responsibilities

The requirements of this Monitoring Plan are in line with the types of information routinely collected by companies operating within the cement manufacturing sector, so internalising the procedures into the rigorous data collection system which is already in place, should be simple and straightforward. If necessary, the Monitoring Plan can be updated and adjusted to meet operational requirements, provided that such modifications are approved by a Designated Operational Entity during the process of verification.

The overall responsibility for ensuring that the monitoring is adequately and rigorously carried out will be that of the Resource Recovery Department headed by its General Manger-Alternative Fuels/Environment Department. In turn designation of this task will be to the managers of the various plants included in the project. It is anticipated that the data will be collected by a designated team of Technical Engineers who will also be responsible for calculating the emissions by the use of a spreadsheet. The monthly and annual

reports containing the volume of emissions reductions will be produced by the plant managers, who will archive the data at the various plants ensuring easy access for verification. The General Manager of the Alternative Fuels/Environment Resource Recovery Department will be responsible for ensuring that the monthly and annual reports have been produced according to the procedures in place. They will also ensure that the archived data and reports are kept in a secure environment, such that they can be accessed when required. LMCB have data back up services in place, into which the data required by the verifier will be incorporated and stored off site on a monthly basis. Furthermore, LMCB will ensure that the data is stored for a period of 2 years beyond the crediting period.

The procedures required in carrying out this monitoring plan are as follows:

a. Procedures for addressing erroneous measurements,
b. Procedures for day-to-day record handling,
c. Procedure for handling of emergencies situations,
d. Procedure for review of reported results/data, and
e. Procedures for corrective actions in order to provide for more accurate future monitoring and reporting.

LMCB is certified to ISO 9001:2000 standard, and as such much of the above procedures will be covered as part of compliance with that standard. However, LMCB will ensure that should any training be required over and above what has already been given to its employees to comply with the CDM procedures, this will be carried out.

There are no procedures identified for emergency preparedness as there will be no unintended emissions due to emergency situation. For example any major unplanned breakdown in the additive handling system will force the plant to be shutdown which will not release any accidental emissions. In such case the plant will either continue to be shutdown until the problem is rectified or the plant will switchback to OPC production in which case the GHG emissions will be captured in the existing monitoring plan (lower emission reduction than expected).

The table below summarizes the tasks and responsibilities required to monitor this project and ensure that the data collected is of adequate quality.

Task	On-site technician within the various plants included in the project	Managers of the various plants included in the project	Resource Recovery Dept within Lafarge
Collect Data	E	R	I
Enter data into Spreadsheet	E	R	I
Make monthly and annual reports	N/A	E	R
Archive data & reports	I	E	R

Calibration/Maintenance; Rectify faults	I	R	I

E = Responsible for executing data collection
R = Responsible for overseeing and assuring quality
I = To be informed

Table B59 Tasks and responsibilities required to monitor this project and ensure that the data collected is of adequate quality and the persons designated for this within the client's organization.

B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

>>
Date of completion of the baseline study: 06/12/2006

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2511 AM Den Haag
The Netherlands

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SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>> 14/06/2006 (Start of project implementation)

C.1.2. Expected operational lifetime of the project activity:

>> 30 years

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>> The crediting period will start on 01/06/2008 or on the date of registration of the CDM project activity, whichever is later.

C.2.1.2. Length of the first crediting period:

>> 7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

C.2.2.2. Length:

>>

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

The project will reduce the negative environmental impacts associated with clinker production: local air pollution from fossil fuel firing, quarrying and transport of raw material, CO2 emissions from the calcinations reaction.

The increase in fly ash use will have a major positive impact on the environmental issue of fly ash disposal – fly ash being a by-product from coal-fired power plants, considered as a waste. It will however need to be transported and therefore the project will result in increased emissions due to ash transport.

An increase in the quantity of fly ash used will result in a greater quantity of fines handled. The entire fly ash transfer and processing system is a closed loop, which would ensure that all of the fines are contained. However, in addition to this, the following measures have also been taken to minimize the impact of dust:

- Air pollution control systems have been installed which will effectively remove the additional dust which has been referred to above.

- The fly ash is transported into closed circuit silos so as to eliminate the fugitive emissions.

- All the unloading points are covered and provided with dust collection systems for maintaining the integrity of the local environment..

- Fly ash is pneumatically conveyed with a flow control system with “de-dusting systems” installed to remove fugitive emissions.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

Given that the project activity will have minimal environmental impacts, a full Environmental Impact Assessment (EIA) will not be required for the project activity. Full EIA’s were completed at the time of construction of the cement plants and also under go annual inspection and are granted licenses to operated by the relevant Malaysian Authorities.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

Stakeholder comments have been obtained through 4 routes:

1) National stakeholders: The CDM approval process in Malaysia requires that the PDD be reviewed and approved by four separate internal organisations. These are provided below and are in the order in which the PDD must be submitted:

a) Pusat Tenaga Malaysia (PTM): This is the CDM Energy Secretariat within Malaysia
b) Technical Committee Energy
c) National Steering Committee for CDM (NSCCDM)
d) Ministry of Natural Resources and Environment (NRE), this is also the DNA.

2) The project has also received stakeholder approval through the application and obtaining of consents to operate from the Malaysian Authorities.

3) The PDD will be posted on the UNFCCC website for 30 days and comments from international stakeholders invited.

4) As discussed in section D.2, the environmental impacts of the project are stated not to be significant. In fact it is deemed that the project will have wider benefits to the local environment. By reducing the amount of clinker being utilized in the cement blend, limestone is being conserved and by increasing the quantity of additive, usage of a waste product from the electricity generating sector is being increased. However, as part of the client's best practice, letters have been sent out to the following stakeholders listed below in the three regions where the plants are located, detailing the project activity and inviting comments:

- Local councils
- Schools
- Community leaders
- NGO's
- Political Parties
- Relevant government agencies (e.g Mineral and Geosciences Dept.)

E.2. Summary of the comments received:

Letters were sent to the stake holders listed in (4) above in the regions where the various plants are located providing details of the project. To date, only two comments have been received both of which are positive. These comments have been summarised and provided in the table below.

Date	Organisation comments received from	Comments received
03/10/2006	Jawatankuasa Kemajuan Dan Keselamatan, Chemor	"The achievement of clinker usage can ensure that our

		Kanthan residents live in a cleaner and healthier environment. The project can be done to try and reduce the pollution of the environment and no coming chemical reaction for our Kanthan residents.”
12/10/2006	Johor Port Berhad	“Congratulations to your esteemed company for the successful achievement of the CDM project. JPB lauds Lafarge for the drive in reducing GHG emissions through reduced clinker usage. We believe this project will create a clean and healthier environment to us of us within the port vicinity.”

E.3. Report on how due account was taken of any comments received:

Since there have only been positive issues raised by the respective stakeholders, no action is required in this regard. It should also be noted that LMCB have taken several measures in order to minimise the effects on the environment of transporting and processing of the fly ash.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Lafage Malayan Cement Bhd
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Represented by:	
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

This project will not receive any public funding.

Annex 3

BASELINE INFORMATION

Rawang Plant

CEMENT PRODUCTION		Average	2003	2004	2005
General Purpose Cement					
Quantity of general purpose cement produced	tonnes/yr	1,776,758	1,755,963	1,774,692	1,799,620
Quantity of clinker used for general purpose cement	tonnes/yr	1,474,953	1,479,774	1,448,107	1,496,979
% clinker per ton of general purpose cement produced	ton clinker/ton cement	83.02	84.27	81.60	83.18
CALCINATION PROCESS		**Average**	**2003**	**2004**	**2005**
Input					
Quantity of raw material used for clinker production	tonnes/yr	2,576,893	2,609,229	2,679,115	2,442,334
CaO content of raw material	%	0	0	0	0
MgO content of raw material	%	0	0	0	0
Output					
Quantity of clinker produced	tonnes/yr	1,550,097	1,531,200	1,634,845	1,484,245
CaO content of clinker	%	66.42	66.45	66.40	66.42
MgO content of clinker	%	0.66	0.71	0.61	0.67

FOSSIL FUEL USE FOR CLINKER PRODUCTION (KILN)		Average	2003	2004	2005
Petrol coke	tons/yr	1,703	5,108	0	0
Heavy oil	tons/yr	3,584	5,235	1,914	3,602
Solvents	tons/yr	0	0	0	0
Diesoline	tons/yr	70.	173	0	36
Coal	tons/yr	193,375	177,573	209,044	193,509
Palm Kernel Shell	tons/yr	34,875	42,470	25,713	36,442

ELECTRICITY USE		**Average**	**2003**	**2004**	**2005**
Grid electricity for clinker production	MWh/year	148,156	148,572	152,384	143,512
Self generated electricity for clinker production	MWh/year	0	0	0	0
Grid electricity for grinding for general purpose cement	MWh/year	76,997	76,789	76,087	78,114
Self-generated electricity for grinding for general purpose cement	MWh/year	0	0	0	0
Grid electricity for grinding for cement 2	MWh/year	0	0	0	0
Self-generated electricity for grinding for cement 2	MWh/year	0	0	0	0
Grid electricity for preparing additives for general purpose cement	MWh/year	0	0	0	0
Self generated electricity for grinding additives for general purpose cement	MWh/year	0	0	0	0
Grid electricity for preparing additives for cement 2	MWh/year	0	0	0	0
Self generated electricity for grinding additives for cement 2	MWh/year	0	0	0	0

TRANSPORT OF ADDITIVES (if all additives are on-site: leave blank)					
Fuel consumption for the vehicle	kg fuel/km	0.213			
Fuel used	type of fuel	Diesel			
Distance between the source of additives and the plant	km/vehicle trip	600			
Amount of additives carried per trip	ton/vehicle trip	25			
Electricity consumption of the conveyor system for additives	MWh/yr	4,412	4,412	4,412	4,412

	Av 3yrs	2003	2004	2005
OPC				
tonnes/yr		919,809	999,900	964,497
ton clinker/ton cement	0.9261	0.9231	0.9277	0.9275
PPC				
tonnes/yr		543,161	528,621	615,972
ton clinker/ton cement	0.7576	0.7939	0.7496	0.7293
Masonry				
tonnes/yr		292,993	246,171	189,699
ton clinker/ton cement	0.69	0.69	0.69	0.69

Clinker in cement	1,483,637	1,482,477	1,493,736	1,474,699
Raw material		2,609,229	2,679,115	2,442,334
Total cement production	1,766,941	1,755,963	1,774,692	1,770,168
Raw material/clinker ratio	1.663	1.704	1.639	1.646

Electricity consumption factor (MWh/kt BC)	**Average**	**2003**	**2004**	**2005**
Clinker	95.64	97.03	93.21	96.69
OPC	43.58	43.73	42.87	44.13
PPC	43.58	43.73	42.87	44.13
Masonary	43.58	43.73	42.87	44.13

Electricity For Additive Conveying		
Total Kwh of drives		503.64
Assuming operation hours/yr		8,760
Total Mwh of power/yr		4,412

Fuel emission factors			
Parameter	Value	Unit	Source
Fuels used for transport of additives:			
Gasoline	3.0736	tCO2/t fuel	IPCC 2006
Diesel	3.185	tCO2/t fuel	IPCC 2006
Fuels used for kiln:			IPCC 2006
Petrol coke	3.170	tCO2/t fuel	IPCC 2006
Heavy oil	3.126	tCO2/t fuel	IPCC 2006
Solvents	0	tCO2/t fuel	IPCC 2006
Diesoline	3.185	tCO2/t fuel	IPCC 2006
Coal	2.668	tCO2/t fuel	IPCC 2006
Palm Kernel Shell	0	tCO2/t fuel	IPCC 2006
-		tCO2/t fuel	IPCC 2006
-		tCO2/t fuel	IPCC

Kanthan Plant

CEMENT PRODUCTION					
General purpose cement		**Average**	**2003**	**2004**	**2005**
Quantity of general purpose cement produced	tonnes/yr	2,753,517	2,748,894	2,776,260	2,735,398
Quantity of clinker used for general purpose cement	tonnes/yr	2,435,937	2,418,759	2,449,348	2,439,704
% clinker per ton of general purpose cement produced	ton clinker/ton cement	88.47	87.99	88.22	89.19

CALCINATION PROCESS		**Average**	**2003**	**2004**	**2005**
Input					
Quantity of raw material used for clinker production	tonnes/yr	4,454,556	4,334,490	4,620,712	4,408,465
CaO content of raw material	%	0	0	0	0
MgO content of raw material	%	0	0	0	0
Output					
Quantity of clinker produced	tonnes/yr	2,774,594	2,691,415	2,868,178	2,764,189
CaO content of clinker	%	65.53	65.69.	65.75	65.15
MgO content of clinker	%	2.48	2.22	2.25	2.97

FOSSIL FUEL USE FOR CLINKER PRODUCTION (KILN)		**Average**	**2003**	**2004**	**2005**
Petrol coke	tons/yr	55,412	35,022	47,243	83,970
Heavy oil	tons/yr	0	0	0	0
Solvents	tons/yr	0	0	0	0
Diesoline	tons/yr	3,957	4,314	3,477	4,081
Coal	tons/yr	333,787	322,420	366,357	312,585
Palm Kernel Shell	tons/yr	19,948	44,618	7,773	7,454

ELECTRICITY USE		**Average**	**2003**	**2004**	**2005**
Grid electricity for clinker production	MWh/year	216,478	214,271	210,426	224,736
Self generated electricity for clinker production	MWh/year	0	0	0	0
Grid electricity for grinding for general purpose cement	MWh/year	136,574	127,665	143,037	139,019
Self-generated electricity for grinding for general purpose cement	MWh/year	0	0	0	0

Grid electricity for preparing additives for general purpose cement	MWh/year	**0**	**0**	**0**	**0**
Self generated electricity for grinding additives for general purpose cement	MWh/year	**0**	**0**	**0**	**0**

TRANSPORT OF ADDITIVES (if all additives are on-site: leave blank)					
Fuel consumption for the vehicle	kg fuel/km	0.213			
Fuel used	type of fuel	Diesel			
Distance between the source of additives and the plant	km/vehicle trip	600			
Amount of additives carried per trip	ton/vehicle trip	25			
Electricity consumption of the conveyor system for additives	MWh/yr	4,412	4,412	4,412	4,412

	Av 3yrs	**2003**	**2004**	**2005**
OPC				
tonnes/yr		1,888,816	1,945,405	1,846,829
ton clinker/ton cement	0.9366	0.9379	0.9435	0.9283
PPC				
tonnes/yr		513,235	585,456	580,325
ton clinker/ton cement	0.7677	0.7939	0.7366	0.7725
Masonry				
tonnes/yr		338,043	245,509	198,245
ton clinker/ton cement	0.6578	0.6289	0.6500	0.6945
Clinker in cement	2,372,828	2,391,671	2,426,402	2,300,412
Raw material	4,454,556	4,334,490	4,620,712	4,408,465
Total cement production	2,713,954	2,740,094	2,776,370	2,625,399
Raw material/clinker ratio	1.605	1.610	1.611	1.595

Electricity consumption factor (MWh/kt BC)	**Av 3yrs**	**2003**	**2004**	**2005**
Clinker	78.09	79.61	73.37	81.30

OPC	50.35	46.59	51.52	52.95
PPC	50.35	46.59	51.52	52.95
Masonary	50.35	46.59	51.52	52.95

Electricity For Additive Conveying		
Total Kwh of drives		503.64
Assuming operation hours/yr		8,760
Total Mwh of power/yr		4,412

Fuel emission factors			
Parameter	Value	Unit	Source
Fuels used for transport of additives:			
Gasoline	3.0736	tCO2/t fuel	IPCC 2006
Diesel	3.185	tCO2/t fuel	IPCC 2006
Fuels used for kiln:			
Petrol coke	3.170	tCO2/t fuel	IPCC 2006
Heavy oil	3.126	tCO2/t fuel	IPCC 2006
Solvents	0	tCO2/t fuel	IPCC 2006
Diesoline	3.185	tCO2/t fuel	IPCC 2006
Coal	2.668	tCO2/t fuel	IPCC 2006
Palm Kernel Shell	0	tCO2/t fuel	IPCC 2006
-		tCO2/t fuel	IPCC 2006
-		tCO2/t fuel	IPCC 2006

Pasir Gudang Plant

CEMENT PRODUCTION					
General purpose cement					

Quantity of general purpose cement produced	tonnes/yr	643,827	565,332	665,309
Quantity of clinker used for general purpose cement	tonnes/yr	590,684	528,698	606,928
% clinker per ton of general purpose cement produced	ton clinker/ton cement	91.75	93.52	91.22

CALCINATION PROCESS				
Input				
Quantity of raw material used for clinker production	tonnes/yr	938,787	823,879	965,712
CaO content of raw material	%	0	0	0
MgO content of raw material	%	0	0	0
Output				
Quantity of clinker brought in from Langkawi	tonnes/yr	587,987	524,402	605,632
CaO content of clinker	%	66.28	66.31	66.48
MgO content of clinker	%	1.71	1.64	1.53

FOSSIL FUEL USE FOR CLINKER PRODUCTION (KILN) in LANGKAWI				
Petrol coke	tons/yr	93,367	94,385	81,401
Heavy oil	tons/yr	0	0	0
Solvents	tons/yr	0	0	0
Diesoline	tons/yr	3,268	3,905	3,054
Coal	tons/yr	311,392	306,133	325,971
Palm Kernel Shell	tons/yr	0	0	0

ELECTRICITY USE				
Clinker production in Langkawi		2,966,294	2,990,724	2,907,995
Electricity Usage For Clinker in Langkawi		234,295	227,893	232,640
Electricity per te of clinker		0.079	0.076	0.080
Grid electricity for clinker production	MWh/year	46,540	39,959	48,451
Self generated electricity for clinker production	MWh/year	0	0	0
Grid electricity for grinding for general purpose cement	MWh/year	29,381	26,341	30,355
Self-generated electricity for grinding for general purpose cement	MWh/year	0	0	0
Grid electricity for preparing additives for general purpose cement	MWh/year	0	0	0
Self generated electricity for grinding additives for general purpose cement	MWh/year	0	0	0

TRANSPORT OF ADDITIVES (if all additives are on-site: leave blank)				
Land transport(via lorries for all additives transported by land)(PFA/Limestone)				
Fuel consumption for the vehicle	kg fuel/km	0.213		
Fuel used	type of fuel	Diesel		
Distance between the source of additives and the plant(PFA and GBFS)	km/vehicle trip	600		
Distance between the source of additives and the plant(Limestone)	km/vehicle trip	1,300		
Amount of additives carried per trip	ton/vehicle trip	25		
Sea transport(for transportation of GBFS and PFA via ship)				
Fuel consumption for the ship	Tons/day	0.546		
Fuel used	type of fuel	Bunker fuel		
No of days travelled between the source of additives and the plant(GBFS)	days	14		
No of days travelled between the source of additives and the plant(PFA)	days	1		
Amount of additives carried per shipment(GBFS)	ton/shipment	1,000		
Amount of additives carried per shipment(PFA)	ton/shipment	3,000		
Electricity consumption of the conveyor system for additives	MWh/yr	4,412	4,412	4,412

	Av 3yrs	**2003**	**2004**	**2005**
OPC				
tonnes/yr		565,332	638,985	660,134
ton clinker/ton cement	0.9206	0.9276	0.9193	0.9150
PPC				
tonnes/yr		0	0	0
ton clinker/ton cement	0	0	0	0
Masonry				
tonnes/yr		0	26,324	40,706
ton clinker/ton cement	0.4755	0	0.6919	0.7346
Clinker in cement	587,987	524,402	605,632	633,925
Raw material	938,787	823,879	965,712	1,026,770
Total cement production	643,827	565,332	665,309	700,840
Raw material/clinker ratio	1.595	1.571	1.595	1.620

Electricity consumption factor (MWh/kt BC)	**Av 3yrs**	**2003**	**2004**	**2005**
Clinker	78.99	76.20	80.00	80.78
OPC	45.70	46.59	45.63	44.87
PPC	45.70	46.59	45.63	44.87
Masonary	45.70	46.59	45.63	44.87

Electricity For Additive Conveying		
Total Kwh of drives		503.64
Assuming operation hours/yr		8,760
Total Mwh of power/yr		4,412

Fuel emission factors			
Parameter	Value	Unit	Source
Fuels used for transport of additives:			
Gasoline	3.0736	tCO2/t fuel	IPCC 2006
Diesel	3.185	tCO2/t fuel	IPCC 2006
Fuels used for kiln:			
Petrol coke	3.170	tCO2/t fuel	IPCC 2006
Heavy oil	3.126	tCO2/t fuel	IPCC 2006
Solvents	0	tCO2/t fuel	IPCC 2006
Diesoline	3.185	tCO2/t fuel	IPCC 2006
Coal	2.668	tCO2/t fuel	IPCC 2006
Palm Kernel Shell	0	tCO2/t fuel	IPCC 2006
-		tCO2/t fuel	IPCC 2006
-		tCO2/t fuel	IPCC 2006

Annex 4

MONITORING INFORMATION

There is no further information to add into this section. The monitoring of the project activity has been documented in Section B.7