MONITORING REPORT FORM (CDM-MR) *
Version 01 - in effect as of: 28/09/2010

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MONITORING REPORT No. 2
Version number 1 dated 05/07/2011

India-FaL-G- Brick and Blocks Project No.1
0707
01/04/2007-31/03/2011

SECTION A. General description of the project activity

A.1. Brief description of the project activity:

'India-FaL-G-Brick and Blocks Project No.1' is primarily a bundled activity of small and micro-industrial plants those practice an eco-friendly technology known as 'FaL-G Technology', using fly ash as one of the main inputs. FaL-G bricks replace sintered clay bricks, contributing to mineral and energy conservation. By avoiding use of thermal energy in the production of fly ash bricks the project contributes for conservation of fossil fuel (coal), and, in turn, abates associated emissions. Fly ash bricks replace clay bricks as walling material serving all functional and performance criteria with better engineering properties.

In addition the project also contributes to sustainable development in many ways as explained below, thus getting qualified under CDM. By displacing burnt clay bricks the project contributes for:

- Ecology protection by minimising eco-hostile practice of topsoil denudation and resultant land degradation;

- Pollution abatement otherwise caused by emission of unprocessed flues out of brick kilns.

- Environment protection by putting to use industrial wastes as value added building materials.

On social front, the project creates business opportunities for the small and micro enterprises. In contrast to the seasonal production-operations in the clay brick industry, FaL-G plants facilitate continuous yearlong operation, and hence provide employment all through the year for the skilled artisans and create self-help livelihood for the illiterate poor.

By taking advantage of CDM program, this project targets to catalyse proliferation of huze number of fly ash brick industries in the country, in order to prevent the use of 200 billion clay bricks and resultant emissions of over 48.40 million tons.

Notwithstanding the intrinsic environmental and social benefits of the project, the specific community benefit program, particularly the health and accident insurance schemes being implemented to meet the requirements of the Community Development Carbon Fund (CDCF) of the World Bank, would enhance the benefits further.

FaL-G has its antecedents from the ancient pozzolanic chemistry practiced over 2000 years back. The modern knowledge on material science has helped to pronounce the process with technical rationale. Basically two machines do involve for a plant; roller (pan) mixer for preparation of FaL-G and casting machine to cast the product.

It needs over 2 to 4 weeks for the development infrastructure. Otherwise the plant can be installed in one day and production can be started immediately. The plant is normally operated for single shift. However, depending on the seasonal demand, extra hours of operation is not uncommon. Similarly the efficiency of man power decides the output rather than the rated capacity of plant.

This project has earned 44,249 ERs for 2007-11, for the four years covered by this Monitoring Report.

The PDD and associated documents can be accessed from UNFCCC web site http://cdm.unfccc.int/Projects/DB/DNV-CUK1161790286.9/history

Reporting Period

The present reporting period for the project is April 01, 2007 to March 31, 2011, inclusive of both the days.

A.2. Project Participants

The list of Parties and Project Participants involved in Project are given vide Table 1.

A.3. Location of the project activity:

Project activity is located in various districts of the State of Andhra Pradesh, India. Please refer Table 2 with geographical coordinates.

A.4. Technical description of the project

THE TECHNOLOGY

It is a known art since millennia that addition of lime to fly ash initiates pozzolanic chemistry, which can be augmented through hydro-thermal treatment in autoclaves at high temperature (150-180 oC) and pressure (8-12 bar). The innovative part of FaL-G technology is to accelerate pozzolanic chemistry by adding gypsum by which the development of ettringite phase to threshold limits invigorate the strengths of fly ash-lime mix. Therefore, FaL-G does not require energy intensive equipments such as heavy duty-press and autoclave, which were otherwise, required in case of erstwhile fly ash brick technologies. FaL-G technology completely eliminates thermal treatment, and does not require combustion of any fossil fuel.

The key ingredients of the FaL-G products are fly ash, lime, and gypsum, which are well-known mineral substitutes. All these materials are available in the form of byproducts from industrial activities and are available in adequate quantities in the areas, where the project activities are located. By-product lime is available at competitive cost over the mineral lime. Alternate to FaL-G in lime route, the technology has also been developed in cement (OPC) route, whereby the surplus lime in cement gets into pozzolanic chemistry. It is economical to use OPC than mineral lime and, hence, OPC is preferred in areas where by-product lime is scarce or not available, may be due to profuse FaL-G activity. In view of quality and logistical issues in procuring lime many entrepreneurs adopt FaL-G in OPC route.

The process-flow chart is enclosed as Figure 1.

A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

The project has been submitted under the Approved Methodology Type II, AMS-IID. Energy Efficiency and Fuel Switching Measures for Industrial Facilities (Version 07: 28 November, 2005).

A.6. Registration date of the project activity:

India-FaL-G Brick and Blocks Project No. 1 is registered with UNFCCC vide Reference No. 0707 on February 16, 2007.

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

Fixed Ten years ie., April 01, 2004-March 31, 2014

A.8. Name of responsible person(s)/entity(ies):

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e-mail: nkalidas@co2credits.biz; Personal mail: bhanukali@vsnl.com

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

The Start Date of the Project activity is January 01, 2003.

This is one of the prompt-start projects where all the units were set up a few months earlier to April 2004. This CDM project has been submitted as a bundle of 14 plants located in different districts in the state of Andhra Pradesh, India, and operated by individual entrepreneurs called Sub-Project Entities (SPEs). However, unit with ID No. AP/VSP/I/12 was closed and hence dropped from the bundle forever right at the beginning of the project without earning any credits. Two other SPEs with ID Nos. AP/VZM/I/13 & AP/VZM/I/14 earned CERs during 2004-07, but were dropped from the bundle for showing non-compliance during the reporting year 2007-08. Thus the number of units remained in Bundle I is 11 and their aggregate capacities district-wise are as follows:

States	District	No. of Plants	Aggregate Capacity - m^3/year
Andhra Pradesh	Krishna	6	27,000
	West Godavari	3	12,600
	East Godavari	1	3,600
	Visakhapatnam	1	4,500
	Vizianagaram	-	--
Total		**11**	**47,700**

In the first monitoring period of April 2004 to March 2007, this project has earned 27,433 CERs.

B.2. Revision of the monitoring plan

Not Applicable

B.3. Request for deviation applied to this monitoring period

No deviation has been applied to this monitoring period.

B.4. Notification or request of approval of changes

No notification is issued nor any request for approval of changes, from the project activity as described in the registered CDM-PDD, is applied for.

SECTION C. Description of the monitoring system

Tables in Section D elucidate the data to be monitored and the frequency of monitoring. Accordingly the data have been collected and archived as per schedule, and emission reductions have been computed at the end of the year.

Monitoring Approach - QC & QA Measures Adopted:

Though all Sub-Project Entities (SPEs) use FaL-G technology, the proportions of the ingredients and type of plant & machinery vary depending on the techno-economic logistics of each SPE's plant. These issues were documented during interaction with SPEs, which had been formed as the basis for developing benchmark values as given vide Table -2.

Project Entity (PE) developed templates on various data for monitoring and provided to SPEs. SPEs submit monthly reports to PE consisting of production and sales data on daily basis and other data on monthly basis. Upon receipt, the monthly reports are reviewed by the monitoring personnel of PE and electronically archived for consolidation. The total data, together with daily reports, are kept ready for submission to DOE for verification.

The monitoring personnel of PE make random visits to SPEs, during which they verify the production records, stock registers and purchase bills to check the diligence of the monthly data. The production output in a small-scale plant does not go by label capacity, and is governed by the manpower number, their efficiency and working hours in a day. Hence instead of taking the production records alone into consideration, it is opined to tally the production output of SPEs through other verifiable factors such as fly ash consumption and electricity consumption, so as to arrive at the conservative datum of production and, in turn, emission reductions. Electricity consumption is recorded from the electricity bills issued by the State Electricity Department. However, as an additional and alternate source, SPEs are asked for providing monthly statement of consumption of Electricity for every calendar month.

The approach is described under 'Computation of Emission reductions'. This is small and micro sector activity involving no monitoring/calibration equipment in production front. Monitoring Electricity meters is taken care by the Electricity departments. Whenever SPE notices a fault/malfunction in the meters, the Electricity department is informed for due replacement with good meters.

The line diagram is attached as Figure 2 showing the monitoring points.

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors	
Data / Parameter:	**EF_{diesel}**
Data unit:	t CO_2/ litre
Description:	Emission of diesel is derived directly out of diesel procured, using default values.
Source of data used:	IPCC default value

Value(s) :	0.0032 ton CO_2/litre
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	To compute project emissions.
Additional comment:	Default values provide for conservative estimates.

Data / Parameter:	**EF_{elec}**
Data unit:	t CO_2/mWh_e
Description:	Emissions of electricity are derived directly out of power consumption using default values.
Source of data used:	IPCC default value
Value(s) :	0.9 t CO_2/mWh
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	To compute project emissions.
Additional comment:	Default values provide for conservative estimates.

Data / Parameter:	**$SEC_{clay\ brick}$**
Data unit:	GWh_{th}/m^3 brick
Description:	Specific energy consumption of burnt clay bricks is taken as the base line energy consumption, which is provided in terms of mJ/kg brick that is duly converted to GWh_{th}/m^3 to tally with cap on energy as per approved methodology.
Source of data used:	'Emission standards for brick kilns – an opportunity for technology upgradation' by Tata Energy Research Institute, Delhi, India.
Value(s) :	0.000725 GWh_{th}/m^3
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	To compute baseline emissions.
Additional comment:	In view of vast country with different conditions of practice, default value is taken for conservative estimates of baseline energy consumption which is in turn used to compute baseline emissions.

Data / Parameter:	**CEF_{coal}**
Data unit:	t C/TJ
Description:	Carbon emission factor for coal is used to compute the baseline emissions.
Source of data used:	IPCC default value
Value(s) :	25.8 t C/TJ
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	To compute baseline emission.
Additional comment:	Default values are taken for conservative estimates.

D.2. Data and parameters monitored	
Data / Parameter:	**QL_{FaL-G}**
Data unit:	m^3
Description:	SPEs maintain the stocks of different sizes of bricks/blocks in number in the stock registers which are duly converted to cubic meters.

Measured /Calculated /Default:	Calculated.
Source of data:	Actual quantities from the production records, to be tallied with consumption of utilities and procurement of fly ash.
Value(s) of monitored parameter:	187306 m^3
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	For baseline calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Calculations are in number duly converted to volume. No monitoring equipment is necessary.
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	Production data vide stock register
QA/QC procedures applied:	The production is recorded in the stock register. As a counter-check mechanism, taking the values of specific fly ash and power consumption, which do vary from unit to unit, two more production quantities are independently derived and, the lowest production value is taken as 'acceptable production'.

Data / Parameter:	**Electricity - Q_{elec}**
Data unit:	kWh otherwise mentioned as units.
Description:	The units are recorded periodically from the Electricity Meter installed by the service provider
Measured /Calculated /Default:	Measured.
Source of data:	Periodical electricity bills provided by the State Electricity Department.
Value(s) of monitored parameter:	386729_kWh
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	For Project Emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Electricity meters installed by the service provider. No calibration is conducted; Erratic meters, if noticed during recording, are replaced with good meters.
Measuring/ Reading/ Recording frequency:	Periodically such as Monthly/bimonthly
Calculation method (if applicable):	NA
QA/QC procedures applied:	NA

Data / Parameter:	**Diesel - Q_{diesel}**
Data unit:	Litre
Description:	The units are recorded from the purchase bills based on which project emissions are calculated.
Measured /Calculated	

/Default:	Measured.
Source of data:	Purchase bills.
Value(s) of monitored parameter:	21386 litres
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	For Project Emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N.A
Measuring/ Reading/ Recording frequency:	As per purchase schedules, whenever diesel is purchased, the same is recorded in stock book.
Calculation method (if applicable):	Based on bills.
QA/QC procedures applied:	NA

SECTION E. Emission reductions calculation

Computation of Emission Reductions:

Emission reductions are computed as the difference between baseline emissions and project emissions as detailed below.

E.1. Baseline emissions calculation

This section shall include all formulae used and description to calculate the baseline emissions applying actual values. A table may be used and included in this monitoring report or include references to spreadsheet.

Baseline and its Development:

As per AMS II.D**.** "the energy baseline consists of the energy use of the existing equipment that is replaced in the case of retrofit measures and of the facility that would otherwise be built in the case of a new facility".

The project involves setting up new facilities for production of bricks and blocks by using the FaL-G technology, which is energy efficient. The energy baseline is therefore the energy use of the facilities that would otherwise be built in the absence of the project in order to meet the demand for walling material, comparable in quality and utility to that of bricks and blocks produced through FaL-G technology. The data on market of walling material indicate that burnt clay bricks represent more than 95% of the total walling material market. Production of burnt clay bricks is therefore considered the baseline scenario.

Energy Baseline

Based on the justifications provided above, energy used in burnt clay brick production is considered as the energy baseline.

Production of burnt clay bricks employs different technologies with different levels of energy consumption. Since it is difficult to determine precisely a particular technology that would be used in the absence of project activity, a weighted average energy use of these technologies is considered to best

represent the baseline energy consumption. The technologies, which are banned by regulation, have not been considered in calculating the weighted average energy use.

Energy consumption of different types of brick kilns in India

Burnt clay brick technologies	Specific energy consumption (MJ/kg-brick) SECx		Production capacities (100000 kg - bricks/year) Qx		No. of Plants Nx
	Range	Average	Range	Average	
BTK- fixed chimney	1.0 – 1.5	1.25	83 - 275	179	25000
High draft/ zig zag	0.8 – 1.0	0.9	83 - 138	110	200
Clamps	2.0 – 3.0	2.5	1.4 – 27.5	14	60,000
Vertical Shaft Brick Kiln	0.8 – 1.0	0.9	14 - 110	62	30

The different technologies that are used to produce burnt clay bricks include clamps, Movable Chimney Bull Tranche Kilns (MCBTK), Fixed Chimney Bull Tranche Kiln (FCBTK), High Draft Kilns (HDKs) and the recently introduced Vertical Shaft Brick Kiln (VSBK) technology. Concerned over the increasing pollution from brick industry, the Government of India has already banned the use of MCBTK and it does not issue any clearances/approvals to set up new brick units using MCBTK. Therefore, MCBTKs have not been considered in the energy baseline. The energy baseline (energy use for production of unit volume of bricks/blocks) is determined by considering the remaining technologies and their prevalence in the market using the data presented in the table above.

The weighted average specific energy for burnt clay brick is thus calculated by using the following formulae.

$$SEC_{claybrick} = \frac{\sum_x SEC_x \bullet Q_x \bullet N_x}{\sum_x Q_x.N_x}$$

Where

$SEC_{clay\ brick}$ = Weighted average specific energy of clay brick (MJ/kg-brick)
SEC_x = Specific energy of brick produced using technology x (MJ/kg)
Q_x = Production capacity of brick plants using technology x (100000 kg-bricks/year)
N_x = No.of plants that use technology x in the country
X = different types of technologies

The weighted average energy consumption figure for clay brick production using the above equation and the data presented above works out to be 1.45 MJ/kg-brick. Considering the popularly practiced dimensions of length, breadth and height of burnt clay brick to be 22 cm, 10 cm, and 7 cm respectively, and weight of the brick to be approximately 2.77 kg/brick (at 1800 kg/m^3), the specific energy consumption translates to be 0.00261 TJ/m^3bricks or 0.000725 GWhth. The value 0.000725 GWhth was used for calculating thermal energy requirement in baseline and computing baseline emissions.

Emission Baseline

Coal is the main source of energy used for manufacturing burnt clay bricks in India. The second choice of fuel is biomass, including fuel wood. In one of the studies undertaken by the FAO[1] the annual use of fuel wood in the entire brick industry in the country is reported to be only 300,000 tons, while the use of coal is reported to be about 14,000,000 tons. Thus use of fuel wood represents less than 2% in terms of energy inputs of the total energy requirement of the brick industry in all of India. Since the values reported in the FAO report do not distinguish between the renewable biomass and nonrenewable biomass, the actual fraction of renewable biomass (with zero emissions) is likely to be lower. Further the situation with biomass, which was earlier available as a cheaper fuel, is changing rapidly nation wide.

The ongoing initiatives for biomass-based power plants have introduced competition in the market, increasing the cost of biomass. In the absence of any precise information on the use of biomass in brick industry, it is proposed to fix the biomass usage in brick production conservatively at 5% of the total energy input, for all the areas included in the project. This figure is higher than the national average figure of less than 2% reported in the FAO report. In order to account for the zero emissions from the use of biomass, the energy use in burnt clay brick production is adjusted appropriately by multiplying it with a "biomass adjustment factor" (0.95 = 1 - 0.05). The baseline emission thus derived would be conservative.

The amount of CO_2 emissions from burning of coal depends largely on the type of coal and its calorific value. Different types of coal are used in India for brick making. In order to address the variability in coal quality, the IPCC default carbon emission factor for Indian coal as 25.8 tC/TJ (IPCC) has been used to estimate the CO_2 emissions associated with burning of coal in the baseline.

Formulae used:

The approved methodology II.D requires each form of energy, used in the project, to be multiplied with corresponding emission coefficient (kg-CO_2 equ/KWh) to determine the CO_2 emissions.

Different forms of energy used in a FaL-G plant include electricity and diesel. In general wherever electricity is available, the same is used in the plant and, in places where electricity is not available, diesel is used to run the plant. However, in certain cases, some of those who run the plants with electricity do keep provision for diesel also in order to overcome intermittent power breakdowns. The emission coefficient of electricity and diesel are therefore used to estimate the project emissions.

Various assumptions and values are provided in the table below which have been applied in the formulae used for ER computation.

<u>For Baseline Emissions:</u>

Baseline Emissions are computed based on the production of bricks and blocks in terms of m^3. In order to make the claim more diligent and conservative, lowest production value ($QL_{x, FaL-G}$) is derived based on three approaches as discussed below:

For this purpose, as referred in D.4 of PDD, fly ash (as raw material) is taken as one of the basis and electricity as the other basis.

Thus the production of bricks and blocks in terms of m^3, is compared based on three approaches viz.,

- Quantity (volume) based on production records, Q_{rec}

[1] Source: FAO Field Document No. 35, "Regional Wood Energy Development Programme in Asia", GCP/RAS/154/NET.

- Quantity (volume) based on fly ash consumption, Q_{fa}
- Quantity (volume) based electricity (Q_{elec}) and/ or diesel (Q_{diesel}) consumption

as discussed below, and the one representing the least ($QL_{x,\ FaL\text{-}G}$) is taken as the basis for ultimate ER computation.

Based on Fly ash procurement:

Based on the fly ash input in total FaL-G mix practiced at each SPE, specific consumption factor of fly ash is arrived in terms of % vide table 3. The procurement of fly ash, duly supported by inward challans/ weighment data, is the total consumption of fly ash. Thus 'Production based on fly ash procurement (Q_{fa})' is computed as follows

$$Q_{fa} = Fa_{con}/Sp.C_{fa} \qquad \textbf{Eq.1}$$

Where Fa_{con} = Total fly ash procurement of unit 'x' for the corresponding year

$Sp.C_{fa}$ = Specific Consumption of factor of fly ash of the unit x.

The applicable factors per each SPE are tabulated as below:

2007-10:

SPE ID No.	I/1	I/2	I/3	I/4	I/5	I/6	I/7	I/8	I/9	I/10	I/11
Fa - Spec. Cons. Factor- $SP.C_{fa}$	17.34	16.97	17.34	27.11	16.18	20	15.58	11.9	10.2	13.16	15

2010-11

SPE ID No.	I/1	I/2	I/3	I/4	I/5	I/6	I/7	I/8	I/9	I/10	I/11
Fa - Spec. Cons. Factor- $SP.C_{fa}$	17.34	19.00	17.50	18.00	20.00	19.00	19.00	12.34	14.18	12.78	55.90

Though certain units manufacture hollow and solid blocks, with different densities of 1.5 tons/m^3 and 2.0 tons/m^3 respectively, for computation ease, as a conservative estimate, total is taken as solid while working out output based on fly ash.

Based on electricity consumption:

The specific power consumption for each SPE is arrived based on actual power consumption to run the machines, and manpower efficiency, monitored over a period of one shift (8 hours).

Thus five typical types of plants (Type I- IV and Type VII) were identified and noted of their specific power consumption on m^3 basis, which formulate as the factor for computation of production and, in turn, for ERs. All the plants fall in one of these five categories.

Thus 'production based on electricity consumption (Q_{elec})' is computed as follows:

$$Q_{elec} = (Elec_{con} - 2\%\ Elec_{con})/Sp.C_{elec} \qquad \textbf{Eq.2}$$

Where $Elec_{con}$ = total electricity consumed by unit x for the corresponding year

$Sp.C_{fa}$ = Specific consumption factor of electricity of the unit x.

2% of total electricity consumption is deducted to account for lighting and other miscellaneous needs, while estimating equivalent production output. However, for computing project emissions total electricity consumed is considered.

The applicable factors per each SPE are tabulated as below:

SPE ID No.	I/1	I/2	I/3	I/4	I/5	I/6	I/7	I/8	I/9	I/10	I/11
Elec - Spec. Cons. Factor	1.2	1.2	1.2	1.2	1.2	1.2	1.2/1.54	1.2	1.54	1.54	1.2

Based on diesel consumption:

Production based on diesel consumption (Q_{diesel}) is computed as follows, wherever diesel is used as an alternate to electricity, totally or partially.

$$Q_{diesel} = Diesel_{con}/Sp.C_{diesel} \qquad \textbf{Eq.3}$$

Where $Diesel_{con}$ = Total diesel consumed by unit x for the corresponding year

$Sp.C_{diesel}$ = Specific consumption factor of diesel of the unit x

Obviously it is "$Q_{elec} + Q_{diesel}$" when both are used.

For Baseline emissions based on 'lowest production value':

The emissions $E_{b,x}$ from the baseline activity for the plant x is calculated as

$$E_{b,x} = (1 - PER_{biomass}) \bullet SEC_{claybrick} \bullet QL_{x,\ FALG} \bullet CEF \bullet CC$$

where,

$PER_{biomass}$ = Biomass correction factor for the baseline = 0.05

$SEC_{clay\ brick}$ = Specific energy consumption of burnt clay bricks (MJ/m^3 clay brick)

$QL_{x,\ FALG}$ = Quantity (Volume) of clay bricks (m^3/year) equal to that of lowest quantity of FaL-G bricks and blocks in plant x (m^3 clay bricks/year) as arrived by three comparative approaches as explained above.

CEF = Carbon Emission Factor for fuel used (bituminous coal) 25.8 tC/TJ (IPCC default value for India)

CC = Carbon to CO_2 conversion factor

The total emissions E_b in the baseline is represented by the formula

$$E_b = \sum_x E_{b,x} \qquad \textbf{Eq. 4}$$

E.2. Project emissions calculation

a). Estimating emissions from electricity consumption

For those plants, which run on electricity, the project emissions are calculated using the formulae

$E_{p,x}$ $= E_{x,elec} = (Q_{x, FALG} \text{ x } SEC_{x, FALG}) \text{ x } EF_{elec}$. **Eq. 5**

$Q_{x,FALG} = Q_{x, bricks} + Q_{x, blocks}$

$SEC_{x, FALG} = Q_{x, elec}/Q_{x,FALG}$

Where,

$E_{p,x}$ = Project emissions for plant x (tCO_2/year)
$E_{x, elec}$ = Annual CO_2 emissions from a plant x associated with annual consumption of electricity (tCO_2/year)
$Q_{x, FALG}$ = Annual production of FAL-G bricks/blocks from the plant x (m^3/year)
$Q_{x,brick}$ = Annual production of FaL-G bricks in plant x (m^3/year)
$Q_{x,block}$ = Annual production of FaL-G blocks in plant x (m^3/year)

$SEC_{x, FALG}$ = Specific energy consumption of FaL-G product in plant x (KWh_e/m^3)
$Q_{x, elec}$ = Annual consumption of electricity in the plant x (KWh_e/year)
EF_{elec} = Emission factor of electricity (tCO_2/KWhe)

b). Estimating emissions from diesel consumption

Wherever electricity supply is not available, diesel is used to run the equipments and machineries in the plant. Consumption of diesel in the plant is monitored and recorded on a monthly basis, from which the annual consumption is calculated. Emission associated with such consumption of diesel is calculated by multiplying the quantity of diesel consumed with the IPCC emission factor for diesel. The project emission is thus represented by the formulae

$E_{p,x} = E_{x,diesel} = Q_{x, FaLG} \text{ x } SEC_{FALG} \text{ x } EF_{diesel}$ **Eq. 6**

$SEC_{x,FALG} = Q_{x, diesel}/Q_{x, FALG}$

Where,

Ex_{diesel} = CO_2 emissions due to direct consumption of diesel in the plant x (tCO_2/year)
$SEC_{x\,prod}$ = Specific energy consumption of FaL-G product in plant x (litre/m^3)
$Q_{x\,diesel}$ = Quantity of diesel used in the plant x per year (litres/year)
EF_{diesel} = CO_2 emission factor for diesel (tCO2/litre), IPCC default value

The field data indicated that specific energy consumption ($SEC_{x\,prod}$) is one litre of diesel/ m^3 of production and this value has been taken to assess the output based on utilities in spreadsheet, as attached.

The total project emissions E_p due to the project activities within the project boundary is represented by the formulae

$$E_p = \sum_x E_{p,x}$$ **Eq.7**

E.3. Leakage calculation

According to II.D. leakage is applicable if the energy efficient technology is equipment transferred from another activity or the existing equipment is transferred to another activity. None of these occur in the project. Therefore, leakage calculation is not applicable for this project.

Total project emissions:

Since no leakage is considered for the project, the total project emissions within the project boundary E_p, as per **Eq. 7** represents the total project activity emissions.

E.4. Emission reductions calculation / table

Emission Reductions:

For arriving to emission reductions, conservative approach has been adopted by computing emission reductions based on least production value, whereas in arriving to baseline emissions actual electricity consumption without any deductions is taken. The ERs derived in this approach are certainly conservative than computation based on production records and rated capacity of motors.

Emission reduction generated by the project consisting of 11 plants (x=11) as computed by Eq.8 below is the difference between the baseline emissions, as represented by Eq.4, and the project emissions vide Eq.7

$$ER = \sum(E_{b,,x} - E_{p,.x})$$ **Eq. 8**

Summary of Emission Reductions achieved:

Summary of calculations of emission reductions for the years 2007-11 for all SPEs in Bundle 1 are available vide Table 4.

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)		
2007-08	**14,162**	**10,177**
2008-09	**14,162**	**8,720**
2009-10	**14,162**	**11,591**
2010-11	**14,162**	**13,761**
Total:	**56,648**	**44,249**

E.6. Remarks on difference from estimated value in the PDD

Please provide an explanation of the cause of any **increase** in the actual emission reductions achieved during the current monitoring period (e.g. higher water availability, higher load plant factor, etc), including all information (i.e. data and/or parameters) that is different from that stated in the registered CDM-PDD.

Not applicable.

Table 1: List of Parties and Project Participants

Name of Party	Project Participant
India (Host)	• Eco-Carbon Private Limited (ECPL)
Canada	• Ministry of Foreign Affairs & International Trade
Denmark	• Aalborg Portland A/S • Danish Ministry of Climate and Energy-Danish Energy Agency • Dong Naturgas A/S • Maersk Olie og Gas A/S • Nordjysk Elhandel A/S
Finland	• Ruukki Metals Oy
Luxembourg	• Ministry of the Environment
Italy	• International Bank for Reconstruction and Development as the Trustee of the Community Development Carbon Fund ("CDCF") • Ministry for the Environment, Land and Sea
Netherlands	• International Bank for Reconstruction and Development as the Trustee of the Community Development Carbon Fund ("CDCF") • Netherlands' Ministry of Infrastructure and the Environment (IenM)
Spain	• Endesa Generación, S.A.

	• Hidroeléctrica del Cantábrico, S.A. • Ministry of Environment and Rural and Marine Affairs; Ministry of Economy and Finance • Gas Natural SDG, S.A. • EDP-Energias de Portugal, S.A.
Switzerland	• Schweizerische Ruckversicherungsgesellschafts AG (Swiss RE)
Belgium	Walloon Region Ministry of the EnvironmentBruxelles Environment - IBGE
Germany	• BASF SE • KfW
Japan	• Daiwa Securities Capital Markets Co. Ltd. • FUJUFILM Corporation • Idemitsu Kosan Co. Ltd. • JX Nippon Oil and Energy Corporation • The Okinawa Electric Power Corporation,, Incorporated
Sweden	• Göteborg Energi AB
Norway	• Statoil ASA • Statkraft Carbon Invest AS
Austria,	• Kommunalkredit Public Consulting GmbH

TABLE 2: LOCATION AND GEOMETRICAL COORDINATES

No.	Name & Address of SPE	SPE ID No.	Geographical Coordinates, Deg	
	Krishna District		North	East
1	Kodali Fly ash Products	AP/KRIS/I/1	16.48	80.68
	7-60. Endowments Colony,			
	Nagarjuna Hospital Road, Kamayyatopu			
	Vijayawada, Krishna Dt. AP			
2	Srinivasa FaL-G Bricks	AP/KRIS/I/2	16.57	80.67
	Nunna, Vijayawada Rural Mandal			
	Krishna Dt. AP			
3	Sri Sai Fly ash Products	AP/KRIS/I/3	16.52	80.70
	D.No. 3-56. Kodalivari Street			
	Enikepadu, Krishna District, AP			
4	Sri Sai Teja Brick Products	AP/KRIS/I/4	16.60	80.47
	Chilkar, Ibrahimpatnam			
	Krishna Dist. AP			
5	Sree Devi Fly ash Industries	AP/KRIS/I/5	16.55	80.75
	Mustabad, Purushothapatnam			
	Gannavaram Mandal, Krishna Dist.			
6	Venkata Lakshmi Industries	AP/KRIS/I/6	16.67	80.28
	Shanthi Ice Factory Compound			
	Amberpet, Nandigama Mandal, Krishna Dist			
	West Godavari District			
7	Srinivasa Fly ash Bricks	AP/WG/I/7	16.92	81.67
	Pangidi Road, Besides FCI Godowns			

	Nidadavole, West Godavari Dist. AP			
8	Kodandarama Fly ash Brick Industries	AP/WG/I/8	16.55	81.55
	Venkayalapalem Road			
	Vissakoderu Post, Palakoderu Mandalam			
	West Godavari Dist. AP			
9	Sri Lakshmi Vasavi FaL-G Brick Industry	AP/WG/I/9	16.65	81.73
	Door No. 16-145 Canal Road			
	Ramachandrarao Peta, Penugonda 534320			
	West Godavari Dist. AP			
	East Godavari District			
10	Sri Satyasai Sri Anjaneya FaL-G Brick Industry	AP/EG/I/10	16.47	81.83
	NH 214 Road, Sompalle Village- 533242			
	Razole Mandal, East Godavari Dist. AP			
	Visakhapatnam District			
11	Hemanth FaL-G Industry	AP/VSP/I/11	17.68	83.07
	Door No. 27-1-171. Srinagar			
	Gajuwaka, Visakhapatnam 530026			

Table 3 a :FaL-G Mix Proportions (kgs) and Factors of Constituents for individual SPEs : 2007-08

ID of SPE	RAW MATERIALS, %											
	Fly ash		Lime		OPC		Gypsum		Stone dust/ Aggregate		TOTAL	
	kgs	Factor,%	kgs	Factor,%	kgs	Factor,%	kgs	Factor,%	kgs	Factor,%	kgs	Factor,%
AP/KRIS/I/1	30	17.34	10.00	5.78	2.00	1.16	1.00	0.58	130	75.14	173.0	100
AP/KRIS/I/2	20	16.97	4.25	3.60	1.70	1.44	1.45	1.23	90.6	76.77	118.0	100
AP/KRIS/I/3	30	17.34	10.00	5.78	2.00	1.16	1.00	0.58	130	75.14	173.0	100
AP/KRIS/I/4	25	27.11	5.70	6.18	--	--	1.50	1.63	60	65.08	92.2	100
AP/KRIS/I/5	25	16.18	6.50	4.21	--	--	3.00	1.94	120	77.67	154.5	100
AP/KRIS/I/6	40	20.00	10.00	5.00	--	--	4.00	2.00	146	73.00	200.0	100
AP/WG/I/7	25	15.58	13.00	8.10	--	--	2.50	1.56	120	74.76	160.5	100
AP/WG/I/8	23	13.51	9.00	5.30			2.00	1.19	136	80.00	170.0	100
AP/WG/I/9	15	10.20	10.00	6.80	--	--	2.00	1.36	120	81.64	147.0	100
AP/EG/I/10	20	13.16	10.00	6.58	--	--	2.00	1.32	120	78.94	152.0	100
AP/VSP/I/11	30	15.00	14.00	7.00	3.00	1.50	3.00	1.50	150	75.00	200.0	100

Table 3 b :FaL-G Mix Proportions (kgs) and Factors of Constituents for individual SPEs : 2008-09

ID of SPE	RAW MATERIALS, %											
	Fly ash		Lime		OPC		Gypsum		Stone dust/ Aggregate		TOTAL	
	kgs	Factor,%	kgs	Factor,%	kgs	Factor,%	kgs	Factor,%	kgs	Factor,%	kgs	Factor,%
AP/KRIS/I/1	30	17.34	10.00	5.78	2.00	1.16	1.00	0.58	130	75.14	173.0	100
AP/KRIS/I/2	20	16.97	4.25	3.60	1.70	1.44	1.45	1.23	90.6	76.77	118.0	100
AP/KRIS/I/3	30	17.34	10.00	5.78	2.00	1.16	1.00	0.58	130	75.14	173.0	100
AP/KRIS/I/4	25	27.11	5.70	6.18	--	--	1.50	1.63	60	65.08	92.2	100
AP/KRIS/I/5	25	16.18	6.50	4.21	--	--	3.00	1.94	120	77.67	154.5	100
AP/KRIS/I/6	40	20.00	10.00	5.00	--	--	4.00	2.00	146	73.00	200.0	100
AP/WG/I/7	25	15.58	13.00	8.10	--	--	2.50	1.56	120	74.76	160.5	100
AP/WG/I/8	23	13.51	9.00	5.30			2.00	1.19	136	80.00	170.0	100
AP/WG/I/9	15	10.20	10.00	6.80	--	--	2.00	1.36	120	81.64	147.0	100
AP/EG/I/10	20	13.16	10.00	6.58	--	--	2.00	1.32	120	78.94	152.0	100
AP/VSP/I/11	30	15.00	14.00	7.00	3.00	1.50	3.00	1.50	150	75.00	200.0	100

Table 3 c :FaL-G Mix Proportions (kgs) and Factors of Constituents for individual SPEs : 2009-10

ID of SPE	RAW MATERIALS, %											
	Fly ash		Lime		OPC		Gypsum		Stone dust/ Aggregate		TOTAL	
	kgs	Factor,%	kgs	Factor,%	kgs	Factor,%	kgs	Factor,%	kgs	Factor,%	kgs	Factor,%
AP/KRIS/I/1	30	17.34	10.00	5.78	2.00	1.16	1.00	0.58	130	75.14	173.0	100
AP/KRIS/I/2	20	16.97	4.25	3.60	1.70	1.44	1.45	1.23	90.6	76.77	118.0	100
AP/KRIS/I/3	27	16.00	9.00	5.50	1.70	1.00	0.80	0.50	131	77.00	170.0	100
AP/KRIS/I/4	25	27.11	5.70	6.18	--	--	1.50	1.63	60	65.08	92.20	100
AP/KRIS/I/5	25	16.18	6.50	4.21	--	--	3.00	1.94	120	77.67	154.5	100
AP/KRIS/I/6	40	20.00	10.00	5.00	--	--	4.00	2.00	146	73.00	200.0	100
AP/WG/I/7	25	15.58	13.00	8.10	--	--	2.50	1.56	120	74.76	160.5	100
AP/WG/I/8	23	13.51	16.50	9.73			1.80	1.08	128.7	75.68	170.0	100
AP/WG/I/9	15	10.20	10.00	6.80	--	--	2.00	1.36	120	81.64	147.0	100
AP/EG/I/10	20	13.16	10.00	6.58	--	--	2.00	1.32	120	78.94	152.0	100
AP/VSP/I/11	30	15.00	14.00	7.00	3.00	1.50	3.00	1.50	150	75.00	200.0	100

Table 3 d: FaL-G Mix Proportions (kgs) and Factors for Constituents for individual SPEs : 2010-11

ID of SPE	RAW MATERIALS, %											
	Fly ash		Lime		OPC		Gypsum		Stone dust/ Aggregate		TOTAL	
	kgs	Factor, %	kgs	Factor, %	kgs	Factor, %	kgs	Factor, %	kgs	Factor, %	kgs	Factor, %
AP/KRIS/I/1	35	17.34	12	5.80	2	1.16	1	0.58	154	75.12	205	100
AP/KRIS/I/2	18	19.00	4	4.50	-	-	1	1.00	70	75.50	93	100
AP/KRIS/I/3	35	17.50	15	7.50	3	1.50	3	1.50	144	72.00	200	100
AP/KRIS/I/4	36	18.00	6	3.00	3	1.50	2	1.00	153	76.50	200	100
AP/KRIS/I/5	20	20.00	8	8.00	-	-	2	2.00	70	70.00	100	100
AP/KRIS/I/6	38	19.00	10	5.00	-	-	3	1.50	149	74.50	200	100
AP/WG/I/7	30	19.00	25	15.80	-	-	3	1.90	100	63.30	158	100
AP/WG/I/8	20	12.34	20	12.34	-	-	2	1.23	120	74.09	162	100
AP/WG/I/9	20	14.18	10	7.09	-	-	1	0.70	110	78.03	141	100
AP/EG/I/10	23	12.78	13	7.23	-	-	3	1.66	141	78.33	180	100
AP/VSP/I/11	90	55.9	-	-	8	4.97	3	1.86	60	37.27	160	100

TABLE 4: EMISSION REDUCTIONS ACHIEVED DURING THE MONITORING PERIOD

Year	Baseline emissions, (t CO_2 e)	Project emissions, (t CO_2 e)	Leakage (t CO_2 e)	Total emission reductions, (t CO_2 e)
2007-08	10,290	113	00	10,177
2008-09	8,819	99	00	8,720
2009-10	11,692	101	00	11,591
2010-11	13,868	107	00	13,761
Total t CO_2 e	**44,669**	**420**	**00**	**44,249**

Figure I: The schematic FaL-G process

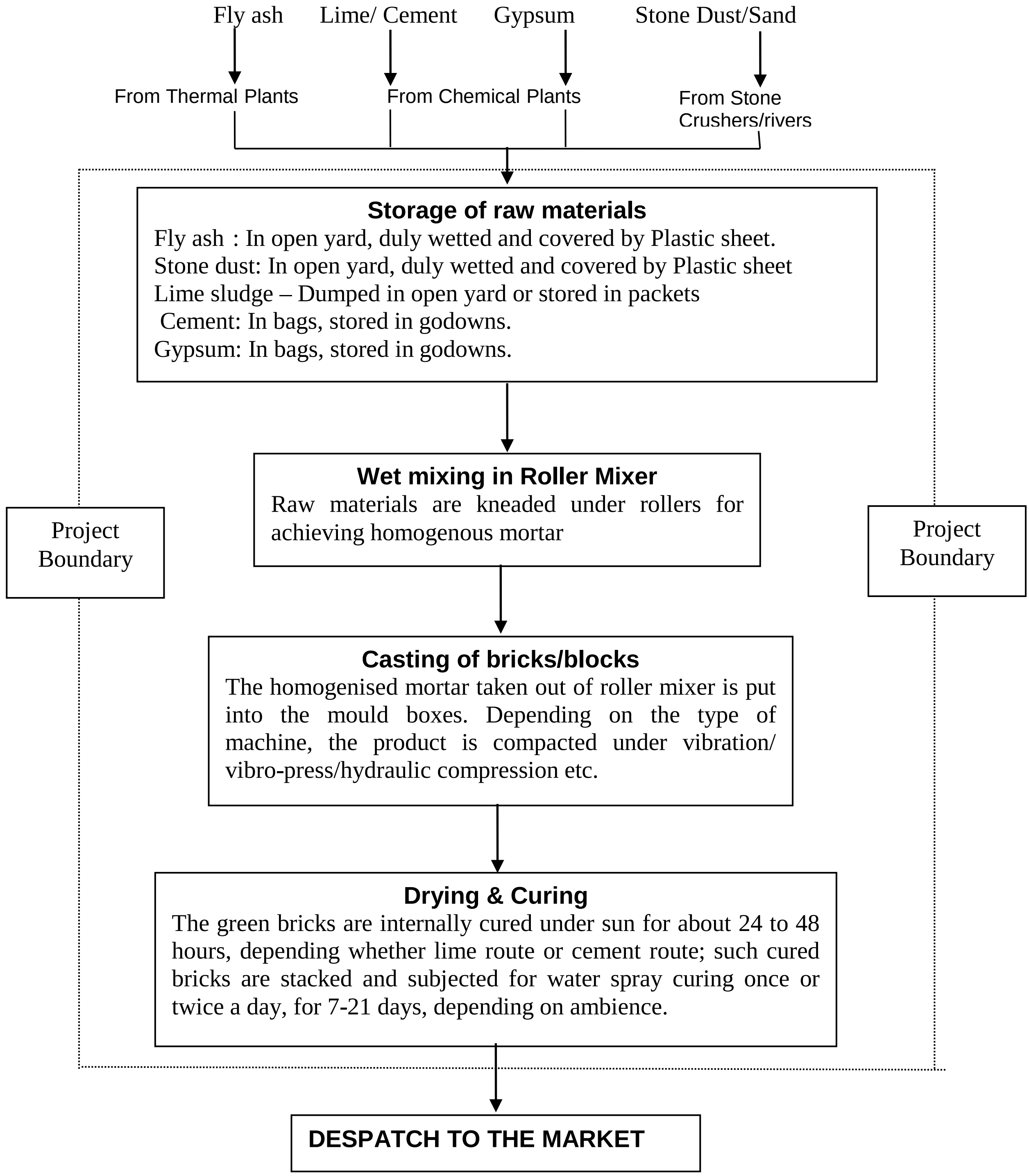
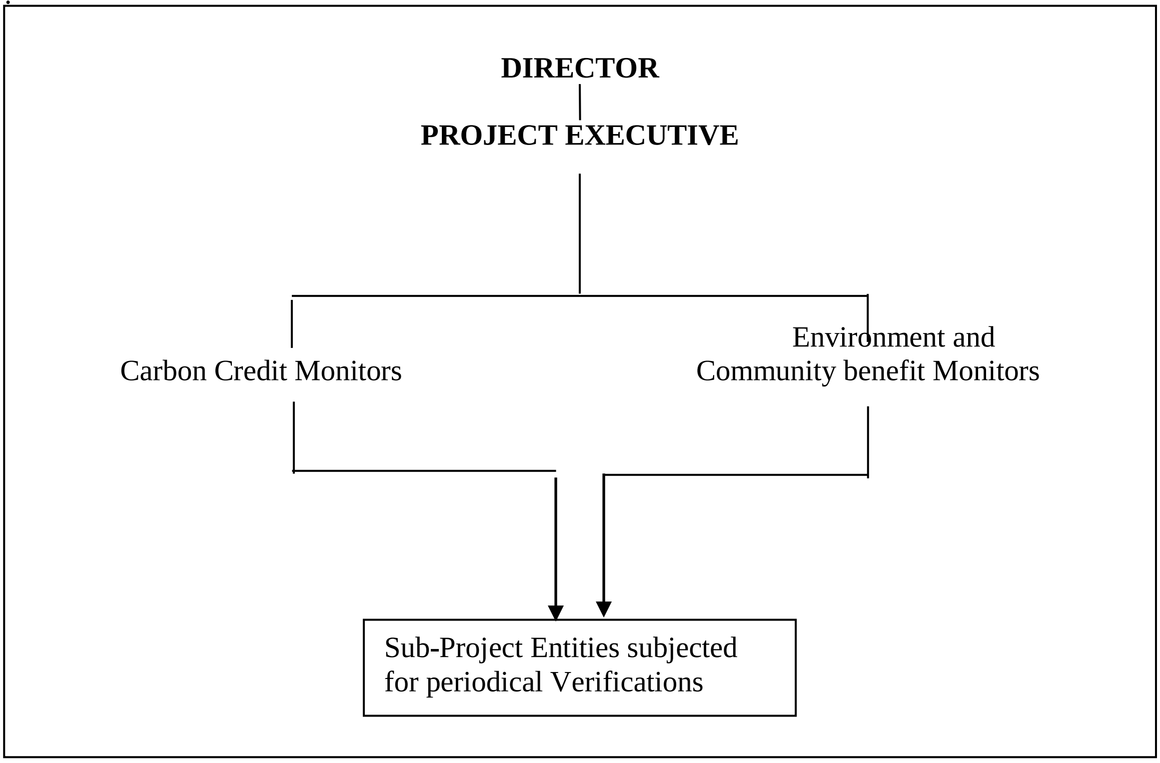


Figure II: MONITORING INFORMATION

Organisation structure for monitoring activity



History of the document

Version	Date	Nature of revision
01	EB 54, Annex 34 28 May 2010	Initial adoption.
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