



**PROJECT DESIGN DOCUMENT FORM  
FOR SMALL-SCALE CDM PROJECT ACTIVITIES (F-CDM-SSC-PDD)  
Version 04.1**

**PROJECT DESIGN DOCUMENT (PDD)**

<b>Title of the project activity</b>	India-FaL-G Brick and Blocks Project No.2.
<b>Version number of the PDD</b>	Version 07
<b>Completion date of the PDD</b>	08/02/2014
<b>Project participant(s)</b>	Eco Carbon Pvt. Ltd., (India) Ministry for the Environment, Land and Sea, The Government of Italy (Italy) The Netherlands' Ministry of Infrastructure and the Environment (IenM), The State of the Netherlands
<b>Host Party(ies)</b>	India
<b>Sectoral scope(s) and selected methodology(ies)</b>	Sectoral Scope : 04  Approved Methodology: Type III: Other Project Types AMS III-Z. Fuel Switch, process improvement and energy efficiency in brick manufacture dt. June 11, 2010.(Version 03)
<b>Estimated amount of annual average GHG emission reductions</b>	8,002 tCO <sub>2</sub> e



## **SECTION A. Description of project activity**

### **A.1. Purpose and general description of project activity**

The purposes of this project activity are:

- (1) To reduce GHG emissions by introducing an energy efficient brick making technology to manufacture FaL-G (fly ash-lime-gypsum) bricks and blocks as alternative building materials to the commonly used burnt clay bricks, which use fossil fuel for their production;
- (2) To reduce air pollution by avoiding the use of fossil fuel; and
- (3) To enhance the use of fly ash, an industrial by-product, as an ingredient of building material.

Burnt clay bricks are predominantly used as walling material by the construction sector in India. The process of producing these bricks involves consumption of fossil fuel and denudation of fertile topsoil. FaL-G bricks and blocks are alternative building materials to the traditional burnt clay bricks and are substitutes to the traditional burnt bricks used for construction. Production process of FaL-G bricks and blocks does not involve sintering and thus completely eliminates the burning of fossil fuels as required in the clay brick production, ultimately contributing to the reduction of greenhouse gas emissions.

This Project Design Document is applicable to the 9 FaL-G plants that have been set up at various locations in the states of Tamil Nadu and Andhra Pradesh since June 2004. The start date of the project is the earliest date of establishment occurred out of 9 SPE units, as mentioned by SPEs in their application given to PE, and duly recorded vide Appendix 9. The chronology of the project activity is given in table under B.5. Though this project was originally designed with 11 SPEs, at the time when the project got registered on 20/06/2011 only 9 SPE units are in operation.

Each FaL-G plant qualifies as a small scale CDM project as per the definition of small scale CDM projects contained in Appendix B to the simplified modalities and procedures for small scale projects. In order to reduce the transaction cost, a bundling approach is being followed in compliance with the rules prescribed by the Executive Board for bundling small scale projects.

### **Contribution to Sustainable Development**

The project promotes an eco-friendly technology for production of alternative building materials. By avoiding use of fossil fuel in the production process, the project contributes to conservation of energy and fossil fuel (coal). By displacing burnt clay bricks in the walling materials market, the project contributes to protect the environment by minimising eco-hostile activities such as topsoil denudation leading to land degradation, and air pollution caused by emission of unprocessed flues. Furthermore, since the alternative building material is manufactured using industrial wastes and byproducts as raw materials, the environmental impacts associated with improper disposal of such industrial wastes are also mitigated by the project. 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 have the advantage of continuous year-wide operation, and hence provide yearlong employment opportunity for the skilled artisans and create self-help livelihood opportunities for the illiterate poor. The intrinsic environmental and social benefits of the project are further enhanced by a specific community benefit program particularly the health and accident insurance schemes that are implemented to meet the requirements of the Community Development Carbon Fund (CDCF) of the World Bank. The project thus contributes to sustainable development in many ways.

## A.2. Location of project activity

### A.2.1. Host Party(ies)

India

### A.2.2. Region/State/Province etc.

One district in the state of Tamil Nadu and Six districts in the State of Andhra Pradesh, India as shown in the geographical maps below.

### Geographical Locations of Tamil Nadu (Blue boundary) and Andhra Pradesh (Red boundary)



### Location of FaL-G plants in the second bundle

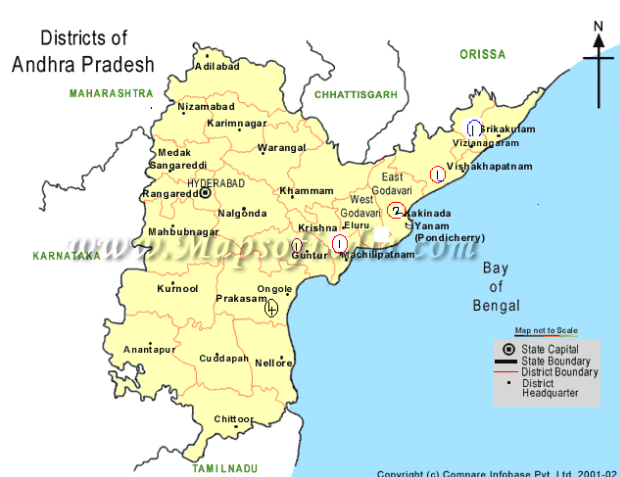
### State of Tamil Nadu and district wise FaL-G plants



Name of District                      No. of plants

Kanchipuram                              1

### State of Andhra Pradesh & District wise FaL-G plants



Name of district	No. of plants
Prakasam	4
Krishna	1
East Godavari	2
Visakhapatnam	1

### A.2.3. City/Town/Community etc.

The districts in which the project activities implemented are as follows.

States	District	No. of Plants	Aggregate Capacity - m <sup>3</sup> /year
Tamil Nadu	Kanchipuram	1	11998
Andhra Pradesh	Prakasam	4	16560
	Krishna	1	4050
	East Godavari	2	7110
	Visakhapatnam	1	3600
Total		9	43318



The capacities of individual plants have been separately shown in Appendix 8.

Based on Version 03 of AMS III-Z dt. 11 June 2010, the cap on emission reductions is 60 kt CO<sub>2</sub>. For the aggregated capacity of 43,318 m<sup>3</sup> in this bundle the emission reductions result at 8,002 tons CO<sub>2</sub>. The capacities of the plants given above are purely indicative based on single shift operations. For a given set of plant and machinery the production output does fluctuate based on workforce efficiency within a shift, and number of shifts operated. Thus the capacity utilisation of individual plants is liable to increase when the operations are stretched to meet the market demand, within the available number of plants in the Bundle.

#### A.2.4. Physical/ Geographical location

FaL-G plants are located in those clusters and geographical areas, which are characterised by easy availability of the key raw materials such as fly ash and also proximity to the brick markets. A typical FaL-G plant is located in rural areas near an urban growth centre where brick demand exists. Each plant requires at least 2000 square meters of land. The plants included in the project are identified by a unique code/serial number for records and administrative convenience. The code consists of identity of the State, followed by identity of the district, Bundle No. in roman, and Serial Number of the plant in that bundle. For example, the ninth Plant in bundle No. II in the state of Andhra Pradesh in East Godavari District is represented by the code: AP/EG/II/9. As these plants are mostly in tiny sector, located largely in rural sector without significant land mark, indicative geographical coordinates are given in Appendix 8.

#### A.3. Technologies and/or measures

By virtue of avoiding sintering process and, in turn, use of coal, FaL-G brick/ block production contributes for emission reductions. Nevertheless machines in FaL-G plant require electricity and/or diesel for their operation. The consumption of such forms of energy (electricity and/or diesel) however is much lower compared to the thermal energy consumed for production of burnt clay bricks. FaL-G technology needs cement and/ or lime as process inputs, which are sources of emissions during their production. However, such emissions are negligible when compared to the emissions from baseline activity. This is a project not with fuel switch but with total fuel avoidance. It is not a process improvement but altogether a new process. It is energy efficient by avoidance of total thermal energy. Based on the criterion of last factor, as per the recommendations of SSC-Working Group earlier, similar project was registered under AMS II-D. However, upon the emergence of III-Z in the scenario of Approved Methodologies for bricks that include fly ash-lime/cement-gypsum (FaL-G) chemistry, as per the recommendations of CDM-EB vide Appendix 10 of this PDD, the project is categorised under ‘Type III - Other Project Types’, and III-Z. “Fuel Switch, process improvement and energy efficiency in brick manufacture.”

Clay brick manufacturing involves two key processes: i) producing green bricks (clay bricks before firing are called ‘green bricks’), and ii) sintering/firing the green bricks in a kiln. The sintering process requires thermal energy inputs. Production of FaL-G bricks and blocks in contrast, does not involve any thermal energy as the product sets and hardens through hydration chemistry, in the lines of cement. Therefore, almost total thermal energy is saved through the use of FaL-G technology. The machinery and equipments used in a FaL-G plant use electricity and/or diesel. But the amount of such energy is much lower compared to the thermal energy used in production of clay bricks. Therefore, total energy savings from the change in brick production process results in substantial energy savings, primarily contributed by the FaL-G technology that completely avoids the use of coal otherwise used in brick production.

The total quantity of emission reductions achieved by the project is estimated as the difference between the emissions due to production of specific volume (m<sup>3</sup>) of bricks and blocks produced in the project, and the emissions

those would have been occurred due to the production of equal volume of clay bricks. The net emission reductions for an aggregated and indicative production capacity of 43318 m<sup>3</sup> bricks/year are estimated at 8002 tons CO<sub>2</sub> per year. Based on improved efficiency and increase in number of shifts the production may go high resulting in further reductions, though net reductions considered would be 60 kt CO<sub>2</sub> only as per Version 03 of AMS III-Z category.

### The Technology

The FaL-G technology used in the project to produce bricks and blocks, has been invented and patented (No. 198639 dated 13.8.1996) by Dr N Bhanumathidas and N Kalidas, and promoted in the host country by the Institute for Solid Waste Research and Ecological Balance (INSWAREB). The technology works with the strength of fly ash, lime and gypsum chemistry. The slow chemistry of fly ash and lime is maneuvered by tapping ettringite phase to its threshold limits through sufficient input of gypsum. Therefore, FaL-G does not require energy intensive equipments such as heavy duty-press or autoclave, which are otherwise required in case of only fly ash and lime brick production. The FaL-G process completely eliminates the 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 wastes and byproducts from industrial activities and are available in adequate quantities in the areas, where the project activities are located.

FaL-G technology is developed in two approaches, viz. “FaL-G in lime route” and “FaL-G in OPC route”. The patent specifications on FaL-G cover both the approaches. Though FaL-G technology was primarily developed using lime, OPC was also identified as a source of lime to facilitate pozzolanic reactions in FaL-G system. . These two approaches have significant bearing on technical point of view in the context of using LT and HT fly ashes as explained below.

INSWAREB has classified fly ash into two categories based on the sintering temperatures of coal in thermal plants and boilers. They are LT (low temperature) fly ash and HT (high temperature) fly ash. The research at INSWAREB established that LT fly ash goes well with lime where as HT fly ash goes well with OPC as per 28-day strength as shown below (pp. 28-30 Fly ash for Sustainable Development, the book authored by Dr Bhanumathidas and Kalidas; 2002).

#### 28-day Compressive strength of FaL-G, MPa

Type of ash	Lime route	OPC route
LT Ash	22.8	20.0
HT Ash	22.0	33.8

However in both the fly ashes either of the routes is interchangeable depending on the logistics of raw material availability and economics. This aspect allowed flexibility in adoption of the technology.

The concept of LT and HT ashes and the related work is the outcome of research during FaL-G development and thus is of proprietary nature. In this background data from INSWAREB labs has authenticity and is considered as third party report.

Byproduct lime is available at almost 1/3<sup>rd</sup> of the mineral lime cost. Otherwise, it is economical to use Ordinary Portland cement (OPC) over mineral lime and, hence, OPC is preferred in areas where byproduct lime is scarce or

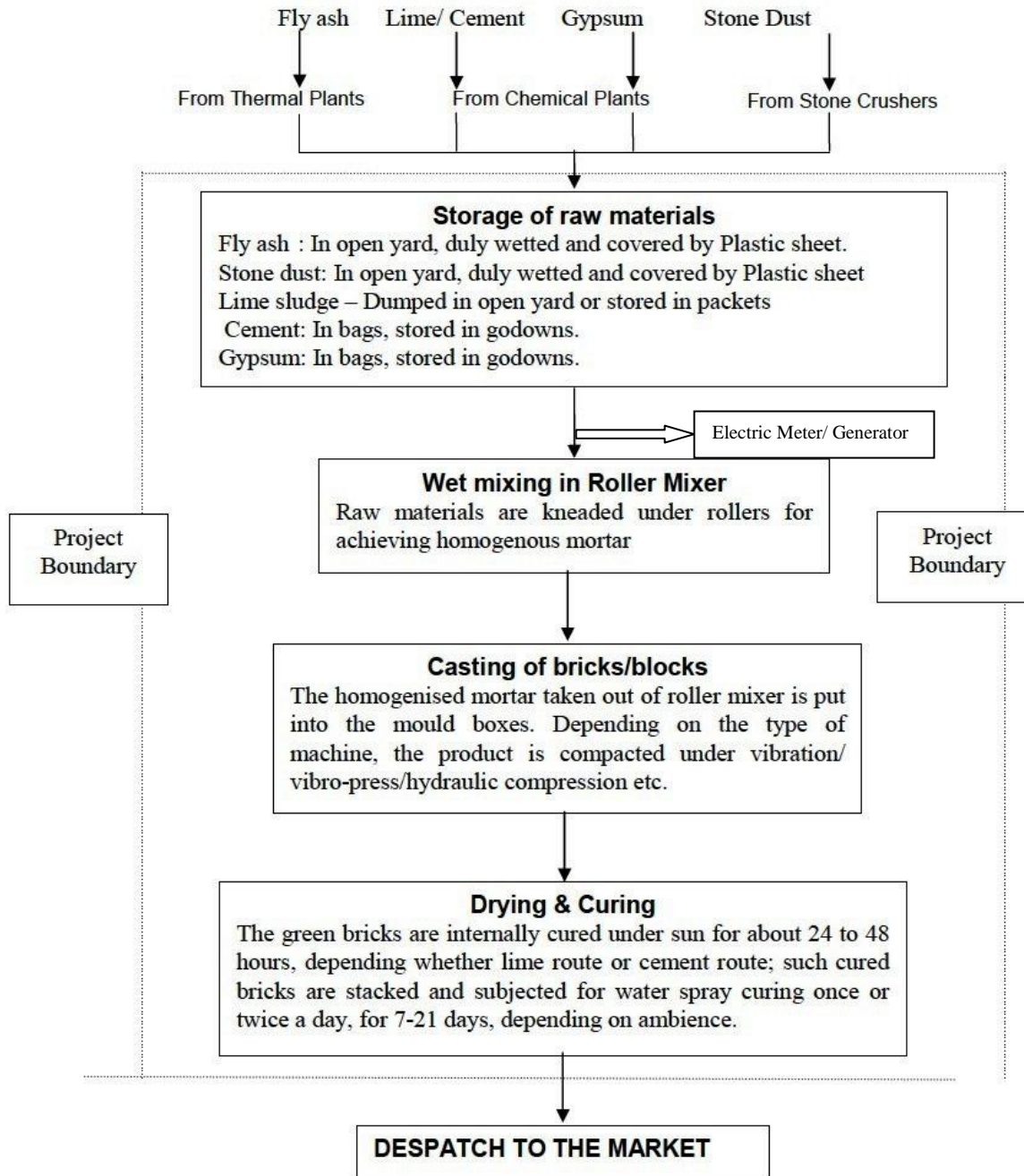


not available due to increased FaL-G activity. In view of quality and logistical issues in procuring lime, many entrepreneurs adopt FaL-G in OPC route and some are using both lime and cement. Notwithstanding the choice of lime and/or OPC, the technological flexibilities in FaL-G facilitate the use of blended cements such as Portland Pozzolan Cement (PPC) (fly ash based) also, still maintaining the ultimate quality of the product. In another dimension, FaL-G technology established the use of ground granulated blast furnace slag in association with corresponding complementary reactive-additives to supplement the use of cement. Thus the recipes are tailor-made keeping in view of the quality requirements of the end product.

The following table gives the raw material inputs per cubic meter, for typical recipes, where the density of FaL-G brick/block is 2,000 kg / m<sup>3</sup>.

<b>Ingredients</b>	<b>Lime route</b>		<b>Cement route</b>	
	%	kg	%	kg
Fly ash	15	300	15.2	304
Lime [as Ca(OH) <sub>2</sub> ]	7.5	150	--	--
Cement	--	--	4.0	80
Gypsum	2.5	50	0.8	16
Filler (aggregate)	75	1500	80	1600
<b>TOTAL</b>	100	2000	100	2000

The schematic FaL-G process is provided in a chart as below.



INSWAREB is the technology source and closely associated with the project as a technology partner and provider of training and capacity building services. As part of the technology transfer, the entrepreneurs and artisans are given sufficient training in technology and production processes.

INSWAREB has already been engaged in conducting various awareness and market development programs to government and private sector. INSWAREB is also conducting awareness workshops to highlight the CDM opportunities in practicing FaL-G technology in different states of India.





The role of INSWAREB, as mentioned in B8, is to determine the baseline and Monitoring methodology. Thus INSWAREB would impart training to the monitoring personnel of ECPL. An agreement between INSWAREB and ECPL has been signed to this effect.

#### A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Government of India (Host)	Eco Carbon Pvt.Ltd. as Project Entity, on behalf of individual entrepreneurs listed in Appendix 8 as Sub-Project Entities.	No
Ministry for the Environment, Land and Sea, The Government of Italy	International Bank for Reconstruction and Development as the Trustee of the Community Development Carbon Fund (CDCF)	Yes
The Netherlands' Ministry of Infrastructure and the Environment (IenM), The State of the Netherlands	International Bank for Reconstruction and Development as the Trustee of the Community Development Carbon Fund (CDCF)	Yes

**Eco Carbon Pvt. Ltd. (ECPL):** A private company, which is committed for promoting FaL-G technology as CDM activity on commercial principles. ECPL will provide the technological and operational support to the individual entrepreneurs for implementing the FaL-G plants. ECPL represents the individual entrepreneurs and is responsible for organising the entrepreneurs in order to promote the project activities for carbon transactions.

**The Community Development Carbon Fund (CDCF):** Trust fund maintained and operated by the World Bank in its capacity as trustee of the CDCF on behalf of the public and private participants. CDCF will purchase the emission reductions generated by the project and supervise the implementation of community benefit program.

The official contact for the CDM project activity is the Community Development Carbon Fund (CDCF) of the World Bank. The contact details of above participants are given in Appendix 1.

#### A.5. Public funding of project activity

No public funding from Annex – I Countries is being received by this project as confirmed vide Appendix 2.

#### A.6. Debundling for project activity



The project activity is not a debundled component of a larger project activity as defined in appendix C to the simplified M&P for the small-scale CDM project activities. There are no other project activities registered or applying for registration as small-scale CDM projects with the same project participants and in the same project category and technology/measure (FaL-G). All the FaL-G plants included in the project are independently owned and operated by different entrepreneurs. Thus each FaL-G plant is a standalone project with total operations right from raw material input upto the finished product. Hence a check on debundling is totally irrelevant as the emission reductions out of all these plants, put together, are well within the cap, thus making the concept of debundling untenable.

The characteristics of the individual FaL-G plants are provided below.

- (i) Each FaL-G plant is independently owned and operated;
- (ii) The FaL-G plants use same technology disseminated from the technological source, INSWAREB, acting as an intermediary; but have independent and one to one technological tie up with INSWAREB. Thus, each FaL-G plant enjoys the technical support of INSWAREB under norms of technology counselling.
- (iii) Each FaL-G plant signs the Sub-Project Agreement with Project Entity, committing to transfer specified quantity of ERs during the project period.
- (iv) No contractual arrangements exist among the bundled FaL-G plants.
- (v) Each plant would be catering to different market segments, depending on transport, commercial and other logistical constraints; and
- (vi) Each plant has specific boundary delineated by the physical and geographical site and equipments employed.

## **SECTION B. Application of selected approved baseline and monitoring methodology**

### **B.1. Reference of methodology**

This project was submitted for validation in November 2006 based on AMS II.D, in convention to its previous project, which was duly registered. However, after successful completion of validation, the project got stuck at registration on the issues of Revision and Deviation with regard to considering leakage due to raw material input. Thus, the project got operational for close to three years and subjected for verification by PP in accordance to AMS II.D. As the project passed through controversies over two years and, meanwhile, AMS III.Z came into prevalence very recently with relevance to this project. Thus, the project is referring to AMS III.Z vide this PDD.

Type III: Other Project Types

Version 03 of AMS III-Z. Fuel Switch, process improvement and energy efficiency in brick manufacture dt. June 11, 2010.

The approved methodology requires monitoring of the following:

- a) Production output (m<sup>3</sup> per day)
- b) Principal raw and additive material purchases on monthly basis
- c) Tests at six-month interval to validate that the project bricks meet the performance requirements in terms of compressive strength.
- d) Daily Consumption of fossil fuel and Monthly electricity consumption. Cross checking of consumption with purchase invoices for fossil fuel.

### **B.2. Project activity eligibility**

The project category selected to the project activity is as follows:

- Type III Other Project Types
- Version 03 of AMS III-Z. Fuel Switch, process improvement and energy efficiency in brick manufacture

Each of the criteria of the methodology is justified vide table below:

Criteria	Justification
<p>The approved methodology AMS III-Z aims for emission reductions through activities comprising of one or more technology/ measures listed below in existing brick production facilities:</p> <ul style="list-style-type: none"> <li>• Shift to an alternative brick production process; or</li> <li>• Partial substitution of fossil fuel with renewable biomass in existing brick production facilities'. or</li> <li>• Complete/partial substitution of high carbon fossil fuels with low carbon fossil fuels.</li> </ul> <p>Thus the methodology is applicable for the production of:</p> <ul style="list-style-type: none"> <li>▪ Bricks that are the same in the project and baseline cases: or</li> <li>▪ Bricks that are different in the project case versus the baseline case due to a change(s) in raw materials, use of different additives, and/or production process changes resulting in reduced use or avoidance of fossil fuels for forming, sintering (firing) or drying or other applications in the facility as long as it can be demonstrated that the service level of the project brick is comparable to baseline brick. Examples include pressed mud blocks (soil blocks) with cement or lime stabilisation and other 'unburned 'bricks that attain strength owing to fly ash, lime/cement and gypsum chemistry.</li> </ul>	<p>This project falls under 'Shift to an alternative brick production process'.</p> <p>The project activity deploys the patented FaL-G technology where the products attain strength due to hydration chemistry among fly ash, lime/cement and gypsum.</p> <p>Manufacturing of burnt clay bricks is an industrial activity, which requires thermal energy inputs for the purpose of sintering. Fossil fuel and/or biomass are primarily combusted to provide the required amount of thermal energy for sintering the clay bricks, which results in CO<sub>2</sub> emissions. Production of FaL-G bricks and blocks however does not require combustion of fossil fuels or biomass as the FaL-G technology does not require any sintering. Instead, the strength is achieved through chemical reactions among the selected raw materials used, viz. fly ash, lime and/or cement, gypsum, and water.</p> <p>The cast products are then simply air and/or solar dried, to facilitate initial internal curing, and water cured for a specific period (curing time) to achieve the desired strength. The use of thermal energy from fossil fuels or biomass is completely avoided in the process. FaL-G plants are run on electricity and/or diesel. Consumption of such forms of energy (electricity or diesel) however is much lower compared to the thermal energy consumption for production of clay bricks. Thus CO<sub>2</sub> emission due to project activity is much less than in the baseline, resulting in considerable quantities of emission reductions.</p> <p>In addition, the service level of project brick in terms of compressive strength is higher at an average value of 6 to 12 MPa as against 3 to 6 MPa for baseline brick. The comparative data from a typical testing conducted by INSWAREB Building Centre is given hereunder:</p>



	<table border="1" data-bbox="869 282 1324 427"> <tr> <th>Type of brick</th><th>Compressive strength, MPa</th></tr> <tr> <td>Clay brick</td><td>4.3</td></tr> <tr> <td>FaL-G brick</td><td>9.8</td></tr> </table> <p>In this background the choice of the methodology AMS III-Z is appropriate.</p>	Type of brick	Compressive strength, MPa	Clay brick	4.3	FaL-G brick	9.8
Type of brick	Compressive strength, MPa						
Clay brick	4.3						
FaL-G brick	9.8						
New facilities (Greenfield projects) and project activities involving capacity additions compared to the baseline scenario are only eligible if they comply with the related and relevant requirements in the General guidance for SSC methodologies	This is a Greenfield project. Clay brick is the most plausible baseline as per methodology and the same baseline is applied in the project activity. Hence the methodology is applicable for the project activity.						
The methodology requires demonstrating the abundance of raw materials in the country/ region according to the specified procedures.	<p>The project does not involve change of raw materials since this is a Greenfield project. Hence para 6 on demonstration of abundance of raw materials is not applicable. Notwithstanding this fact, this issue has been discussed below.</p> <p>The need of demonstration on abundance of raw materials is applicable to plants with large production capacities in single project boundary where the requirement of raw materials is high, and the opportunities for consistent availability get confined/ restricted probably due to growth in demand for the relevant raw materials.</p> <p>The present project activity is a bundle of small scale units with annual capacities ranging in the order of 2,700 to 13,500 m<sup>3</sup> (~ 9 to 45 m<sup>3</sup> per day) and scattered in different locations of the region and states. As the major raw materials are available within logistical radius for any FaL-G unit in general, INSWAREB in its status as Observer Organisation submitted Request for Revision (Ref No. 297) to SSC-WG seeking to exclude the small scale sector with a capacity of &lt;200 m<sup>3</sup> from the demonstration on abundance of raw materials.</p> <p>The comments of SSC WG, as given below, at its 20<sup>th</sup> meeting for above request are significant and confirm that demonstration of abundance of raw material can be done on country/ region basis.</p> <p>“The SSC WG could not accept the proposal to have any thresholds on the production capacity and the request on exclusion of demonstration of availability of alternative material keeping in view of the competing uses of raw material /additives</p>						



	<p>i.e., the alternative material used in the project activity could be used for other purposes in the absence of the project and its subsequent possibility of leakage effects. Also it should be noted that in terms of demonstration of availability of alternative material, this can be done on a country/region basis (not necessarily required for each brick production facility) as indicated in AMS III.Z paragraph 6”</p> <p>Fly ash is one of the main raw materials used in the project activity. The annual nationwide generation of fly ash is over 130 million tons. (<a href="http://www.dst.gov.in/whats_new/what_new08/fly-ash.pdf">http://www.dst.gov.in/whats_new/what_new08/fly-ash.pdf</a>)</p> <p>Though fly ash constitutes 60-80% in FaL-G as the cementitious binder, the fly ash content comes down to 10-20% in brick by weight when fly ash is added with filler, depending on the fly ash quality and other logistics. Considering average of 15% fly ash per brick and 3 million bricks of annual output per unit, 130 million tons of fly ash is sufficient for 76,157 units against 9 units of B-II, which abundantly demonstrates the abundance of raw material.</p> <p>Being a by product of coal based thermal power plants with annual generation in millions of tons, fly ash is abundantly available within a feasible distance for any unit in the bundle.</p> <p>The fly ash sources in Andhra Pradesh are Simhadri Thermal Power Project, Visakhapatnam and Ramagundam Thermal Power Project at Ramagundam, both of NTPC and Vijayawada Thermal Power Station at Vijayawada, Kothagudem Thermal Power Station at Kothagudem, Rayalaseema Thermal Power Station at Muddanur and Ramagundam Thermal Power Station at Ramagundam, all of Andhra Pradesh Power Generation Corporation (APGENCO). Notwithstanding the above fly ash is also available from captive thermal plants and steam boilers. Thus all put together the total generation is about 10.0 mtpa in Andhra Pradesh.</p> <p>Similarly fly ash sources in Tamil Nadu are Ennore Thermal Power Station and North Chennai Thermal Power Station both at Chennai, Mettur Thermal Power Station, Mettur and Tuticorin Thermal Power Station, Tuticorin all of Tamil Nadu Electricity Board (TNEB), and Neyveli Lignite</p>
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	<p>Corporation, Neyveli. The total generation of fly ash in Tamil Nadu is about 6.0 mtpa</p> <p>In addition to the above scenario, with the power plants in pipeline, about 5 million tons of fly ash is expected to be added every year over the next ten years. When compared to the generation of such huge volume the fly ash requirement by small scale units is minuscule. The scenario itself demonstrates the abundance of fly ash in the regions where SPEs in the bundle operate.</p> <p>Cement is a commercially available product in the market and more so is a product of localised market in a given logistical radius. With an annual production of over 200 million tons at national level and having plants spread through all the regions in the country there is no dearth for cement availability. Also the cement input in a brick is low in the range of 2.5 to 4% and this further demonstrates the cement availability without problem.</p> <p>Similarly lime is also a commercial product procured in open market. There is no data available on lime production. However cement being the predominant input as source of lime the users of lime have come down in preference to cement. As already discussed earlier byproduct lime is also used in the process that is available from acetylene industries.</p> <p>Moreover, this technology provides a flexible process mechanism to use cement and/or lime in accordance to availability and other logistics.</p> <p>Gypsum comes as a byproduct from hydrofluoric acid and fertiliser industries with an annual generation of about 3 to 4 million tons and also is available commercially in the market. Gypsum input in FaL-G bricks/ block production is very small at 0.1% of total mass hence there is no shortage for this product also.</p>
<p>The service level of project brick shall be comparable to or better than the baseline brick i.e., the bricks produced in the brick production facility during the crediting period shall meet or exceed the performance level of the baseline brick. An appropriate national standard shall be used to identify the strength class of the bricks, bricks that have compressive strength lower than the lowest class bricks in the standard are not eligible under</p>	<p>The average range of compressive strength of baseline bricks is 3 to 6 MPa against which project bricks give compressive strength of 6 to 12 MPa.</p> <p>The strength of baseline brick is stagnant based on clay quality and sintering process whereas the strength of the project brick can be enhanced, by changing the hydration chemistry, to meet the applicational needs. Hence project brick is not only</p>



<p>this methodology. Project bricks are tested in nationally approved laboratories at 6 months interval (at a minimum) and test certificates on compressive strength are made available for verification.</p>	<p>a walling element but also the element for infrastructural constructions.</p> <p>“IS 12894: Pulverised Fuel ash-Lime Bricks” is the national standard for identifying the strength class of the project bricks.</p> <p>IS 516: Methods of Test for Strength of Concrete is the national standard to assess the performance of project bricks in terms of compressive strength.</p> <p>IS 3495: Methods of Tests for Burnt Clay Building Bricks (Part I) is the national standard to test the compressive strength of the clay bricks, the baseline product.</p> <p>The different codes have been made applicable because baseline brick is a ceramic product and project brick is a hydraulic product in the lines of cement concrete.</p> <p>In the context of testing of bricks/blocks, the SSC WG, at its 22<sup>nd</sup> meeting clarified as follows:</p> <p>“The testing can be undertaken based on the national/regional standards or guidelines applicable to the type of project activity bricks. Testing can also be undertaken as per the procedures provided by the technology provider as long as the testing methods can be substantiated with reference to peer reviewed literature i.e. relevant international journal, publications, publications of national/international building research centres etc. As long as the testing procedures in the guidelines/standards are met, the testing itself can be undertaken in polytechnics, engineering colleges, building centers, national laboratories etc.”</p> <p>Accordingly the test procedure vide Appendix 11 shall be adopted and the bricks/ blocks be tested for their compressive strength at six month interval.</p>
<p>Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO<sub>2</sub> equivalent annually.</p>	<p>The project activity consisted of 11 SPEs in the bundle with an aggregated capacity of 61138 m<sup>3</sup> per annum resulting in projected emission reductions of 11,294 tons CO<sub>2</sub> equivalent. However when the project got registered on 20/06/2011 only 9 SPEs are in operation with an aggregated capacity of 43318 m<sup>3</sup> per annum resulting in projected emissions reductions of 8002 tons CO<sub>2</sub> equivalent.</p>



	<p>These are indicative capacities based on single shift operation. However based on the efficiency of man power and market demand there is likelihood that the capacity utilization of individual plants does increase, and sometimes they work for more shifts. In this context the maximum output would be 129954 m<sup>3</sup> based on three shift operation @ 8 hours /shift. Despite such increase the annual emission reductions would be 24006 t CO<sub>2</sub> which is still within the limits of 60 kt CO<sub>2</sub> specified by the methodology.</p> <p>Means even at increased output, emission reductions are much lower to the specified limits of the approved methodology.</p>
<p>This methodology is not applicable if local regulations require the use of proposed technologies or raw materials for the manufacturing of bricks unless widespread non compliance (less than 50% of brick production activities comply in the country) of the local regulations evidenced.</p>	<p>The annual brick demand in the country is about 200 billion nos. Despite government regulations, and monitoring by judiciary, central and various state governments, penetration by fly ash bricks could not go beyond 9%.</p> <p>There is no regulation in India to use FaL-G technology. There is local regulation to use fly ash to manufacture fly ash bricks, and as of date only FaL-G is the feasible technology to manufacture fly ash bricks in India. However the regulations face widespread non-compliance, which is evident from the statistical analyses of the fly ash brick market vide table 1.2.</p> <p>From that time onwards till now, over the period of five years, the penetration level is increased from 1.4% to 9%, based on the data of INSWAREB, and is too meagre in the national perspective, which is due to purely non-compliance of regulations.</p> <p>Ministry of Environment and Forests, Government of India came out with a Gazette Notification No. 2804 dated 3<sup>rd</sup> November 2009 wherein it is mentioned that the fly ash use in manufacturing bricks and other products increased from 1.5 million tons in 2002-03 to 3.19 million tons in 2006-07, which is commensurate for the production of 3.19 billion bricks. This is only 1.59% on national demand for the bricks.</p> <p>In either way the penetration is very meagre demonstrating the non-compliance of the national regulation.</p> <p>Hence referred methodology is applicable for the project activity.</p>





### B.3. Project boundary

In line with the definition for type III-Z methodology, the boundary for the purpose of the proposed project is defined as the physical and geographical area affected by the project activity. Accordingly, the boundary of the project is defined to include the physical and geographical limits of the FaL-G plants in the project, and shown in the process flow chart. The production sites typically include the following facilities:

- The storage yard for raw materials.
- Pan mixer for mortar preparation
- Casting machine
- Drying yard (natural drying in ambient temperature)
- Curing yard (water spray curing in ambient temperature)

The only source of CO<sub>2</sub> emission that occurs within the project boundary is the CO<sub>2</sub> emission associated with consumption of diesel, where the mechanical equipments are run by diesel engines. In such cases diesel is burnt either directly in the engine (not converted to electricity) to run the mechanical equipments such as the pan mixer, or in the gensets for electricity generation during intermittent power breakdowns. Wherever available, electricity is used to run the equipments. Emissions, associated with the consumption of diesel and electricity, are accounted for while estimating the emission reductions.

Project activity covers spatial boundaries of different states where each electricity grid has its specific emission factor and T&D losses. Hence India can be considered as the spatial boundary and emission factor of 0.86 t CO<sub>2</sub>/MWh of power generated at national level can be taken for computation of project emissions due to electricity ([http://www.cea.nic.in/planning/c%20and%20e/user\\_guide\\_ver5.pdf](http://www.cea.nic.in/planning/c%20and%20e/user_guide_ver5.pdf)). Even after considering T&D losses of 45% as highest national average ([http://en.wikipedia.org/wiki/Electricity\\_sector\\_in\\_India](http://en.wikipedia.org/wiki/Electricity_sector_in_India)) this value comes to 1.247.

However to avoid uncertainties in the values a conservative default value of emission factor of 1.3 t CO<sub>2</sub>/MWh of power consumed is taken as suggested by “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”, and this value is higher than the national average. Thus the approach results in highest project emissions, and, in turn, lesser emission reductions which are more conservative.

### B.4. Establishment and description of baseline scenario

#### Baseline

As per AMS III-Z the baseline emissions are the emissions related to fossil fuel consumption (fossil fuel consumed multiplied by an emission factor) associated with the systems(s), which were or would have otherwise been used, in the clay brick production facility in the absence of project activity.

The approved methodology suggests “For project involving installation of systems in a new facility, the average annual historical baseline fossil fuel consumption value and the baseline brick production rate shall be determined as that which would have been consumed and produced, respectively, under an appropriate baseline scenario. If the baseline scenario identified includes different technologies with different levels of energy consumption, a weighted average energy use of these technologies can be considered for determining the baseline emissions of the facility or facilities.”

The project activity involves setting up new facilities for production of bricks and blocks by adopting the FaL-G technology, which results in emission reductions. The baseline is therefore the fossil fuel consumption 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. Under Indian conditions coal is only fossil fuel used in the manufacture of clay brick. The data on walling material market (provided in table 1.2) show 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.

In the absence of the project activity, it is expected that the burnt clay brick manufacturing using conventional technologies will continue to meet the walling material demand in the country resulting in substantial CO<sub>2</sub> emissions. Production of burnt clay bricks employs different technologies with different levels of coal consumption. Since it is difficult to determine precisely a particular technology that would be used in the absence of project activity, a weighted average coal consumption of these technologies is considered to best represent the baseline coal consumption in lieu of the weighted average energy use suggested by methodology. The technologies, which are banned by regulation, have not been considered in calculating the weighted average coal consumption.

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 baseline. The baseline specific coal consumption (coal 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 1.1 below. Annual production specific emission factor is then computed based on the specific coal consumption and its calorific value. (source<sup>1</sup> : Emission Standards for brick kilns- An opportunity for Technology upgradation by Sameer Maithel, The Energy Research Institute (TERI), India).

### **Basis:**

Size and Density of clay brick	22 x 10 x 7 cm; 1.8 t/m <sup>3</sup>
Specific emission factor for coal	25.8 tC/ TJ
Calorie to Joule	4.1858
Specific heat of coal	4500 kCal/kg
Carbon to CO <sub>2</sub>	3.666

Burnt clay brick technologies	Coal consumption,			Production capacities				No. of Plants Nx	Total production in m3/year/ all plant types	Total coal consumption in tons for total production
	tons/lakh bricks		Avg t/m3 F avg	100000 kg bricks/year		Tons/yr/ plant	m3/year/ plant Qx			
	Range	Average		Range	Average	Avg x 100	Tons x 55.55		Prod T = Qx x Nx	F T = Prod T x F avg
BTK- fixed chimney	16.00 - 24.00	20.00	0.13	83 - 275	179	17900	994345	25000	24858625000	3226649525
High draft/ zig zag	13.00 - 16.00	14.50	0.09	83 - 138	110.5	11050	613827.5	200	122765500	11552847
Clamps	32.00 – 48.00	40.00	0.26	1.4 – 27.5	14.45	1445	80269.75	60,000	4816185000	1250281626
Vertical Shaft Brick Kiln	13.00 – 16.00	14.50	0.09	14 - 110	62	6200	344410	30	10332300	972321

<sup>1</sup> <http://www.brickindia.com/articledetail.asp?id=36&cat=5>



<b>TOTAL</b>									29807907 800	44894563 19
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Weighted average Specific coal consumption,  $t/m^3 = F_T / \text{Prod}_T$

= 0.15061293

Specific heat consumption,  $k \text{ Cal}/m^3$

=  $4500 \times 0.15061293 \times 1000 =$

677758

**Annual production specific emission factor,  $t \text{ CO}_2/m^3 =$**

**$677758 \times 25.8 \times 4.1858 \times 3.666 / 10^9 = 0.2683$**

In the context of applicability of above values it is to be clarified that baseline of brick manufacturing process is same as that of 500 years back. New technologies in clay brick such as VSBK would have caused reduction in energy consumption, but they could not penetrate due to various socio-logistical issues, and thus not widely used. These issues are emphasised and substantiated in the study conducted and documented under “Energy Efficiency Improvements in the Indian Brick Industry” by TERI in association with UNDP.

(<http://www.resourceefficientbricks.org/background.php>)

Hence the applicability of thermal energy data can be much accepted.

Moreover, as conservative approach, baseline with weighted average thermal energy is taken as the basis out of various technological options available in clay brick production. Therefore the energy baseline continues to be the same.

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<sup>2</sup> 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 fuel inputs of the total fuel 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 emissions 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.

<sup>2</sup> Source: FAO Field Document No. 35, “Regional Wood Energy Development Programme in Asia”, GCP/RAS/154/NET.

The project activity is a bundle consisting of small scale units scattered throughout the country, resulting in variations in quality and quantum of coal used. Hence the project activity takes energy baseline based on National average. The amount of CO<sub>2</sub> 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<sub>2</sub> emissions associated with burning of coal in the baseline.

The total net emissions from the baseline scenario are estimated to be 11,041 tonnes of CO<sub>2</sub> equivalent per annum out of 9 plants included in the project. Ex-ante calculations vide Table under B6.3 may be referred for details.

### B.5. Demonstration of additionality

It is expected that, in the absence of the project activity, the burnt clay brick production deploying conventional technologies will continue to meet the walling material demand in the country resulting in substantial CO<sub>2</sub> emissions. The project activity is therefore considered additional and would result in abatement of emissions that would have otherwise occurred if the equivalent amount of clay bricks were to be produced.

However clay brick is an age-old product with irresistible receptivity in Indian market due to which introduction of any alternate product or technology gets stiff competition and challenge. In this background, FaL-G technology looked at CDM revenue as an opportunity to meet the costs in upholding the quality and to maintain the price line that can withstand the price competition from clay brick market. Efforts to get registered as CDM project were initiated as early as in 2000, and the following events are evident in this direction.

### Chronology of Events

S. No.	Timeline (dd/mm/yyyy)	Description of Events	Stakeholders involved and notes
CN1	07.09.2000	The earliest discussion on record concerning FaL-G Project in India, well before India ratified Kyoto Protocol.	World Bank Carbon Funds and Project developer in India INSWAREB, Visakhapatnam.
CN2	03.01.2003	Following ratification of Kyoto Protocol by India, submission of first Project Idea Note (PIN) even before the Community Development Carbon Fund (CDCF) was operational	As above
CN3	09.09.2003	Official submission of PIN to the CDCF, which was eventually accepted in the portfolio.	As above
CN4	20.09.2003	INSWAREB's Resolution No. 42/I to launch special drive to promote FaL-G bricks plants highlighting the contribution of CDM Revenue to overcome the impediments with regard to price competition with clay bricks, market promotion etc. Thus the new units would be encouraged to take CDM revenue for budgeting their projects. Such projects would be bundled as per the norms and	INSWAREB and ECPL



		<p>offered as CDM project to the World Bank.</p> <p>During the meeting it was also ratified that INSWAREB encourages activities of Eco Carbon Pvt. Ltd., (ECPL) to enable the latter's participation in commercial pursuits with the World Bank.</p>	
CN5	20.01.2004	Submission of Project Concept Note (PCN) together with financial workings to CDCF for FaL-G Brick Units in tiny sector- multiple units to be bundled under CDCF. It was envisaged that suitable number of Micro Industrial Plants (MIPs) would be roped into these bundles. PCN amply explained the various barriers faced by the project activity and clearly indicated that CDM revenue would be of help in overcoming the barriers.	International Bank for Reconstruction and Development (IBRD) as trustee of CDCF, INSWAREB and Eco Carbon Pvt. Ltd., (ECPL) Visakhapatnam, India(an associate of INSWAREB))
CN6	01.06.2004	The start date of the project is the earliest date of commencement of production occurred out of 11 SPE units in this bundle , which has come down to 9 SPE units at the time of registration. (Appendix 9)	
CN7	03.06.2004	Letter of Intent signed for purchase of potential ERs from FaL-G Bricks and Blocks Project (consisting of Micro Industrial Plants (MIPs) or FaL-G units in small scale bundles.	IBRD and Eco Carbon Pvt. Ltd. in its own right and on behalf of the Entrepreneurs to be bundled in the project (Project Entity).
CN8	25.8.2004	Scheme For Project Finance (Term Loan) And Working Capital Loan To Micro Industrial Plants of FaL-G Bricks/Blocks Under Bundling Of CDM.	--
CN9	10.01.2005	Submission of Financial scheme after meeting with SBI, Corporate Office, at Mumbai and presentation on FaL-G MIPs seeking bank finance at National level against carbon credit revenue.	
CN10	21.01.2005	Draft of ERPA sent by World Bank to ECPL	IBRD and ECPL
CN 11	24.04.2005	<p>First submission of New draft Methodology and PDD by World Bank to EB-CDM</p> <p>New Methodology was proposed because FaL-G avoids total thermal energy in the manufacturing process, and none of the approved methodologies were found</p>	SSC_014



		suitable for FaL-G project activity.	
CN 12	13.02.2006	Final recommendation of SSC-WG at its 4 <sup>th</sup> meeting, after protracted exchange of clarifications, to put the Project Activity under AMS-II.D with a conclusion that there is no need of New Methodology.	<a href="http://cdm.unfccc.int/methodologies/SSCmethodologies/clarifications/87033">http://cdm.unfccc.int/methodologies/SSCmethodologies/clarifications/87033</a>
CN 13	28.06.2006	ERPA signed	IBRD as Trustee of CDCF and ECPL as Project Entity.
CN 14	17.11.2006	Web Hosting of the PDD using AMS II.D	DNV, IBRD and ECPL ( <a href="http://cdm.unfccc.int/Projects/Validation/DB/3V6X4DEK3LXA9G3TBV41KG6NKUM26G/view.html">http://cdm.unfccc.int/Projects/Validation/DB/3V6X4DEK3LXA9G3TBV41KG6NKUM26G/view.html</a> )
CN 15	15.02.2008	Request for deviation, submitted	Request for Deviation is rejected by UNFCCC.
CN 16	05.09.2008	SSC_228	On 21.11.2008 the SSC WG advised that a request for deviation should be filed instead of revision.  ( <a href="http://cdm.unfccc.int/methodologies/SSCmethodologies/clarifications/85866">http://cdm.unfccc.int/methodologies/SSCmethodologies/clarifications/85866</a> )
CN 17	11.03.2009	Request for deviation M-DEV0219	EB advised the PE to consider using AMS III.Z that was approved at the EB48 in March 2009  ( <a href="http://cdm.unfccc.int/Projects/deviations/31797">http://cdm.unfccc.int/Projects/deviations/31797</a> )
CN 18	03.04.2009	Following EB ruling, a request for revision to enable use of AMS III.Z ver. 1 was submitted (SSC_297)	Methodology AMS III.Z revised ( <a href="http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_7UZF38D574Y74P8OL1ETOHWOA0COKU">http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_7UZF38D574Y74P8OL1ETOHWOA0COKU</a> )
CN 19	03.04.2009	Request for revision to AMS III.Z ver1 was submitted (SSC_298)	Methodology revised and AMS III. Z version 2 published  ( <a href="http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_02OBBFLWV1LVC4VRN7K8SJFT6UUFZ">http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_02OBBFLWV1LVC4VRN7K8SJFT6UUFZ</a> )
CN 20	24.09.2009	Request for revision submitted for AMS III.Z (SSC_322)	Methodology not revised but clarification provided as a response from SSC-WG 22 in September 2009

			<a href="http://cdm.unfccc.int/Projects/Validation/DB/MRSZEJRVVC7YZWWCRQGTKS3ALLBKS8/view.html">http://cdm.unfccc.int/Projects/Validation/DB/MRSZEJRVVC7YZWWCRQGTKS3ALLBKS8/view.html</a> )
CN 21	25.11.2009	Web hosting of the PDD using AMS III.Z ver.2	<a href="http://cdm.unfccc.int/Projects/Validation/DB/MRSZEJRVVC7YZWWCRQGTKS3ALLBKS8/view.html">http://cdm.unfccc.int/Projects/Validation/DB/MRSZEJRVVC7YZWWCRQGTKS3ALLBKS8/view.html</a> )

The analyses in the following paragraphs illustrate a number of barriers for the FaL-G technology.

### Barrier due to prevailing practice

Burnt clay bricks continue to be the most popular form of walling material in the country. They are cheap and have traditionally been believed to be the most suitable walling material for building construction. Although alternative building materials such as cement concrete block and fly ash bricks have been introduced in the recent past, burnt clay bricks account for more than 95% of the total market for walling material in larger parts of the country. This can be seen from the data presented below (Source: A study on “Cost Effective Building Materials & Technologies” undertaken by Holtec Consulting Private Limited in the year 2004 on behalf of Building Materials Technology Promotion Council, a Government of India).

**Table 1.2 : Market share of different walling materials**

Type of walling material	Market size (Rs. Crores <sup>3</sup> )	% of Total Market
Burnt clay bricks	32825	95.3
Cement Concrete Blocks	1135	3.3
Fly ash bricks incl. FaL-G	485	1.4
<b>Total</b>	<b>34445</b>	<b>100</b>

Clay brick production is a simple activity and is practiced even at the tiny and cottage sector level, which, even at the brink of 21<sup>st</sup> century, is continued as a family trait that has been passed on from generation to generation. Small fired clay brick producers have no incentives to introduce alternate technologies, which require new investments, training to stabilize the operation, and a different business practice in long term perspective.

Production and use of burnt clay bricks are therefore considered to be the most common practice at present and is expected to remain a common practice in the future unless significant regulatory mechanisms are evolved and enforced effectively.

In spite of various superiorities of the FaL-G brick over clay brick, the grey color (imparted by the color of fly ash) of FaL-G products creates a barrier in terms of low consumer acceptance. This is the common observation made by consumers during various informal explorations of market prospects for FaL-G bricks by different promoters. In addition to the color, the presence of ash in the product also creates negative and sentimental perception on the quality of the product.

FaL-G brick uses cost-intensive raw materials such as cement/lime and gypsum. The other raw material, stone dust is also costlier than clay used for clay bricks, as the latter is excavated without compliance to cess payment in majority of the cases. Hence FaL-G brick loses to clay brick on price front in various parts of the country. In his paper, fly

<sup>3</sup> 1 crore = 10 million

ash-lime-phosphogypsum cementitious binder: A new trend in bricks, Kumar from BIET, Jhansi, reports, “Some beneficiation is needed to increase the strength of FaL-G bricks. The Process of beneficiation increases the cost of bricks considerably compared to the burnt clay bricks”( <http://www.springerlink.com/content/f376400212484564/>).

To facilitate penetration, Union Government has exempted FaL-G brick from duties (<http://indiabudget.nic.in/bspeech/bs199192.pdf>), which, however did not help due to meagre relief at tiny sector level. Meanwhile, from fiscal year (2006), the product has been imposed with excise duty (<http://indiabudget.nic.in/ub2006-07/cen/exnotecex.pdf>). Moreover, fly ash bricks, which enjoyed tax exemptions till 2004, have been suffering taxes with implementation of VAT (Value Added Tax) by different states since 2004. Though duties and taxes are applicable for clay brick industry, the activity, being positioned in unorganised sector with socio-political overtones, does not comply with tax regime, as against that of FaL-G bricks in organised sector ([http://www.fal-g.com/Lr\\_to\\_Editor\\_ET\\_on\\_Dr\\_Chand\\_article.pdf](http://www.fal-g.com/Lr_to_Editor_ET_on_Dr_Chand_article.pdf)). Thus the price disparity has become one more barrier for the promotion of FaL-G technology.

In this background CDM revenue helps as follows:

- Part of the CDM revenue is used for technological upgradation and support from INSWAREB who also conduct programs for market development and capacity building, which benefits SPEs of this bundle in particular and FaL-G brick industry at large.
- Out of the revenue transferred to the SPEs, a portion of the revenue is utilised to meet the price competition with clay bricks and the remaining revenue is utilised to meet continued high-quality operation, production as well as product promotion.

### **Technological Barriers**

FaL-G technology in particular, requires a recipe control of 3 main ingredients namely fly ash, lime/cement and gypsum plus water at the mixing step. This is followed by manual/mechanical casting and lining up the bricks on the platform or casting yard for drying for one or two days. The dried up bricks are stacked and cured with water for one to two weeks, depending on the ambient temperature upon which the product is ready for despatching to the market.

FaL-G is a proven technology in terms of the strength for use in walling material. However, the technology needs to be promoted among the entrepreneurs, and technical skills of artisans need to be developed for large scale implementation of technology.

Two important technical features that have led to high-risk perception of FaL-G are discussed below.

***Sourcing of raw materials:*** In contrast to the clay brick industry, where the basic raw material is the soil and available in and around the production sites, FaL-G technology and products require fly ash, cement and/or lime and gypsum as key ingredients. These ingredients are required to be tested, selected and sourced from industrial facilities, where they are produced. FaL-G Plants are therefore required to be carefully located unlike the traditional clay brick plants, which require only the supply of adequate amount of soil.

***Operating within the specified limits for right chemistry:*** FaL-G technology, unlike the traditional clay brick making, requires recipe control of 3 main ingredients namely fly ash, cement/ lime and gypsum plus water and fine aggregate at the mixing step. In case there are changes in the sources of the raw materials, the chemistry as well as the recipe needs to be reworked. This is perceived as an interruption to plant operation leading to production loss. In this context the observations of Professor from University of California, Berkeley, Dr PK Mehta, at an International Conference, makes an interest reading to perceive the scientific values of FaL-G technology. He observes,



“Industrial fly ash and slags happen to differ widely in both the phase composition and particle size, which, of course, influence their reactivity. A particular application may require a relatively reactive material; others may not require high reactivity. Thus, instead of an outright rejection of byproduct materials on account of differences in reactivity, an integrated approach to safe and economical disposal of these materials would require innovative match-making to find suitable homes within the concrete construction industry for every type of fly ash and slag produced. Bhanumathidas and Kalidas at the Institute for Solid Waste Research & Ecological Balance, Visakhapatnam, southern India, have developed the technology to make fly ash-lime-gypsum or fly ash-portland cement bricks and blocks. By disregarding the standard chemical and physical requirements for use of fly ash in the cement and concrete industries, the authors found that tailor-made blends of even non-standard fly ashes with lime and gypsum or with Portland cement produced adequate strength on normal curing.” (ref: PK Mehta, *Role of Pozzolanic and Cementitious Material in Sustainable Development of Concrete Industry*; Proceedings of Sixth CANMET/ACI International Conference on fly ash, silica fume, slag in natural pozzolans in concrete at Bangkok, 1998 pp.9 and 10).

The above observations of Prof Mehta ratifies the barriers discussed above with regard to judiciousness in procurement of raw materials and then developing commensurate recipes to achieve tailor-made process to yield standard products of FaL-G. In this direction hand-holding of entrepreneurs is essential that is possible only through systematic technology transfer. Wherever entrepreneurs have deviated from this disciplinary requirement, there are instances of quality abuse and criticism from market forces.

Though FaL-G is the Patented Technology, the promoters of the technology are working with the objective of promoting eco-friendly (green) product and are keen to support wide proliferation of this technology. The Licensors have not been rigorously enforcing the patent due to their vision that this technology has the potential to provide a large environmental benefit to the country by encouraging production of FaL-G bricks; and the associated high legal cost of enforcement of the patent on brick-makers across the country. However, a number of unlicensed plants were utilising pirated technology and producing poor quality fly ash bricks. To provide an incentive for all type of brick-makers to use genuine FaL-G technology and seek technical advice and support, this project was created with the following objectives:

- The first prerogative of a FaL-G plant desirous to participate in CDM is to become Licensee, practice the technology in a methodical manner and manufacture the product with quality standards.
- As the technology fee is taken care by the CDM-Revenue, this technology-interaction is possible primarily because of participation in CDM project.
- Moreover, these licensed plants get the benefit of receiving ‘Improvement Information’ of the technology from INSWAREB from time to time.

To accomplish this task, as resolved vide a special Resolution No. 42/I, INSWAREB keep conducting the Technology-awareness programs in order to sensitise entrepreneurs and market forces such as construction agencies, engineers, builders and contractors about the virtues and opportunities of this technology and its linkage to CDM. Much of the budget for these workshops is derived out of Technology fee.

## **B.6. Emission reductions**

### **B.6.1. Explanation of methodological choices**

As per approved methodology III-Z project activity emissions (PEy) consist of those emissions associated with the use of electricity or fossil fuel or both and are calculated in accordance with the “Tool to calculate baseline, project and /or leakage emissions from electricity consumption” and/or “Tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion” (tCO<sub>2</sub>e).

FaL-G plants do use electricity and/or 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 a few cases, some

of those who run the plants with electricity do keep provision to operate diesel based generators in order to overcome intermittent power breakdowns.

### **Estimating emissions from electricity consumption**

“Tool to calculate baseline, project and /or leakage emissions from electricity consumption” discusses the applicability of three scenarios to adopt the tool. Out of these three ‘Scenario A’ as given below is applicable for project activity.

***Scenario A:** Electricity consumption from the grid. The electricity is purchased from the grid only. Either no captive power plant is installed at the site of electricity consumption or. If any on-site captive power plant exists, it is not operating or it can physically not provide electricity to the source of electricity consumption.*

As per the tool the project emissions from the electricity are calculated based on the quantity of electricity consumed, an emission factor for electricity generation and a factor for transmission losses, as follows:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1+TDL_{j,y}) \quad \text{Eq.1}$$

Where:

$PE_{EC,y}$  Project emissions from electricity consumption in year y (tCO<sub>2</sub>/yr)

$EC_{PJ,j,y}$  Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)

$EF_{EL,j,y}$  Emission factor for electricity generation for source j in year y (tCO<sub>2</sub>/MWh)

$TDL_{j,y}$  Average technical and transmission and distribution losses for providing electricity to source j in year y

For determining the emission factor for electricity generation the tool facilitates to use conservative default value of 1.3 tCO<sub>2</sub> / MWh under Option A2 if Scenario A applies only to project and/ or leakage electricity consumption sources but not to baseline electricity consumption sources. Project activity falls under Scenario A hence uses the recommended default value of 1.3 tCO<sub>2</sub>/ MWh for emission factor for electricity consumption as against the IPCC default value of 0.9 tCO<sub>2</sub>/MWh power generation. In the background of considering the conservative default value together with TDL, no additional TDL factor is considered in the project emissions due to electricity.

Thus project emissions due to electricity consumption are computed as below:

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \quad \text{Eq.2}$$

$PE_{EC,y}$  Project emissions from electricity consumption in year y (tCO<sub>2</sub>/yr)

$EC_{PJ,j,y}$  Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)

$EF_{EL,j,y}$  Emission factor for electricity generation for source j in year y (tCO<sub>2</sub>/MWh)



In arriving to baseline emissions total (actual) electricity consumption without any deductions would be taken as a conservative approach.

The responsibility for calibration of power meters lies with the State Electricity Board. The State Electricity Board is required to follow the national standard set by the Central Electricity Authority, Ministry of Power, Government of India, Clause 18 of Gazette Notification No. 502/70/CEA/DP&D dt. 17.3.2006, to undertake calibration of power meters once in 5 years. The consumer does not have any control over the process. Currently, State Electricity Boards do not have established calibration schedules and the government regulation is also not enforced stringently, especially for domestic consumers and small scale industrial consumers, like the FaL-G plants.

Monitoring Methodology as per AMS III.Z does not specify calibration requirements for electricity meters. The general guidance for SSC-CDM projects, paragraph 17 (c) and (d), specifies that “Measuring equipment should be certified to national or IEC standards and calibrated according to the national standards”. This sentence in the general guidance goes on to require that recalibration should be undertaken at least once in three year. Despite best of efforts, if recalibration is not done as per the current CDM requirements, the project will submit a request for revision at the time of verification, referring to clause 7 of the *Guidelines for Assessing compliance with the calibration frequency requirement*. (Annex 60 of EB 52 meeting report).

#### b). Estimating emissions from diesel consumption

Wherever electricity supply is not available, diesel is used to run the equipments and machinery in the plant. Consumption of diesel in the plant is monitored and recorded on a monthly basis, from which the annual consumption is calculated.

As per “Tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion” CO<sub>2</sub> emissions from fossil fuel combustion in process j are calculated based on the quantity of fuels combusted and the default values of CO<sub>2</sub> emission factor of those fuels as follows:

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y}$$

$PE_{FC,y}$  = Project emissions from fossil fuel combustion in year y (tCO<sub>2</sub>/yr)

$FC_{i,j,y}$  = Quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)

$COEF_{i,y}$  = CO<sub>2</sub> emission coefficient of fuel type i in year y (t CO<sub>2</sub>/ mass or volume)

i = fuel types combusted in process j during the year y

Tool suggests calculating CO<sub>2</sub> emission coefficient based either on chemical composition or on net calorific value multiplied with CO<sub>2</sub> emission factor of the fuel type. In the present calculation the latter approach is considered. Accordingly the equation is as follows:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO_2,i,y}$$

Where:

$COEF_{i,y}$  = the emission coefficient of fuel type  $i$  in year  $y$  (t CO<sub>2</sub>/mass or volume unit)

$NCV_{i,y}$  = the weighted average of net calorific value of the fuel type  $i$  in year  $y$   
(GJ/mass or volume unit)

$EF_{CO_2,i,y}$  = the weighted average CO<sub>2</sub> emission factor of fuel type  $i$  in year  $y$  (t CO<sub>2</sub>/GJ)

$i$  = the fuel types combusted in process  $j$  during the year

Tool suggests four alternates for emission factor of diesel out of which one recommendation is to use IPCC default value. This is recommended in the absence of invoices, providing emission factors by the fuel supplier. The project activity consists of small scale units those purchase the diesel from retail dealers in small quantities but not on contract basis. Under these conditions no suggested data would be available. Hence recommended IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC guidelines on National GHG Inventories are taken for emissions from diesel.

Based on above, project emissions due to diesel consumption are computed as below:

$$PE_{FC,y} = \sum_i FC_{i,jy} \times NCV \times EF_{CO_2y} \quad \text{Eq.3}$$

$PE_{FC,y}$  = Project emissions from diesel consumed in year  $y$  (tCO<sub>2</sub>/yr)

$FC_y$  = Quantity of diesel consumed during the year  $y$  (litres/yr)

$NCV_F$  = Net calorific value of diesel (GJ/t)

$EF_{CO_2y}$  = CO<sub>2</sub> emission factor (tCO<sub>2</sub>/GJ)

The total project emissions  $PE_y$  due to the project activities within the project boundary is thus represented by the formulae

$$PE_y = \sum (PE_{ECy} + PE_{FC,y}) \quad \text{Eq. 4}$$

#### c). Estimating emissions due to leakage:

As per AMS III-Z leakage is applicable in the case of project activities involving change in production process or a change in type and quantity of raw and /or additive materials as compared with the baseline. The incremental emissions associated with the production/ consumption and transport of those raw materials consumed as compared to baseline, shall be calculated as leakage.

The activity outside the project boundary that leads to CO<sub>2</sub> emissions is the transport of raw materials to the FaL-G plants. Since substantial transport activity (for soil and coal) also occurs in the baseline to support clay brick activity (the baseline activity), as well as to support waste disposal activity (for various kinds of wastes - fly ash, gypsum etc.), net emissions associated with transport of raw materials, as per computation below, are observed to be insignificant and hence not included in the project emissions.

#### Emissions due to transport of raw materials

**In the baseline activity**

<b>Production of bricks avoided, m<sup>3</sup>/year</b>	<b>4500</b>
Thermal energy requirement, GWhth/year @ 0.000725 GWhth/m <sup>3</sup>	3.2625
Thermal energy requirement, kcal/year	2805245056
Thermal energy, kcal/year, after discounting for 5% use of biomass	2664982803
Calorific value of coal, kcal/kg	4500
Coal requirement, tons/year	592.2
Distance of availability of coal, kms	100-1000
Average distance of coal availability, kms	550
No. of trips @ 10 tons/trip	59.2
Diesel consumption, litres/year @ 4 litre/km	8143
<b>CO<sub>2</sub> emission due to transport of coal, tCO<sub>2</sub>/year@0.0032tCO<sub>2</sub>/litre</b>	<b>26.1</b>

**In the project activity**

**For a typical FaL-G plant with production capacity of 4,500 m<sup>3</sup>/ year**

Lime route:

	<b>Fly ash</b>	<b>Lime</b>	<b>Gypsum</b>	<b>Stone dust</b>
Raw material requirement as % of product weight	14.50	8	2.50	75
Quantity in tons/year (FaL-G production @4,500 m <sup>3</sup> /year)	1305	720	225	6750
Typical distance of raw material availability, kms	50-150	50-200	100-1000	10-50
Average distance of raw material availability, kms	100	125	550	30
Truck capacity, tons/trip	10	10	10	10
No. of trips per year	130.5	72	22.5	675
Distance travelled, kms/year	13050	9000	12375	20250
Fuel efficiency of trucks, km/litre	4	4	4	4
Diesel consumed, litres/year	3262.5	2250	3093.75	5062.5
CO <sub>2</sub> emissions from diesel consumption @0.0032tons/litre(t CO <sub>2</sub> /year)	10.44	7.2	9.9	16.2
<b>CO<sub>2</sub> emissions due to transport of all raw materials = 10.44+7.2+9.9+16.2 t CO<sub>2</sub>/ year</b>	<b>43.74</b>			

OPC route

	<b>Fly ash</b>	<b>OPC</b>	<b>Gypsum</b>	<b>Stone dust</b>
Raw material requirement as % of product weight	15.2	4.0	0.8	80
Quantity in tons/year (FaL-G production @4,500 m <sup>3</sup> /year)	1368	360	72	7200
Typical distance of raw material availability, kms	50-150	50-200	100-1000	10-50
Average distance of raw material availability, kms	100	125	550	30
Truck capacity, tons/trip	10	10	10	10



No. of trips per year	136.8	36	7.2	720
Distance travelled, kms/year	13,680	4500	3960	21600
Fuel efficiency of trucks, km/litre	4	4	4	4
Diesel consumed, litres/year	3420	1125	990	5400
CO2 emissions from diesel consumption @0.0032tons/litre(t CO <sub>2</sub> /year)	10.9	3.6	3.17	17.28
<b>CO<sub>2</sub> emissions due to transport of all raw materials = 10.9+3.6+3.17+17.28 t CO<sub>2</sub>/ year</b>	<b>34.95</b>			

As per above computation of emissions due to transportation of the raw materials results as follows:

For baseline activity: 26.1 t CO<sub>2</sub>

For project activity: 35 to 44 t CO<sub>2</sub> depending on the FaL-G recipe.

In the absence of data for energy consumption towards fly ash disposal, related leakage could not be computed. Otherwise, this is additional energy that the project conserves by consuming fly ash.

From above values it is evident that the net emissions out of transport are meagre and thus ignored.

In this project cement and lime are two inputs with significant emissions during their production and, thus need to be considered in the leakage computation.

As per AMS III-Z cement and / or lime would be monitored as per purchase bills and taken for computing leakages vide equations 5 and 6 respectively as below:

*Leakage due to cement:*

$$E_{L,x} = E_{x, OPC} = Q_{OPC} \times EF_{OPC} \quad \text{Eq.5}$$

Where

$$\begin{aligned} Q_{OPC} &= \text{Quantity of OPC purchased (tons)} \\ EF_{OPC} &= \text{CO}_2 \text{ emission factor for OPC (tCO}_2\text{/ ton OPC)} \end{aligned}$$

Even though PPC is used the emission factor of which is lower in comparison to OPC, emission factor of OPC will be taken for computation as a conservative approach.

*Leakage due to mineral lime:*

$$E_{L,x} = E_{x, ML} = Q_{ML} \times EF_{ML} \quad \text{Eq.6}$$

Where

$$\begin{aligned} Q_{ML} &= \text{Quantity of mineral lime purchased (tons)} \\ EF_{ML} &= \text{CO}_2 \text{ emission factor for mineral lime} \\ &\quad \text{(tCO}_2\text{/ ton mineral lime)} \end{aligned}$$

EF<sub>ML</sub> is arrived based on lime purity, which is tallying with IPCC default value

The total emissions due to leakage E<sub>L</sub> is represented by the formulae

$$E_L = \sum_x E_{L,x} \quad \text{Eq.7}$$

**Estimating Baseline emissions:**

Baseline Emissions are computed based on production of bricks and blocks in terms of m<sup>3</sup> as follows:

$$BE_y = EF_{BL} * P_{PJ,y} \quad \text{Eq. 8}$$

where

$BE_y$  = The annual baseline emissions from fossil fuels displaced by the project activity in t CO<sub>2</sub>e in year (of the crediting period)

$EF_{BL}$  = The annual production specific emission factor for year y, in t CO<sub>2</sub>/kg or m<sup>3</sup>

$P_{PJ,y}$  = The annual net production of the facility in year y, in kg or m<sup>3</sup>

The annual production specific emission factor ( $EF_{BL}$ ) can be calculated ex ante as follows:

$$EF_{BL} = (FC_{BL,i,j} \times NCV_j \times EF_{CO_2,j}) / P_{Hy} \quad \text{Eq. 8 (i)}$$

Where:

$FC_{BL,i,j}$  = Average annual baseline fossil fuel consumption value for fuel type  $j$  combusted in the process  $I$ , using volume or weight units

$NCV_j$  = Average net calorific value of fuel type  $j$  combusted, TJ per unit volume of mass unit

$EF_{CO_2,j}$  = CO<sub>2</sub> emission factor for fuel type  $j$  combusted in the process  $i$  in t CO<sub>2</sub>/TJ

$P_{Hy}$  = Average annual historical baseline brick production rate in units of weight or volume, kg or m<sup>3</sup>

While Eq 8 gives gross emission in the baseline, biomass correction factor of 0.05 is taken for emissions and are deducted from gross emissions to be more conservative as already discussed under B.4. Thus net baseline emissions are computed as below and shown in ex-ante calculations of emission reductions.

$$\text{Net } BE_{y,x} = BE_y (1-0.05) \quad \text{Eq. 8 (ii)}$$

The total emissions  $BE_{y, \text{total}}$  in the baseline is represented by the formula

$$BE_{y, \text{total}} = \sum \text{Net } BE_{y,x} \quad \text{Eq 9}$$

**Emission Reductions:**

Emission reduction generated by the project consisting of 9 plants ( $x=9$ ) as computed by Eq.10 below is the difference between the baseline emissions, as represented by Eq.9 and, the project emissions as per Eq.4 and emissions due to leakage vide Eq.7

$$ER = \sum (BE_{y, \text{ total}} - PE_y - E_{L,x}) \quad \text{Eq. 10}$$

Various assumptions and values used in the above calculations are given in Appendix 4.

#### B.6.2. Data and parameters fixed ex ante

<b>Data / Parameter</b>	<b>EF<sub>BL</sub></b>
<b>Unit</b>	t CO <sub>2</sub> / m <sup>3</sup>
<b>Description</b>	The parameter is Annual production specific emission factor. The units are derived based on the calorific value of fuel, which was duly documented by TERI.
<b>Source of data</b>	TERI (Emission Standards for Brick Kilns-an opportunity for technology upgradation. ( <a href="http://www.brickindia.com/article/detail.asp?id=36&amp;cat=5">http://www.brickindia.com/article/detail.asp?id=36&amp;cat=5</a> ))
<b>Value(s) applied</b>	0.2683 t CO <sub>2</sub> / m <sup>3</sup>
<b>Choice of data or Measurement methods and procedures</b>	<p>The baseline coal consumption is determined considering different technologies used in the production of burnt clay bricks, as studied by TERI at national level. The results of the study are given vide Table 1.1. Since it is difficult to determine precisely a particular technology that would be used in the absence of project activity, a weighted average coal consumption of these technologies is considered to best represent the baseline coal consumption in lieu of the weighted average energy use suggested by methodology. The annual production specific emission factor is thus computed based on the weighted average coal consumption.</p> <p>Use of biomass represents less than 2% in terms of fuel input in the production of clay bricks, which is conservatively taken as 5%, keeping in view the periodical escalation that may take place in the future.</p>
<b>Purpose of data</b>	For computing baseline emissions
<b>Additional comment</b>	This value is fixed ex-ante. Whenever two different data are available, it is always safe to consider the data on higher side, as an approach of abundant conservation to avoid controversy.





<b>Data / Parameter</b>	<b>EF<sub>EL</sub></b>
<b>Unit</b>	t CO <sub>2</sub> / MWh
<b>Description</b>	The parameter is emission factor for electricity. The value for emission factor is taken from the Tool to make the project emissions due to electricity to be on higher side and ERs as conservative.
<b>Source of data</b>	“Tool to calculate baseline, project and/or leakage emissions from electricity consumption (Version 01)”
<b>Value(s) applied</b>	1.3 ton CO <sub>2</sub> per MWh.
<b>Choice of data or Measurement methods and procedures</b>	AMS III - Z recommends calculating the project emissions in accordance with the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”. The tool has given options for determining the emission factor for electricity generation, and facilitated to adopt a conservative default value of 1.3 t CO <sub>2</sub> / MWh as one of the options. In this background the default value is taken for emission factor.
<b>Purpose of data</b>	For computing project emissions
<b>Additional comment</b>	The emission factor for electricity is fixed ex-ante. As and when there is revision in this value the revised value will be taken for Verification.

<b>Data / Parameter</b>	<b>EF<sub>CO2</sub></b>
<b>Unit</b>	tCO <sub>2</sub> /TJ
<b>Description</b>	The parameter is emission factor for diesel which is taken from 2006 IPCC Guidelines.
<b>Source of data</b>	2006 IPCC Guidelines on National GHG Inventories:’ Table 1.4 -Default CO <sub>2</sub> Emission factors for Combustion’ of Chapter 1 of Vol 2. Default value at the upper limit of the uncertainty at a 95% confidence interval is taken as recommended.
<b>Value(s) applied</b>	74.8 t CO <sub>2</sub> / TJ at NCV of 43TJ/Gg
<b>Choice of data or Measurement methods and procedures</b>	AMS III-Z recommends calculating the project emissions from fossil fuel in accordance to the “Tool to calculate project or leakage emissions from fossil fuels (version02)”. The tool has given four options for emission factor from diesel out of which IPCC default value is one option. This can be adopted in the absence of invoices by fuel supplier containing the emission factors. Such data are not available with small scale units who purchase diesel in small quantities.
<b>Purpose of data</b>	For computing project emissions
<b>Additional comment</b>	The emission factor and Net Calorific Value (NCV) of diesel, taken from IPCC 2006, is fixed ex-ante. However should there be any revision in IPCC values in future the same would be taken for Verification. While this default value is applicable on weight basis (per Gg ie., 1000 tons), the data from SPEs is monitored on volume basis based on the purchase bills that are mentioned with units in litres. Hence litres would be multiplied by density of 820kg/KL ( <a href="http://www.siamindia.com/scripts/Diesel.aspx">http://www.siamindia.com/scripts/Diesel.aspx</a> ) in order to arrive to weight-units (tons).

<b>Data / Parameter</b>	<b>EF<sub>OPC</sub></b>
<b>Unit</b>	t CO <sub>2</sub> / ton of cement
<b>Description</b>	The parameter is emission factor for OPC, which is on higher side for conservative approach
<b>Source of data</b>	National average based on prevailing production practices of cement production in the country
<b>Value(s) applied</b>	0.82 ton CO <sub>2</sub> per ton of cement as conservative approach.
<b>Choice of data or Measurement methods and procedures</b>	<p>The value is taken based on the technical coverage in Press Information Bureau, Government of India.  <a href="http://www.pib.nic.in/release/release.asp?relid=55724">http://www.pib.nic.in/release/release.asp?relid=55724</a></p> <p>With more and more concern for energy efficiency and conservation of fuel, cement industry in India is striving to reduce the emission factor for OPC. This has resulted in emission factor at as low as 0.77 in some cement plants. However a factor of 0.82 is taken as a conservative value.</p>
<b>Purpose of data</b>	For computing emission due to leakage
<b>Additional comment</b>	This value is fixed ex-ante.

<b>Data / Parameter</b>	<b>EF<sub>ML</sub></b>
<b>Unit</b>	t CO <sub>2</sub> / ton of CaO
<b>Description</b>	The parameter is emission factor for mineral lime and is taken based on the commercially available lime .
<b>Source of data</b>	2006 IPCC Guidelines for National Green House Inventories; Table 2.4 of Volume 3.
<b>Value(s) applied</b>	0.42 t CO <sub>2</sub> / ton of CaO
<b>Choice of data or Measurement methods and procedures</b>	In the general practice lime from mineral source is available with a purity of 30-45% in terms of CaO that results in lesser emissions. However to ensure conservativeness, the highest lime purity of 53% for commercial limes is taken into consideration, and emission factor is computed using the stoichiometric ratio of 0.785 tones CO <sub>2</sub> / ton of CaO as per above referred table.
<b>Purpose of data</b>	For computing emissions due to leakage
<b>Additional comment</b>	The emission factor for lime is fixed ex-ante. However should there be any revision in IPCC values in future the same would be taken for Verification.

### B.6.3. Ex-ante calculation of emission reductions

Sl. No.	Identification number	Parameters to be monitored				Project Emissions estimate		Leakage emission	Baseline Emissions			Net Emission Reductions
		Brick/ Block production	Consumption			Electricity consumption	Project Emissions		Gross Emissions	Less for Biomass	Net Baseline emissions	
			Electricity	Diesel	OPC							
		m <sup>3</sup> /year	KWh <sub>e</sub> /year	Litres/year	Tons/year	GWh <sub>e</sub> /yr	tCO <sub>2</sub> /yr	t CO <sub>2</sub> /yr	tCO <sub>2</sub> /yr	tCO <sub>2</sub> /yr	tCO <sub>2</sub> /year	





Year	Baseline emissions (tCO <sub>2</sub> e)	Project emissions (tCO <sub>2</sub> e)	Leakage (tCO <sub>2</sub> e)	Emission reductions (tCO <sub>2</sub> e)
01/08/2011-31/07/2012	11041	197	2842	8002
01/08/2012-31/07/2013	11041	197	2842	8002
01/08/2013-31/07/2014	11041	197	2842	8002
01/08/2014-31/07/2015	11041	197	2842	8002
01/08/2015-31/07/2016	11041	197	2842	8002
01/08/2016-31/07/2017	11041	197	2842	8002
01/08/2017-31/07/2018	11041	197	2842	8002
01/08/2018-31/07/2019	11041	197	2842	8002
01/08/2019-31/07/2020	11041	197	2842	8002
01/08/2020-31/07/2021	11041	197	2842	8002
<b>Total</b>	<b>110410</b>	<b>1970</b>	<b>28420</b>	<b>80020</b>
<b>Total number of crediting years</b>	10 years			
<b>Annual average over the crediting period</b>	11040	197	2842	8002

## B.7. Monitoring plan

### B.7.1. Data and parameters to be monitored

Data / Parameter	Production-P <sub>PI,y</sub>
Unit	m <sup>3</sup> bricks/ blocks
Description	SPE maintains the actual quantities of production in number on daily basis, based on each size of brick/block, which is duly converted to volume (m <sup>3</sup> ) to facilitate computations.
Source of data	Stock registers of SPE.
Value(s) applied	43318 m <sup>3</sup> ; used in ex-ante calculations
Measurement methods and procedures	SPEs record the production of bricks/ blocks on daily basis. These are made available to PP once in a month.
Monitoring frequency	Daily
QA/QC procedures	Upon receipt of the monthly data on brick/ block production and fuel use (electricity and or /diesel) from the plants, PE will review the data. The personnel of PE will make periodical visits to SPEs' plants to check the diligence of record keeping and the accuracy for ultimate diligence of emission computations.
Purpose of data	For computing baseline emissions
Additional comment	None



<b>Data / Parameter</b>	<b>Electricity-EC<sub>PJ,i,y</sub></b>
<b>Unit</b>	kWh
<b>Description</b>	The electricity consumption is monitored continuously by the Electricity Meter and recorded by the Service Provider (State Electricity Department) monthly or bimonthly based on which the Electricity bills are provided.
<b>Source of data</b>	Electricity bills provided by the service provider (state electricity department).
<b>Value(s) applied</b>	151613 kWh; used in ex-ante calculations
<b>Measurement methods and procedures</b>	SPEs submit to PE the electricity bill as provided by the Service Provider. The information is verified and tallied with the records of SPE by the personnel of ECPL periodically. For this purpose ECPL personnel are imparted with in-house training.
<b>Monitoring frequency</b>	Monthly/ bimonthly as provided by the service provider
<b>QA/QC procedures</b>	Refer to Section B.6.1
<b>Purpose of data</b>	For computing project emissions
<b>Additional comment</b>	NA

<b>Data / Parameter</b>	<b>Diesel-FC<sub>y</sub></b>
<b>Unit</b>	Litre
<b>Description</b>	Daily consumption of diesel would be provided by SPEs to PE on monthly basis.
<b>Source of data</b>	Stock register.
<b>Value(s) applied</b>	0 litres; used in ex-ante calculations
<b>Measurement methods and procedures</b>	SPEs records diesel consumption on daily basis and sends the details to PE on monthly basis.
<b>Monitoring frequency</b>	Daily
<b>QA/QC procedures</b>	All the information is verified and tallied with the records of SPE by the personnel of ECPL periodically. For this purpose in-house training is imparted to ECPL personnel. Consumption is cross checked with the purchase bills.
<b>Purpose of data</b>	For computing project emissions
<b>Additional comment</b>	NA



<b>Data / Parameter</b>	<b>Cement-Q<sub>OPC</sub></b>
<b>Unit</b>	Tons
<b>Description</b>	Purchase details are provided by the SPEs through monthly statement.
<b>Source of data</b>	Purchase bills of cement.
<b>Value(s) applied</b>	3465.44 tons; used in ex-ante calculations
<b>Measurement methods and procedures</b>	Quantities of cement as per purchase bills would be taken for computation of leakages.
<b>Monitoring frequency</b>	As and when OPC is purchased
<b>QA/QC procedures</b>	Upon receipt of the monthly data of purchase bills, the personnel of PE will make periodical visits to SPEs' plants to check the diligence of record keeping.
<b>Purpose of data</b>	For computing emissions due to leakage
<b>Additional comment</b>	The leakage emissions for using Cement is derived based on the default values of national average.

<b>Data / Parameter</b>	<b>Mineral Lime-Q<sub>ML</sub></b>
<b>Unit</b>	Tons
<b>Description</b>	Purchase details are provided by the SPEs through monthly statement.
<b>Source of data</b>	Purchase bills of lime
<b>Value(s) applied</b>	0 tons; used in ex-ante calculations
<b>Measurement methods and procedures</b>	Purchase bills for mineral lime would be taken for computation of leakages.
<b>Monitoring frequency</b>	As and when mineral lime is purchased
<b>QA/QC procedures</b>	All the information is verified and tallied with the records of SPE by the personnel of ECPL periodically. For this purpose in-house training is imparted to ECPL personnel.
<b>Purpose of data</b>	For computing emissions due to leakage
<b>Additional comment</b>	<p>The object of monitoring lime purchases is to compute the leakage emissions. Purchase bills may not be available when by product lime is procured. In such case delivery challans would be accepted for computing the quantity of procurement.</p> <p>The leakage is taken into account only when lime from mineral source is procured. In the case of by product lime, the data is recorded, but no leakages are accounted for as the same would not have any impact.</p>

Data / Parameter	Performance of project brick/block in terms of Compressive Strength once in six months
Unit	MPa
Description	The brick/ block is tested in a Compressive strength Testing Machine (CTM) in any of the laboratories of polytechnics, engineering colleges, building centers, national laboratories etc., and the test certificates are provided by the laboratory.
Source of data	Test Certificate as provided by the testing laboratories
Value(s) applied	NA
Measurement methods and procedures	The test procedure is followed as per Appendix 11
Monitoring frequency	Once in six months
QA/QC procedures	Calibration of CTM for strength test is taken care by respective laboratories and outside the project boundary.
Purpose of data	Quality checking of project activity brick/block
Additional comment	NA

### B.7.2. Sampling plan

There is no sampling involved in the Project.

### B.7.3. Other elements of monitoring plan

Day to day data wherever applicable will be recorded by the sub-project entity who sends monthly statements to project entity. These statements are reviewed for the diligence of data, which are then electronically archived for computation of emission reductions. All such archived data would be stored until two years after the end of the crediting period.

In order to ensure due diligence, the PE conducts periodical inspection of units randomly at any given time in a year. For this purpose the PE deploys monitoring personnel who visit the SPEs and inspect their records and tally with their monthly statements. Errors in data, if any, would be corrected at all points of archiving the data. . The monitoring personnel would duly attest the records as a mark of inspection. The PE would randomly check the visits of monitoring personnel in order to ensure due compliance. Management structure for monitoring has been given in Appendix 5.

Various templates are made to record the data to be monitored. The monitoring personnel of PE would be provided with such templates. As the steps involved in monitoring are simple, in-house training is imparted in recording the data and to translate the same into the computation of ERs.

Based on the monitoring requirements of AMS III-Z as described under B.1, following records would be verified by Inspectors:

#### Production records:

- Stock register showing daily production

#### Raw materials inwards:

- Inward stock registers for fly ash, cement and/ or lime.
- Delivery Challans of thermal plants/boilers/Transporters for fly ash.
- Purchase bills of cement and lime
- Delivery Challans for byproduct lime in case of non-availability of purchase bills.

### **Diesel and/or Power Consumption data**

The consumption of diesel is to be recorded on daily basis, and of power on monthly basis. In the case of diesel, the purchase bills would be verified for cross checking the consumption. In case of power, the meter reading and consumption as provided on the state electricity bill would be taken as record. .

The monitoring personnel keep inspecting the accredited units from time to time through checks and help the SPEs in optimum upkeep of the records in case any deviations are observed. The SPEs, who disregard the advice of monitoring personnel and prove continuously complacent in maintaining the stipulated records, would be dropped from the bundle and would not be entitled to receive carbon credits.

### **Performance criteria by testing Compressive Strength**

The methodology requires making available the test certificates on the strength performance of bricks tested at six-month interval. In the context of testing of bricks/blocks, the SSC WG, at its 22<sup>nd</sup> meeting clarified that the testing can be undertaken based on the national/regional standards or guidelines applicable to the type of project activity bricks. Testing can also be undertaken as per the procedures provided by the technology provider as long as the testing methods can be substantiated with reference to peer reviewed literature i.e. relevant international journal publications, publications of national/international building research centres etc. As long as the testing procedures in the guidelines/standards are met, the testing itself can be undertaken in polytechnics, engineering colleges, building centers, national laboratories etc.

Accordingly the test procedure vide Appendix 11 shall be adopted and the bricks be tested for their compressive strength at six month interval.

The only code applicable for fly ash bricks in IS: 12894. However, this test procedure has erratically asked for strength test in the lines of tests applicable for clay bricks due to the nomenclature of bricks. As bricks are by and large sold in the market based on physical appearance, without relying upon codes, there was no concern to challenge the code nor to propose amendment. In this background based on the recommendations of SSC WG at its 22<sup>nd</sup> meeting, INSWAREB, as the technology provider, has made available a test procedure considering the hydration chemistry, as applicable to that of cementitious products. Based on the above, the test certificates on the strength performance of bricks tested at six-month interval would be made available, as per test procedure vide Appendix 11.

Already there is a practice to procure the bricks/blocks at random from the SPEs and test them at the labs of INSWAREB-Building Centre. Also there is a practice to visit the SPE with mobile testing facility and conduct the tests on the product in as in where in condition on site. Hereafter, tests would be done in accordance to the procedure of Appendix 11 and INSWAREB-Building Centre would provide certificates to the extent of possible. Wherever INSWAREB is unable to visit SPE with mobile testing facility, the SPEs shall be asked to furnish the test certificates from the labs of polytechnics, engineering colleges or local building centres.



**SECTION C. Duration and crediting period****C.1. Duration of project activity****C.1.1. Start date of project activity**

01/06/2004

**C.1.2. Expected operational lifetime of project activity**

20 years

**C.2. Crediting period of project activity****C.2.1. Type of crediting period**

Fixed crediting period

**C.2.2. Start date of crediting period**

01/08/2011

**C.2.3. Length of crediting period**

10 years

**SECTION D. Environmental impacts****D.1. Analysis of environmental impacts**

FaL-G plants, being very small industrial activities, do not require any environmental impact assessment study. However, the Project Entity has carried out an environmental and social review of the project. The analysis reveals that FaL-G activity is environmentally benign and has several positive impacts. The principal beneficiaries of the project include

- Local communities: due to reduced negative environmental impacts from the traditional clay brick manufacturing process, such as land degradation and heavy air pollution, as well as reduced waste from better fly ash utilisation options.
- The global community, due to the expected reduction in GHG emissions and contribution for reduction to climate long-term change.
- Industrial and utility sectors, which would benefit from the reduced cost of waste disposal due to increased off-take by the FaL-G manufacturers.

The significant positive impacts on environment associated with the project largely outweigh the few negative impacts, which are mostly linked to the simple operational practices that are followed in small and micro scale FaL-G plants. These impacts are however manageable. The Project Entity has developed an Environment Management Plan/Good Practice Manual, which will be implemented at all the FaL-G plants. In addition, a specific Community Benefit Program has also been designed for the benefit of the workers. All these issues are documented as Environment & Social Review (ESR), which is an exhaustive document. Hence the salient features of ESR have been made into an action-plan document called Environment Monitoring and Community Benefit Plan (EMCBP), which is attached as Appendix 7.



The EMCBP is included in Sub-Project Agreement already signed between PE and SPEs. Accordingly all the SPEs have to implement EMCBP, which would be periodically monitored by Project Entity. Disciplinary action would be taken if SPEs prove as non-compliant.

## **SECTION E. Local stakeholder consultation**

### **E.1. Solicitation of comments from local stakeholders**

The yardsticks adopted in seeking stakeholders' comments on environmental impacts for scheduled industries in medium and large-scale sector are of different dimension. This project being an agglomeration of tiny sector units scattered over a large geographical area, no special process has been adopted to invite the comments at National level.

Extensive consultations, involving a wide spectrum of stakeholders, have been carried out in the form of promotional workshops during the past years by INSWAREB on FaL-G technology. While some of these workshops were at district level, some were relatively big events. The one conducted in 2001(October 18-19) and the two in 2003 (19.04.2003 at Cuddapah, and September 26-27 at Hyderabad) were some such events. The recent workshops include those conducted in Visakhapatnam & Hyderabad (Andhra Pradesh) and Bhubaneswar (Orissa) in Aug 2007, at Raipur (Chhatisgarh), Tatanagar (Jharkhand) and Vijayawada (Andhra Pradesh) in 2008 and at Pune (Maharashtra), Coimbatore (Tamil Nadu) and Visakhapatnam (Andhra Pradesh) in 2009.

The workshops were conducted under knowledge dissemination program, therefore no registration fee was collected and the workshops were open to all interested participants. Government engineers, civil and structural consultants, builders, construction houses, researchers, and faculty from academic institutes and engineering colleges attended the workshops, in addition to the entrepreneurs practicing FaL-G technology and those who have interest to set up the units.

The project sponsors also carried out several formal and informal consultations at different sites, targeting a range of stakeholders since 2003 that included

- a) The entrepreneurs
- b) The brick consumers
- c) The local residents
- d) The workers, manufacturing FaL-G blocks at FaL-G plants.
- e) The suppliers of raw materials.

### **E.2. Summary of comments received**

It may be noted that brick entrepreneurs, brick consumers, the local residents, the brick workers and the raw material suppliers are the principal stakeholders associated with the FaL-G activity. The response by the stakeholders has been generally positive about the product and the technology. However, certain concerns of these stakeholders are summarised below.

#### **FaL-G Entrepreneurs**

These entrepreneurs felt that carbon credits would help them in giving discounts in order to face stiff price competition from clay bricks.

They consider that the credits would be certainly an incentive to enthruse them in order to produce more FaL-G bricks and blocks and abate more CO<sub>2</sub>.



Several of them reflected the positive contribution of the project activity in contributing to the environment.

Some of them questioned the authenticity of price and striking the deal at specified price.

### **FaL-G consumers**

The consumers wondered whether they would get reduction in price of FaL-G blocks to the extent of credits received by their supplier. They argued that consumers were equally responsible for the generation of credits and, hence, it would be fair that the entrepreneurs share the benefits with them.

Some of them admitted that, whether they get carbon benefits or not, FaL-G bricks were their product of choice for avoiding at least 10-15% wastage, which is unavoidable with clay bricks produced with poor quality of clay and insufficient sintering.

Some of the builders hoped that, encouraged by carbon credit mechanism, more and more entrepreneurs would take up the production to increase the supply position so that their projects do not suffer scarcity, more so while their construction project based on FaL-G were halfway through.

### **Local residents:**

Local folks desired that the raw materials in bulk, such as fly ash and stone dust, be handled in wet state so that there would not be dust emanation.

Some of them wished to get more and more plants so that employment potential to the youth would brighten up.

Giving reference to the proximity of the plant, many of them ascertained that they would be getting more qualitative product over clay brick for their constructions with least transportation cost.

Some of them have shown interest to become entrepreneurs and get into FaL-G activity, if they were assured of the technology support and carbon credit incentive.

### **Brick Workers:**

Some of the workers argued that they are part of the production process and, thereby, they deserve to get a portion of the carbon benefit?

One section of the workers expressed that, as long as they get wages promptly with no interruption of work, they would wish their employer to get more and more such incentives.

### **Raw material suppliers:**

Almost all of them hoped that carbon incentive would ease the financial crunch of entrepreneurs and, in turn, may help in resolving undue payment-delays, which is a menace in construction industry.



### **E.3. Report on consideration of comments received**

As can be seen from the previous section, the comments received from various stakeholders are largely positive. The concern on dust emanation from FaL-G units is addressed by requiring the FaL-G units handle fly ash and stone dust in wet condition. The thermal plants do operate hydra-mixers so that the fly ash is delivered into the trucks of entrepreneurs without dust emanation. It is same with stone dust also.

With regard to workers' comments, FaL-G offers them continuity of work and wage-earnings, which is the basic need of a worker that could not be made possible with clay brick industry. In addition, a Community Benefit Plan comprising of welfare measures such as group insurance for accidents and death, and safe sanitation for workers will be implemented to enhance the workers' benefits.

### **SECTION F. Approval and authorization**

Letter of approval from each Party involved in the project activity has been made available at the time of submitting the PDD to the DOE.

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**Appendix 1: Contact information of project participants**

<b>Organization</b>	Eco Carbon Pvt. Ltd.	
<b>Street/P.O. Box</b>	I Floor, 32-10-55, Shri Venkateswara Colony, Sheila Nagar	
<b>Building</b>	INSWAREB Laboratory Building	
<b>City</b>	Visakhapatnam	
<b>State/Region</b>	Andhra Pradesh	
<b>Postcode</b>	530012	
<b>Country</b>	India	
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<b>Fax</b>	++91-891-2517429	
<b>E-mail</b>	info@co2credits.biz	
<b>Website</b>	www.co2credits.biz	
<b>Contact person</b>		
<b>Title</b>	Mg. Director	Executive Director
<b>Salutation</b>	Dr	Mr
<b>Last name</b>	Bhanumathidas	Kalidas
<b>Middle name</b>		
<b>First name</b>	Nateri	Nateri
<b>Department</b>	Research & Development.	Business Development
<b>Mobile</b>	++91-98483-69930	++91-98481-91453
<b>Direct fax</b>	++91-891-2517429	++91-891-2517429
<b>Direct tel.</b>	++91-891-2516411	++91-891-2516411
<b>Personal e-mail</b>	bhanukali@vsnl.com	bhanukali@gmail.com



<b>Organization</b>	International Bank for Reconstruction & Development as the Trustee for Community Development Carbon Fund (CDCF)
<b>Street/P.O. Box</b>	1818 H street NW
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<b>City</b>	Washington
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<b>Country</b>	USA
<b>Telephone</b>	1202 458-1873
<b>Fax</b>	1202 522 7432
<b>E-mail</b>	<a href="mailto:IBRD-carbonfinance@worldbank.org">IBRD-carbonfinance@worldbank.org</a>
<b>Website</b>	<a href="http://www.carbonfinance.org">www.carbonfinance.org</a>
<b>Contact person</b>	--
<b>Title</b>	Manager, Carbon Finance
<b>Salutation</b>	Mr
<b>Last name</b>	Chassard
<b>Middle name</b>	--
<b>First name</b>	Joelle
<b>Department</b>	ENVCF
<b>Mobile</b>	--
<b>Direct fax</b>	--
<b>Direct tel.</b>	--
<b>Personal e-mail</b>	--



<b>Organization</b>	Ministry for the Environment, Land and Sea, The Government of Italy
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<b>State/Region</b>	--
<b>Postcode</b>	--
<b>Country</b>	Italy
<b>Telephone</b>	--
<b>Fax</b>	--
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<b>Website</b>	--
<b>Contact person</b>	--
<b>Title</b>	--
<b>Salutation</b>	Mr
<b>Last name</b>	Clini
<b>Middle name</b>	--
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<b>Personal e-mail</b>	--



<b>Organization</b>	The Netherlands' Ministry of Infrastructure and the Environment(IenM), The State of the Netherlands
<b>Street/P.O. Box</b>	Rijnstraat 8 30945
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<b>Country</b>	The Netherlands
<b>Telephone</b>	0031-70-339.5199
<b>Fax</b>	0031-70-339.1306
<b>E-mail</b>	cdm.dna@minvrom.nl
<b>Website</b>	---
<b>Contact person</b>	---
<b>Title</b>	---
<b>Salutation</b>	Ms.
<b>Last name</b>	Gerards
<b>Middle name</b>	---
<b>First name</b>	Marisa
<b>Department</b>	---
<b>Mobile</b>	---
<b>Direct fax</b>	0031-70-339.1306
<b>Direct tel.</b>	0031-70-339.5199
<b>Personal e-mail</b>	--



**Appendix 2: Affirmation regarding public funding**

No Public funding is availed.

**Appendix 3: Applicability of selected methodology**

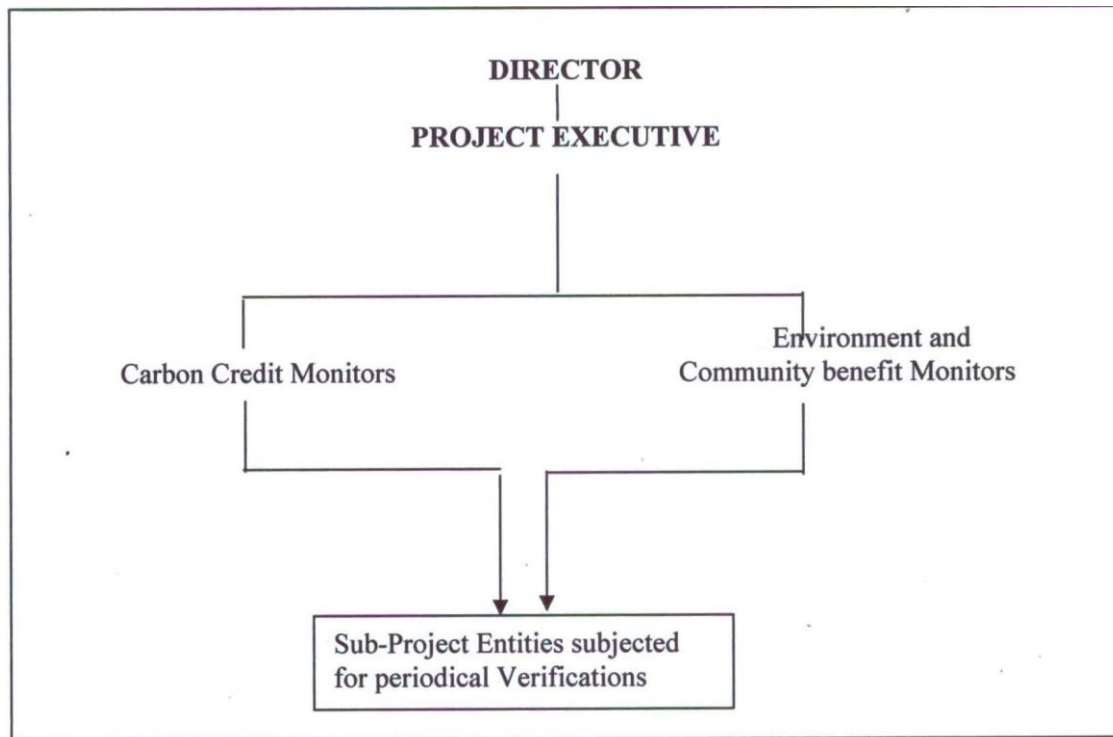
Additional information -NIL

**Appendix 4: Further background information on ex ante calculation of emission reductions**

Sl. No.	Parameter	Variable	Values	Units	Remarks
	<b>Project related parameters</b>				
	Emission factor of diesel	EF <sub>diesel</sub>	74.8	tCO <sub>2</sub> /GJ	IPCC 2006 default value vide Table 1.4 of Chapter 1/ Vol .2
	Emission factor for electricity	EF <sub>elec</sub>	1.3	tCO <sub>2</sub> /MWh <sub>e</sub>	Methodological tool**
	<b>Baseline related parameters</b>				
	Density of conventional clay brick	D <sub>clay brick</sub>	1.80	Tons/m <sup>3</sup>	
	Annual Production specific emission factor	EE <sub>y</sub>	0.2683	t CO <sub>2</sub> / m <sup>3</sup>	TERI Document
	Carbon Emission Factor for Coal	CEF <sub>coal</sub>	25.8	tC/TJ	IPCC default
	Fraction of energy supplied by biomass in brick kilns	R <sub>biomass</sub>	0.05		
	Carbon to CO <sub>2</sub> conversion factor	CC	3.666	tCO <sub>2</sub> /tC	

\*\* Tool to calculate baseline, project and/or leakage emissions from electricity consumption (version 01)

### Appendix 5: Further background information on monitoring plan



### Appendix 6: Summary of post registration changes

One SPE having ID No. AP/GTR/II/6 has withdrawn voluntarily and another SPE with ID No. AP/VZM/II/11 has been terminated due to non-compliance. These changes have resulted in reduced number of operating plants from 11 to 9 . However the above changes do not effect the following:

- The applicability and application of the applied methodology under which the project activity has been registered
- The additionality of the project activity
- The scale of the project activity



### Appendix 7: Salient features of Environment Monitoring & Community Benefit Plan (EMCBP)

All the SPEs should have concern for the welfare of environment, workers and community while carrying on their production.

Measures under this plan, as notified in the table below, would be executed by SPEs, under due supervisory coordination from Project Entity.

Activity	Intensity of compliance	
<b>Environment Monitoring Plan:</b>		
To ensure covering raw materials with Plastic sheets, to prevent flying of dust.	Compulsory	
To increase the height of stack to a height of 2.0 mtr from workers-standing level, wherever diesel engines are used.	Compulsory	
To provide booklet to each worker on material handling and occupational health.	Compulsory	
Raw materials should be transported duly covered.	Compulsory	
Raw materials should be kept in closed conditions or wherever it is stored in open yards, it has to be duly covered.	Compulsory	
Bulk materials such as stone dust should be sprinkled with water to prevent dusting, during its storage in open yard.	Compulsory	
All internal roads may be paved and kept clean.		Optional, as good practice.
Minimise spillage of oils and grease through suitable preventive maintenance.	Compulsory	
Wherever DG sets are used, SPE should obtain necessary guidelines and adhere to them.	Compulsory	
SPE should avoid leakage and wastage of water. If possible, the surplus of the cured water may be recycled.		Optional, as good practice.



<b>Community Benefit Plan:</b>		
<b>Insurance to Workers:</b> <b>Basis: 12 workers per SPE</b> <u>Janata Personal Accident</u> To cover death, bodily injuries or permanent disability as a result of accident, upto Rs. 1.00 lakh.  <u>Swasthya Bheema</u> Individual Health Insurance policy to cover 24 hours of the day and not limited to place of employment.	Compulsory	
Personal Protection Gadgets: Gum Boots, hand gloves and nose masks need to be given to workforce.	Compulsory.	
Health Check up for Workers: Each worker needs to be checked up for health once in a year.	Compulsory	
Toilets and bathing facility to workers together with taps, flush and overhead water tank:	Compulsory	
HIV Awareness program: All the workers need to be explained with virtues of safe sex and implications of AIDS.	Compulsory	
Protected Drinking water	Compulsory	
Do not employ child labour	Compulsory	
Ensure wage parity between male and female workers.	Compulsory	

**Appendix 8: List of SPEs**

Name & Address of the MIP					
State of Tamil Nadu	Name and relation of Authorised Signatory	Geographical Coordinates & ID No.	Established in	Crediting period	Output/ year in Cu.mtr
<b>Kanchipuram Dist.</b>					
NRK Infra System Pvt. Ltd., Plot No. 62-64. Nallambakkam Village Kattan Kulathyur Block, Chengelpet Taluk, TN Kanchipuram Dist. TN	N S Krishnammaraja Director 94444-08585	12. 23° N 79.97° E TN/KCP/II/1	Aug-04	2011-2021	11998



State of Andhra Pradesh						
Prakasam Dist.						
Sagar Quality Bricks Door No. 281/2. Nayuduvripalem Village Karamchedu Mandal, 523167 Prakasam Dist. AP	Ms. T Geeta Vani Proprietrix 98499-88681	15.8° N 80.32° E AP/PSM/II/2	Dec-04	2011-2021	3600	
Sri Varalakshmi Fly ash Bricks Survey No. 83/1. Near Petrol Bunk, Gundlapalle Village, Maddipadu Mandal Prakasam Dist. AP	U Veerabhadrachari Proprietor 98494-53830	15.5° N 80.03° E AP/PSM/II/3	June-04	2011-2021	4320	
Golden Brick Industries Near AKP Junior College, Vadarevu Road Chirala, Prakasam Dist. AP	Ms U Padma Proprietrix 94402-18327	15.82° N 80.35° E AP/PSM/II/4	June-05	2011-2021	4320	
Sai Niveditha Brick Industries Near R.R.Exports, Polavari Palem Chinna Ganjam, Prakasam Dist. AP	Ms. Saini Veerakumari Proprietrix 98497-66808	15.68° N 80.22° E AP/PSM/II/5	Jan-06	2011-2021	4320	
Krishna Dist.						
Koneru Flyash Products Opp: Madonna Deaf & Dumb School Karmel Nagar Gunadala, Krishna Dist. AP	K Raghuchandra Mg. Partner 98480-52779	16.52° N 80.65° E AP/KRIS/II/7	Feb-05	2011-2021	4050	

## Appendix 8: List of SPEs (contd.,)

Name & Address of the MIP	Name and relation of Authorised Signatory	Geographical Coordinates & ID No.	Established in	Crediting period	Output/year in Cu.mtr	Emission Reductions t CO <sub>2</sub> /yr
East Godavari Dist.						
Anaparthi Reddy FaL-G Brick Industry D. No. 1-215. Yanam Road, Uppalanka Kakinada - 533016, East Godavari Dist	Ms. T Nagamani Proprietrix 92466-90699	16.54° N 82.23° E AP/EG/II/8	Jan-05	2011-2021	2610	482.16
Sai Lakshmi FaL-G Bricks Rajahmundry Road, Valuthimmapuram Peddapuram Mandal, East Godavari Dist.	Mr. M. Dorayya Chowdary Manager 98497-81775	17.07° N 82.07° E AP/EG/II/9	Apr-06	2011-2021	4500	831.31



Visakhapatnam Dist.						
Sri Sai Kripa Innovative Building Material Industries, Survey No.163, Ravada Village Paravada Mandal Visakhapatnam Dist.	Ms. S Vijayasri Mg. Partner 0891-5521758	17.6° N 83.07° E AP/VSP/II/10	Nov-04	2011-2021	3600	665.05
<b>Grand Total</b>					<b>43318</b>	<b>8002.35</b>

**Appendix 9: Small Scale Industries' Registration of SPEs -Date of Commencement of Production -  
Date of Establishment**

SI No.	Name of the SPE	ID No.	Date of SSI Registration		Date of Part 2 Validity	Date of	
			Provisional /Part-1	Permanent Regn / Part-II		Commencement of Production as per SSI Regn	Establishment as mentioned in SPEs' application to PE
1	NRK Infra System Pvt. Ltd.,	TN/KCP/II/1	-	20.03.2006	No Limit	10.03.2005	Aug, 2004
2	Sagar Quality Bricks	AP/PSM/II/2	-	10.01.2005	No Limit	09.12.2004	Dec, 2004
3	Sri Varalakshmi Fly Ash Bricks	AP/PSM/II/3	25.04.2004	03.02.2005	No Limit	04.12.2004	June, 2004
4	Golden Bricks Industries	AP/PSM/II/4	26.03.2003	27.05.2006	No Limit	19.04.2006	June, 2005
5	Sai Niveditha Brick Industries	AP/PSM/II/5	25.08.2005	25.04.2007	No limit	13.04.2006	Jan, 2006
7	Koneru Fly ash Products	AP/KRIS/II/7	-	23.05.2005 / 25.06.2010 (Extn)	No Limit	17.02.2005	Feb, 2005



8	Anaparthi Reddy Fal-G Brick industry	AP/EG/II/8	-	16.03.2005	No Limit	01.01.2005	Jan, 2005
9	Sai Lakshmi FaL-G Bricks	AP/EG/II/9	-	24.05.2006	05-01-2013	02.04.2006	Apr, 2006
10	Sri Saikripa Innovative Building Materials Industries	AP/VSP/II/10	-	27.03.2006 / 18.04.2010 (Extn)	No Limit	30.11.2004	Nov, 2004

**Appendix 10: Recommendation of CDM-EB on Methodology**



**Request for Deviation - Registration: Including leakage from production of one of the raw materials input to an energy efficiency project**

The Board agreed not to accept the proposed deviation. Reasons include, *inter alia*:

- Comparable level of service: project bricks use different input raw materials and have different characteristics as compared to baseline bricks, therefore, convincing proof that baseline and project bricks have comparable strength characteristics would be required;
- Project emissions: the Fal-G method of brick production also involves the use of fossil fuel/electricity for mixing equipment and vibrators; these emissions need to be accounted for as project emissions;
- Leakage: consideration of potential leakages due to the use of raw/additive materials that are not used in the baseline would be required.

The project proponent may evaluate if AMS-III Z is applicable to the proposed project activity.





Bricks and blocks shall be tested for their strength class as per the procedures below.

Step 1: Identify the product type; ceramic product or hydraulic product.  
This procedure is applicable only to hydraulic product.

Step 2: Identify the national standard for strength-class  
Table 1 of IS: 12894-2002 Pulverized Fuel Ash-Lime Bricks Specifications.

Step 3: Follow the appropriate national standard for recording their grade strength at 28-day.  
IS: 516 -1959: Method of Test for Strength of Concrete

Step 4: Sampling shall be based on relevant standard  
IS: 516-1959: Methods of Test for Strength of Concrete, which suggests testing of three specimens under field conditions. As per this standard, three specimen bricks/blocks are randomly selected from a 28-day lot at each production site.

Step 5: Submerge the specimen in water for 24-hours before subjecting for compressive strength test.

Step 6: The specimens are capped with high-grade strength mortar for even surface. Alternately, for quick tests, the specimen surfaces can be dressed with sand evenly.

Step 7: Use testing equipment such as hydraulic compressive strength testing machines.

Step 8: Repeat this procedure every 6 months (e.g., March and September of each year) or at a specified interval for seasonally operating units.

Step 9: Test Certificate should be provided for each production unit, specifying the following:

- a) Name and address of production unit
- b) Date and location of testing
- c) Type of product tested
- d) Name and number of Testing standard
- e) Results of the test

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#### History of the document

Version	Date	Nature of revision
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04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for small-scale CDM project activities” (EB 66, Annex 9).
03	EB 28, Annex 34 15 December 2006	<ul style="list-style-type: none"><li>• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.</li></ul>
02	EB 20, Annex 14 08 July 2005	<ul style="list-style-type: none"><li>• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.</li><li>• As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <a href="http://cdm.unfccc.int/Reference/Documents">http://cdm.unfccc.int/Reference/Documents</a>.</li></ul>
01	EB 07, Annex 05 21 January 2003	Initial adoption.
<b>Decision Class:</b> Regulatory <b>Document Type:</b> Form <b>Business Function:</b> Registration		