



VALIDATION REPORT

INDIA-FAL-G BRICK AND BLOCKS PROJECT No.2. IN INDIA

REPORT No. 2009-0392

REVISION No. 02

DET NORSKE VERITAS



VALIDATION REPORT

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Client: Eco-Carbon Private Limited		Client ref.: Mr. N.Kalidas, Executive Director

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Summary:

Project Name: India-FaL-G Brick and Blocks Project No.2.

Country: India

Methodology: AMS-III.Z

Version: 03

GHG reducing Measure/Technology: Fuel switch, process improvement and energy efficiency in brick manufacture

ER estimate: 11 294 tCO₂e per year (average) over a fixed crediting period of ten years

Size

☐ Large Scale

☒ Small Scale

Validation Phases:

☒ Desk Review

☒ Follow up interviews

☒ Resolution of outstanding issues

Validation Status

☐ Corrective Actions Requested

☐ Clarifications Requested

☒ Full Approval and submission for registration

☐ Rejected

In summary, it is DNV's opinion that the India-FaL-G Brick and Blocks Project No.2 project in India as described in the PDD, version 4, dated 16 June 2011, meets all relevant UNFCCC requirements for the CDM and all relevant host country criteria and correctly applies the baseline and monitoring methodology AMS-III Z, version 03. DNV thus requests the registration of the project as a CDM project activity. This report has been revised in response to review requests from three CDM Executive Board members.

Report No.: 2009-0392	Subject Group: Environment
Report title: India-FaL-G Brick and Blocks Project No.2 in India.	
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Climate Change

Kyoto Protocol

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Clean Development Mechanism

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***Abbreviations***

CAR	Corrective Action Request
CDM	Clean Development Mechanism
CER	Certified Emission Reduction(s)
CH ₄	Methane
CL	Clarification request
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
DNV	Det Norske Veritas
DNA	Designated National Authority
FAR	Forward Action Request
GHG	Greenhouse gas(es)
IPCC	Intergovernmental Panel on Climate Change
LoA	Letter of approval
NGO	Non-governmental Organisation
ODA	Official Development Assistance
PDD	Project Design Document
tCO ₂ e	Tonnes of CO ₂ equivalents
UNFCCC	United Nations Framework Convention on Climate Change
GWP	Global Warming Potential



1 EXECUTIVE SUMMARY – VALIDATION OPINION

DNV Climate Change Services AS (DNV) has performed a validation of the project activity “India-FaL-G Brick and Blocks Project No.2.” in India. The validation was performed on the basis of UNFCCC criteria for the Clean Development Mechanism and host Party criteria, as well as criteria given to provide for consistent project operations, monitoring and reporting.

The review of the project design documentation and the subsequent follow-up interviews have provided DNV with sufficient evidence to determine the fulfilment of stated criteria.

The host Party is India and the Annex I Parties are Italy and the Netherlands. All the Parties fulfil the participation criteria and have approved the project and authorized the project participants Eco-Carbon Private Limited. The DNA from India confirmed that the project assists in achieving sustainable development and issues the Letter of Approval on 8 June 2007 /50/.

The project correctly applies the baseline and monitoring methodology AMS-III.Z, version 03 “Fuel Switch, process improvement and energy efficiency in brick manufacture”. The determination of the baseline is well elaborated, transparent and sufficiently supported with facts. The selected baseline scenario is reasonable for the selected 10 years of fixed crediting period. As a result, the project results in reductions of CO₂ emissions that are real, measurable and gives long-term benefits to the mitigation of climate change. It is demonstrated that the project is not a likely baseline scenario. Emission reductions attributable to the project are hence additional to any that would occur in the absence of the project activity.

The total emission reductions from the project are estimated to be on the average 11 294 tCO₂e per year over the selected 10 years of fixed crediting period. The emission reduction forecast has been checked and it is deemed likely that the stated amount is achieved given that the underlying assumptions do not change.

The monitoring plan provides for the monitoring of the project’s emission reductions. The monitoring arrangements described in the monitoring plan are feasible within the project design and it is DNV’s opinion that the project participants are able to implement the monitoring plan. The PDD was webhosted in UNFCCC website for global stakeholder consultation. No comments were received.

In summary, it is DNV’s opinion that the project activity “India-FaL-G Brick and Blocks Project No.2” in India, as described in the PDD, version 04 dated 16 June 2011, meets all relevant UNFCCC requirements for the CDM and all relevant host Party criteria and correctly applies the baseline and monitoring methodology AMS-III.Z, version 03. Hence, DNV requests the registration of the project as a CDM project activity.

Oslo, 17 June 2011.

Astakala Vidyacharan
CDM Validator

Michael Lehmann
Director of Services and Technologies
DNV Climate Change Services AS (DNV)



2 INTRODUCTION

Eco-Carbon Private Limited (ECPL) has commissioned DNV Climate Change Services AS (DNV) to perform a validation of the India-FaL-G Brick and Blocks Project No.2 project in India (hereafter called “the project”). This report summarises the findings of the validation of the project, performed on the basis of UNFCCC criteria for the CDM, as well as criteria given to provide for consistent project operations, monitoring and reporting. UNFCCC criteria refer to Article 12 of the Kyoto Protocol, the CDM modalities and procedures, the simplified modalities and procedures for small-scale CDM project activities and the subsequent decisions by the CDM Executive Board.

2.1 Objective

The purpose of a validation is to have an independent third party assess the project design. In particular, the project's baseline, monitoring plan, and the project's compliance with relevant UNFCCC and host Party criteria are validated in order to confirm that the project design, as documented, is sound and reasonable and meets the identified criteria. Validation is a requirement for all CDM projects and is seen as necessary to provide assurance to stakeholders of the quality of the project and its intended generation of certified emission reductions (CERs).

2.2 Scope

The validation scope is defined as an independent and objective review of the project design document (PDD). The PDD is reviewed against the criteria stated in Article 12 of the Kyoto Protocol, the CDM modalities and procedures as agreed in the Marrakech Accords, the simplified modalities and procedures for small-scale CDM project activities and the relevant decisions by the CDM Executive Board, including the approved baseline and monitoring methodology AMS-III.Z, version 03. The validation was based on the recommendations in the Validation and Verification Manual /53/.

The validation is not meant to provide any consulting towards the project participants. However, stated requests for clarifications and/or corrective actions may have provided input for improvement of the project design.



3 METHODOLOGY

The validation consisted of the following three phases:

- I a desk review of the project design documents
- II follow-up interviews with project stakeholders
- III the resolution of outstanding issues and the issuance of the final validation report and opinion.

The following sections outline each step in more detail.

3.1 Desk review of the project design documentation

The following tables list the documentation that was reviewed during the validation.

3.1.1 Documentation provided by the project participants

- /1/ Eco Carbon Pvt. Ltd.,: *CDM-SSC-PDD for project activity "India-FaL-G Brick and Blocks Project No.2." in India*, Version 01 dated 11 August 2009, version 02, dated 30 June 2010, version 03, dated 18 January 2011 and version 04, dated 16 June 2011.
- /2/ Affirmation regarding no diversion of official development assistance from Government of Italy, dated 09 September 2005
- /3/ Emission reduction purchase agreement between Eco Carbon Private Limited and International Bank for Reconstruction and Development, as Trustee of the Community Development Carbon Fund, dated 28 June 2006.
- /4/ IS:516-1959: Method of test for strength of concrete: Indian standard: Bureau of Indian Standards.
- /5/ IS:3495:1992: Method of test of burnt clay building bricks: Indian standard: Bureau of Indian Standards.
- /6/ IS:1077:1982: Common burnt clay building bricks specifications: Indian standard. Bureau of Indian standards.
- /7/ IS: 12894: 2002: Pulverized fuel ash building bricks specifications: Indian standard. Bureau of Indian standards.
- /8/ Abundant availability of fly ash – R&D and technology development/ application in Fly Ash area, Publication by Dept. of Science & Technology:
http://www.dst.gov.in/whats_new/what_new08/fly-ash.pdf
- /9/ Agreement for technical services between Institute for Solid Waste Research & Ecological Balance and Eco Carbon Pvt. Ltd, dated 4 November 2006
- /10/ Patent number 198639 dated 13.08.1996 for the project technology (hydraulic cement composition) from Intellectual Property India granted on 30 January 2006.
- /11/ Status and development issue of brick industry in Asia by Food and Agriculture Organization of United Nations, April 1993
- /12/ Workshop on fly ash, Hyderabad, dated 18 – 19 October 2001
- /13/ Clearances from the pollution control board for each individual unit under the project activity.
- /14/ Small-scale industries certificate by Director of Industries for the individual units of the



- project activity.
- /15/ E-mail communication between Institute for Solid Waste Research & Ecological Balance (INSWAREB) and World Bank regarding the development of FaL-G project and its potential barriers and the estimated CERs from the project activity, dated 7 September 2000.
 - /16/ Project Idea Note (PIN), dated 03 January 2003, submitted to Community Development Carbon Fund (CDCF).
 - /17/ Excerpts of minutes of the 42nd Governing Body meeting of INSWAREB at FaL-G Mansion, Visakhapatnam, dated 20 September 2003 (on the consideration of CDM revenue and involvement of Eco Carbon Pvt. Ltd for participating in commercial pursuit)
 - /18/ E-mail to World Bank, dated 20 January 2004: PCN on FaL-G Brick units in tiny sector. Multiple units to be bundled under Community Development Carbon Fund (CDCF) and financial workings
 - /19/ Letter of intent for the purchase of potential CERs from FaL-G Brick units in tiny sector Multiple units, India, between Eco Carbon Pvt. Ltd and World Bank, International Bank for Reconstruction and Development, dated 03 June 2004.
 - /20/ E-mail to State bank of India on scheduling of meeting, dated 4 January 2005 and Note to SBI on carbon activity between World Bank and Eco Carbon Pvt. Ltd., through FaL-G brick/block production in India.
 - /21/ Submission of New draft Methodology and PDD by World Bank to EB-CDM: SSC_014 and subsequent recommendation by CDM EB to use AMS-II.D on 13 February 2006.
 - /22/ PDD for the project activity "India-FaL-G Brick and Blocks Project No.2" webhosted with methodology AMS-II.D, version 7 on 17 November 2006
<http://cdm.unfccc.int/Projects/Validation/DB/3V6X4DEK3LXA9G3TBV41KG6NKU/M26G/view.html>
 - /23/ Request for deviation was filed by DNV for the applied methodology of the project activity on 15 February 2008 and the response from CDM EB to apply for revision in the methodology on 18 March 2008.
 - /24/ CDM SSC PDD for "India-FaL-G Brick and Blocks Project No.2" webhosted with methodology AMS-II.D, version 11
<http://cdm.unfccc.int/Projects/Validation/DB/IL5Q4SP0HB1ZV83IQCXDIR4U9N7313/view.html>
 - /25/ Revision of AMS-II.D to include energy-efficient project activities that involve changes in raw materials and/or production processes: SSC_228, submitted on 5 September 2008 and the response from small-scale working group, dated 12 November 2008 to submit request for deviation.
 - /26/ Request for deviation submitted by DNV on 16 December 2008 (M-DEV0219) to the response to the deviation request.
 - /27/ SSC_297: Revision of AMS-III.Z regarding demonstration of abundance of raw materials and quality of bricks, submitted on 03 April 2009 and the response from SSC WG.
 - /28/ SSC_298: Revision to remove FaL-G technology-based brick manufacturing project activity from the scope of AMS-III.Z, submitted on 3 April 2009



- /29/ SSC_322: Revision of AMS-III.Z to provide clarity on nationally approved laboratories and product service life, submitted on 18 June 2009
- /30/ Article in news paper The Hindu, on the challenge related to quality assurance of FaL-G bricks, dated 26 March 2009 and 11 April 2009.
- /31/ 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
- /32/ Emission Standards for brick kilns- An opportunity for Technology upgrade by Sameer Maithel, The Energy Research Institute (TERI), India.
- /33/ Central Electricity Authority, Ministry of Power, Government of India: Clause 18 of Gazette Notification No. 502/70/CEA/DP&D, dated 17 March 2006.
- /34/ Press Information Bureau, Government of India: Indian Cement Industry – Opportunities and Challenges <http://www.pib.nic.in/release/release.asp?relid=55724>
- /35/ Food and Agriculture Organization of the United Nations: Field Document No. 35, “Regional Wood Energy Development Programme in Asia”, GCP/RAS/154/NET
- /36/ Minutes of the meeting conducted at the premises of INSWAREB Building Centre, Ootagedda Junction, Paravada, dated 28 July 2003.
- /37/ Work shop on FaL-G technology at Hyderabad and Cuddapah in September 2003.
- /38/ INSWAREB Building Centre: Compressive strength test results, dated 02 February 2010.
- /39/ Eco Carbon Pvt. Ltd: Emission reduction spreadsheet.
- /40/ Technical report on fly ash-lime-phosphogypsum cementitious binder: A new trend in bricks, by S. Kumar from Department of civil engineering, BIET, Jhansi.
<http://www.springerlink.com/content/f376400212484564/>
- /41/ Explanatory Notes (Central Excise) on withdrawal of excise duty exemption:
<http://indiabudget.nic.in/ub2006-07/cen/exnotecex.pdf>
- /42/ Restoration of excise duty exemption sought on fly ash bricks: Indian Concrete Journal:
http://www.icjonline.com/news_apr2006.htm
- /43/ Letter to the Editor of Economic Times on 10 May 2006 by Institute for Solid Waste Research & Ecological Balance (INSWAREB): http://www.fal-g.com/Lr_to_Editor_ET_on_Dr_Chand_article.pdf
- /44/ Test certificate by Institute of Solid Waste Research and Ecological Balance, dated 19 March 2010 and by Department of Technivcal Education, Government Polytechnic, Ongole, Government of Andhra Pradesh, dated 31 March 2010
- /45/ Diesel density: Society of Indian Automobile Manufactures:
<http://www.siamindia.com/scripts/Diesel.aspx>
- /46/ Sixth CANMET/ACI international conference on fly ash, silica fume, slag in natural pozzolans in concrete at Bangkok in the article “*Role of Pozzolan and Cementitious Material in Sustainable Development of Concrete Industry*” by Prof PK Mehta
- /47/ TERI: “Energy Efficiency Improvements in the Indian Brick Industry” by TERI in association with UNDP.
<http://www.resourceefficientbricks.org/background.php>
- /48/ A book on “Prospect and problem of Brick Industry” (2008) by Ghoshal, Pallab K
- /49/ Eco Carbon Pvt. Ltd.: Agreement between the individual brick manufacturing units and Eco Carbon Pvt. Ltd. for the participating the bundling of project activity.



3.1.2 Letters of approval

- /50/ Letter of approval from DNA of India, dated 08 June 2007.
- /51/ Letter of approval from DNA of Italy, dated 15 April 2010.
- /52/ Letter of approval from DNA of the Netherlands, dated 26 April 2010. The revised LOA by the present DNA of the Netherlands, dated 21 January 2011.

3.1.3 Methodologies, tools and other guidance by the CDM Executive Board

- /53/ CDM Executive Board: *Validation and Verification Manual*. Version 1.2.
- /54/ Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories AMS-III.Z Version 03 “*Fuel Switch, process improvement and energy efficiency in brick manufacture*”.
- /55/ CDM Executive Board: Tool to calculate baseline, project and /or leakage emissions from electricity consumption, version 01.
- /56/ CDM Executive Board 49 “Guidelines on the demonstration and assessment of prior consideration of the CDM”, version 3.1.
- /57/ 2006 IPCC default values.
- /58/ CDM India, Designated National Authority, Ministry of Environment and Forest ID No.397-06: http://cdmindia.in/reports_list_details.php?id=Small&reporttype=4&page=74

Main changes between initially webhosted PDD and the revised PDD:

- The emission reduction calculation formula has been corrected as per the methodology (CAR 5).
- The additionality of the project activity has been further justified to explain the need of CDM to alleviate the barriers.
- The start date of the crediting period has been revised to 1 August 2011.
- Each applicability criteria of the methodology has been justified.
- The chronology of events for securing CDM status has been included in the PDD.
- The starting date of the project activity has been revised as per CDM glossary.
- The monitoring plan has been revised to use net production of FaL-G bricks by the project activity as required by the methodology (CAR 5). The comparison of the production with three approaches: production records, fly ash consumption and electricity or diesel consumption has been removed.

3.2 Follow-up interviews with project stakeholders

Between 5 February and 5 March 2010 DNV visited the sampled locations of the project and performed interviews with project stakeholders.

Date	Name	Organization	Topic
05 February 2010	Mr. N. Kalidas	Eco Carbon Pvt	Project design
- 05 March 2010	Dr. Bhanumathidas	Ltd.	Baseline scenario
			Additionality
			Monitoring and reporting



U Veerabhadrachari	Sri Varalakshmi	Stake	holders
	Fly ash Bricks	consultation	
Ms U Padma	Golden Brick		
	Industries		
Ms. Saini	Sai Niveditha		
Veerakumari	Brick Industries		
U Udaya Bhaskar	Bhaskar Brick		
	Industries		
K Raghuchandra	Koneru Flyash		
	Products		
Ms. T Nagamani	Anaparthi Reddy		
	FaL-G Brick		
	Industry		

3.3 Resolution of outstanding issues

The objective of this phase of the validation is to resolve any outstanding issues which need be clarified prior to DNV's positive conclusion on the project design. In order to ensure transparency a validation protocol was customised for the project. The protocol shows in a transparent manner the criteria (requirements), means of verification and the results from validating the identified criteria. The validation protocol serves the following purposes:

- It organises, details and clarifies the requirements a CDM project is expected to meet;
- It ensures a transparent validation process where the validator will document how a particular requirement has been validated and the result of the validation.

The validation protocol consists of four tables. The different columns in these tables are described in the figure below. The completed validation protocol for the project activity "India-FaL-G Brick and Blocks Project No.2" in India is enclosed in Appendix A to this report.

A corrective action request (CAR) is raised if one of the following occurs:

- (a) The project participants have made mistakes that will influence the ability of the project activity to achieve real, measurable additional emission reductions;
- (b) The CDM requirements have not been met;
- (c) There is a risk that emission reductions cannot be monitored or calculated.



A clarification request (CL) is raised if information is insufficient or not clear enough to determine whether the applicable CDM requirements have been met.

A forward action request (FAR) is raised during validation to highlight issues related to project implementation that require review during the first verification of the project activity. FARs shall not relate to the CDM requirements for registration.



Validation Protocol Table 1: Mandatory Requirements for CDM Project Activities		
Requirement	Reference	Conclusion
<i>The requirements the project must meet.</i>	<i>Gives reference to the legislation or agreement where the requirement is found.</i>	<i>This is either acceptable based on evidence provided (OK) or a corrective action request (CAR) if a requirement is not met.</i>

Validation Protocol Table 2: Requirement Checklist				
Checklist question	Reference	Means of verification (MoV)	Assessment by DNV	Draft and/or Final Conclusion
<i>The various requirements in Table 1 are linked to checklist questions the project should meet. The checklist is organised in different sections, following the logic of the CDM-PDD</i>	<i>Gives reference to documents where the answer to the checklist question or item is found.</i>	<i>Means of verification (MoV) are document review (DR), interview (I) or any other follow-up actions (e.g., on site visit and telephone or email interviews) and cross-checking (CC) with available information relating to projects or technologies similar to the proposed CDM project activity under validation.</i>	<i>The discussion on how the conclusion is arrived at and the conclusion on the compliance with the checklist question so far.</i>	<i>OK is used if the information and evidence provided is adequate to demonstrate compliance with CDM requirements. A corrective action request (CAR) is raised when project participants have made mistakes, the CDM requirements have not been met or there is a risk that emission reductions cannot be monitored or calculated. A clarification request (CL) is raised if information is insufficient or not clear enough to determine whether the applicable CDM requirements have been met. A forward action request (FAR) during validation is raised to highlight issues related to project implementation that require review during the first verification of the project activity.</i>

Validation Protocol Table 3: Resolution of Corrective Action and Clarification Requests			
Corrective action and/or clarification requests	Ref. to checklist question in table 2	Response by project participants	Validation conclusion
<i>The CARs and/or CLs raised in Table 2 are repeated here.</i>	<i>Reference to the checklist question number in Table 2 where the CAR or CL is explained.</i>	<i>The responses given by the project participants to address the CARs and/or CLs.</i>	<i>The validation team's assessment and final conclusions of the CARs and/or CLs.</i>

Validation Protocol Table 4: Forward Action Requests		
Forward action request	Ref. to checklist question in table 2	Response by project participants
<i>The FARs raised in Table 2 are repeated here.</i>	<i>Reference to the checklist question number in Table 2 where the FAR is explained.</i>	<i>Response by project participants on how forward action request will be addressed prior to first verification.</i>

Figure 1: Validation protocol tables



3.4 Internal quality control

The validation report underwent a technical review performed by a technical reviewer qualified in accordance with DNV's qualification scheme for CDM validation and verification.

3.5 Validation team

<i>Role</i>	<i>Last Name</i>	<i>First Name</i>	<i>Country</i>	<i>Type of involvement</i>						
				Administrative	Desk review	Site visit / Interviews	Reporting	Supervision of work	Technical review	Sectoral competence
Project manager	Astakala	Vidyacharan	India	✓						
Technical team leader (CDM validator)	Astakala	Vidyacharan	India		✓	✓	✓	✓		
GHG auditor	Shome	Sharmistha	India		✓	✓	✓			
GHG auditor trainee	Faggin	Matteo	Italy		✓		✓			✓
Technical reviewer	Brinks	Hendrik	Norway						✓	
Person with sectoral competence assisting technical reviewer	Yang Xiao Shan	Alan	China						✓	✓

The qualification of each individual validation team member is detailed in Appendix B to this report.



4 VALIDATION FINDINGS

The findings of the validation are stated in the following sections. The validation criteria (requirements), the means of verification and the results from validating the identified criteria are documented in more detail in the validation protocol in Appendix A.

The validation report relates to the project design as documented and described in the PDD, version 4, dated 16 June 2011 /1/

4.1 Participation requirements

The project participants are Eco-Carbon Private Limited (ECPL) of host Party, India and International Bank for Reconstruction and Development as the Trustee of the Community Development Carbon Fund (CDCF) from Annex I Party of Italy and the Netherlands. The host Party (India) and the Annex I Party (Italy and Netherlands) meet all relevant participation requirements. The host Party India fulfils the participation requirements, having ratified the Kyoto Protocol on the 26 August 2002 and having established National Clean development Mechanism Authority, Ministry of Environment and Forests (MoEF), as its DNA. Both Italy and Netherlands have ratified the Kyoto protocol on 31 May 2002 established their respective Designated National Authority.

The DNA of India has issued a Letter of Approval (LoA) on 8 June 2007 /50/, authorizing Eco Carbon Private Limited (ECPL) as a project participant and confirming that the project assists in achieving sustainable development. The issuance of the Letter of Approval by DNA of India for the proposed project activity has been further verified by DNV from the Ministry of Environment and Forest, CDM India, Designated National Authority's website /58/.

The DNA of Italy and Netherlands has also approved the project on 15 April 2010 /51/ and 21 January 2011 /52/, respectively, confirming the voluntary participation of International Bank for Reconstruction and Development as the Trustee of the Community Development Carbon Fund (CDCF). The letters of approval were received from the project participants. DNV does not doubt the authenticity of the letters of approval. DNV considers the letters are in accordance with paragraphs 45- 48 of the VVM /53/.

The validation did not reveal any information that indicates that the project can be seen as a diversion of official development assistance (ODA) funding towards India and this has been verified from the affirmation regarding no diversion of official development assistance from Government of Italy, dated 9 September 2005 /2/. It is confirmed in the letter of Approval from Netherlands that no diversion of official development assistance towards India is involved in the project activity.

4.2 Project design

The project activity is a bundling project of 11 small FaL-G (Fly ash-Lime-Gypsum) plants located in the states of Tamil Nadu and Andhra Pradesh, India. Out of 11 plants, 10 plants are located in various districts of Andhra Pradesh and other one plant is located in the state of Tamil Nadu. Details of locations of the each plant have been clearly included in the project design document. The geographical coordinates of the individual facilities have been provided in the Annex 6 of PDD /1/.



The project activity involves the installation of the new FaL-G technology for the manufacture of brick and blocks which works with the hydration chemistry of fly ash, lime and/or OPC and gypsum. The technology does not require any thermal energy for brick manufacturing. The raw materials used in FaL-G technology for brick preparation are fly ash, lime and/or cement (OPC), gypsum and stone dust. The raw materials are mixed wet as a homogeneous mortar in the roller mixer and moulded into bricks/blocks which are compacted under vibro-press or hydraulic compression. Subsequently, the bricks/blocks are dried under sun and subjected to periodical water spray. No vapour curing is involved in the project activity as verified during the site visit. The technology used in project activity is based on the hydration chemistry and thus avoids the sintering process with usage of coal. Electricity and/or diesel are used for the operation of project activity units. The project activity results to the emission reduction by avoiding the usage of coal in the brick making process.

The project activity is expected to result in an estimated average emission reduction of 11 294 tCO_{2e} per year. The technology used in the project activity is good and is expected to remain same during the crediting period.

The starting date of the project activity has been selected to be 1 June 2004, which is the earliest of date of the establishment among all the bundle units.(cf. section 4.5). The expected operational lifetime of the project is 20 years and a fixed crediting period of 10 years has been chosen with the starting date of the first crediting period as 1 August 2011 or date of registration, which ever is later.

The accuracy of the description in the PDD with the actual project technology has been verified during the site visit. DNV considers that the project description is complete and accurate.

4.3 Application of selected baseline and monitoring methodology

The project activity correctly applies the baseline methodology stipulated for category III.Z of the “simplified modalities and procedure for small scale CDM project activity” The simplified baseline methodology AMS-III.Z, version 03 is applicable for fuel switch, process improvement and energy efficiency in brick manufacture. The applicability of the project activity to AMS-III.Z, version 03 meets all the applicability criteria and this was assessed as following:

- The project activity involves the change in the raw material in comparison to the baseline. The project activity involves the brick production using the hydration chemistry of fly ash, lime and/or cement and gypsum mixed together in the correct proportion. The compressive strength of the project activity brick ranges from 6 to 12 MPa in contrast to the compressive strength of 3 to 6 MPa in the baseline clay bricks. This has been verified from the sample test results certificate of the project activity bricks (FaL-G technology). The tests are conducted and the certificates are issued by Institute of Solid Waste Research and Ecological Balance, dated 19 March 2010 /44/ and by Department of Technivcal Education, Government Polytechnic, Ongole, Government of Andhra Pradesh, dated 31 March 2010 /44/ The service level of the baseline and the project activity has been assessed as per the national standard:
 - IS: 12894: 2002: Pulverized fuel ash building bricks specifications /7/,
 - IS:516-1959: Method of test for strength of concrete: Indian standard /4/



- IS:3495:1992: Method of test of burnt clay building bricks: Indian standard: Bureau of Indian Standards /5/ and
 - IS:1077:1982: Common burnt clay building bricks specifications: Indian standard. Bureau of Indian standards /6/.
- The project activity is a greenfield project. This has been confirmed during the site visit by DNV. It has been verified from the 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 /31/ that 95.3% of the material is contributed by the clay burnt bricks and also the most conventional process of brick manufacturing.
- The project activity is a greenfield project and does not involve any replacement of the existing equipment. The project changes the starting materials from the process that otherwise would have been carried out. Even though not all of these have been considered raw materials as not all of them are in a natural, unrefined stage, but instead produced/incidentally generated materials, the availability of the starting materials for the process has been demonstrated. The starting materials for the process used in the project activity are fly ash, lime or cement and gypsum. The availability of fly ash, which is the main raw material in the FaL-G brick manufacturing process, has been verified from publication by Dept. of Science & Technology the R&D and technology development/ application in Fly Ash area /8/. As per the publication by Dept. of Science & Technology, Ministry of Science and Technology /8/, the fly ash generation in India increased to the level of 130 million tonne per year, whereas the utilization the fly ash increased to only 60 million tonne during the year 2006-07. Furthermore, the publication also states that though the utilization of fly ash has been increased from 1 million tonnes in 1993-1994 to 60 million tonnes in 2006-2007, the quantum of un-utilized fly ash has also increased from 39 million tonne per year to 70 million tonne per year in 2006-2007. This demonstrates the availability of fly ash in India. The cement (OPC) and lime are available in the commercial market and shall be purchased from the localized market. Production of cement depends on the localized market demand and with the present annual production of 150 million tons at national level, there is no shortage of cement. Moreover, cement or lime or both can be used for the project activity based on the availability. Gypsum is used to an extent of 0.1% of the total mass. It is a by-product from hydrofluoric acid and fertiliser industries and is also available commercially in the market.
- As explained above, the compressive strength of the project activity brick ranges from 6 to 12 MPa in contrast to the compressive of 3 to 6 MPa in the baseline clay bricks. This has been verified from the sample test results of the project activity bricks (FaL-G technology). The service level of the baseline and the project activity has been assessed as per the national standard /4//5//6//7/. It has been verified from the test results conducted by the INSWAREB Building Centre, dated 02 February 2010,/39/ that compressive strength of clay brick is 4.3 MPa in comparison to compressive strength of 9.8 MPa of FaL-G bricks.
- The net annual emission reduction from the project activity is calculated to be 11 294 tCO₂e which is lower than the stipulated limit of 60 000 tCO₂e per year. The project activity has 11 brick-manufacturing units and the maximum net production from each



unit is 183 414 m³ (considering continuous production in all the three shifts per day at the rate of 8 hours per shift). Thus, the maximum emission reduction plausible under the project is 33 882 tCO₂e.

- It has been verified from the Study on “Cost Effective Building Materials & Technologies” /31/ that 95.3% of the material is contributed by the clay burnt bricks and also the most conventional process of brick manufacturing. It has been verified from the Gazette Notification No. 2804, dated 3 November 2009 by Ministry of Environment and Forests, Government of India, that only 1.59% of the total national brick demand is produced by FaL- G technology. There is national regulation on the usage of fly ash in the brick manufacturing. The Union government has passed the regulation for the usage of fly ash by the brick manufacturing industries however, the regulation at the national level encounters wide spread non-compliance, which is evident from the aforementioned Study on “Cost Effective Building Materials & Technologies” /31/ that 95.3% of the material is contributed by the clay burnt bricks and also the most conventional process of brick manufacturing.

A similar project activity (UNFCCC# 0707) was registered on 16 February 2007 applying the methodology AMS-II.D. DNV has verified that the project activity in question is not to be considered a de-bundled project activity as the project apply different methodologies (AMS-II.D vs. AMS-III.Z) and the individual brick manufacturing units in the project activities are legally independently owned and operated. Eco Carbon Pvt. Ltd. only acts as a coordinator and focal point. Eco Carbon Pvt. Ltd. is authorized by individual entrepreneurs to represent them for all matters related to CDM and this fact has been verified by DNV from the sub-project agreement signed between each brick manufacturing unit owner and Eco Carbon Pvt. Ltd /49/. Thus, the project activity has not been considered as de-bundled component of a larger project.

4.4 Baseline determination

In line with the applied methodology, AMS-III.Z, version 03, the baseline of the project activity has been determined to be the fossil fuel that would have been used in the related technology in the brick manufacturing units in absence of the project activity.

As verified from the Study on “Cost Effective Building Materials & Technologies” /31/, clay burnt bricks contributes for 95.3% of total market size of the walling material. In India, the different technologies that are used to produce burnt clay bricks are clamps, Movable Chimney- Bull Tranche Kilns (MCBTK), Fixed Chimney-Bull Tranche Kiln (FCBTK), High Draft Kilns (HDK) and the recently introduced Vertical Shaft Brick Kiln (VSBK) technology. It has been verified from the emission standards for brick kilns by TERI /32/ that coal is used as fuel for the above mentioned systems used in the clay brick production. As shown in Section 4.5, the project activity faces barrier that, in the absence of CDM funding, would have prevented the project activity. Thus, production of clay burnt bricks has been considered as the baseline scenario.

Since the project activity is a greenfield project, the weighted average energy used by all the mentioned technologies has been considered for the baseline emission calculation (as detailed in section 4.7). DNV concludes that baseline scenario has been determined as per the applied methodology.



4.5 Project boundary

The project boundary of the project activity includes the physical and geographical limits of all the 11 FaL-G plant units in the project activity. The facilities included in the boundary of each of the FaL-G plant unit are storage yard for raw materials, pan mixer for mortar preparation, casting machine, drying yard and curing yard.

Emission sources and gases included in the project boundary are:

	GHGs involved	Description
Baseline emissions	CO ₂	Emission due to the usage of coal in the clay brick manufacturing system that would have used in absence of the project activity.
Project emissions	CO ₂	Emission due to the usage of electricity and/or diesel consumption in the project activity.
Leakage	CO ₂	<p>Emission due to the cement (OPC) and/or lime usage in the project activity has been considered as leakage as per the methodology.</p> <p>Since the net emission due to the transportation of raw materials is 0.15% for lime route and 0.07% for OPC route, on the average annual emission reductions by the project activity, same has been considered as insignificant and neglected for simplicity.</p>

The selected sources and gases are justified for the project activity. No other project emission or leakage sources contributing more than 1% and not mentioned by the methodology have been found.

4.6 Additionality

The additionality of the project activity has been demonstrated as per the Attachment A to Appendix B of simplified modalities and procedures for small-scale CDM project activities.

4.6.1 Evidence for prior CDM consideration and continuous actions to secure CDM status

The starting date of the project activity has been selected to be 01 June 2004, which is the earliest of the date of establishment among all the 11 FaL-G plants, as verified from the Small-scale industries certificate by Director of Industries for the individual units of the project activity /14/.

This earliest subsequent real action has been verified from the following:

- The earliest date of commencement of production among all the 11 FaL-G units as per the SSI certificate is 30 November 2004 /14/.



- The earliest date of SSI permanent registration among all the 11 FaL-G units as per the SSI certificate is 10 January 2005 /14/.

The project activity does not require any construction period, thus date of establishment, which is the earliest date available, has been considered as the starting date of the project activity.

It is demonstrated that CDM was seriously considered in the decision to proceed with the project activity in compliance with “Guidelines on the demonstration and assessment of prior consideration of the CDM”, version 3.1 /56/, which was confirmed through:

- E-mail communication between Institute for Solid Waste Research & Ecological Balance (INSWAREB) and World Bank regarding the development of FaL-G project and its potential barriers and the estimated CERs from the project activity, dated 7 September 2000 /15/.
- Project Idea Note (PIN) for the FaL-G project activity as CDM project activity was developed and submitted to Community Development Carbon Fund (CDCF), dated 3 January 2003 /16/.
- Excerpts of minutes of the 42nd Governing Body meeting of INSWAREB at FaL- G Mansion, Visakhapatnam, dated 20 September 2003, on the consideration of CDM revenue to overcome barrier due to price competition and investment in the market promotion. The involvement of Eco Carbon Pvt. Ltd for participating in commercial pursuit has also been verified from the same /17/.
- Letter of intent for the purchase of potential CERs from “FaL-G Brick units in tiny sector Multiple units” (i.e. individual units), India, between Eco Carbon Pvt. Ltd and World Bank, International Bank for Reconstruction and Development, dated 3 June 2004 /19/.

The assessment that continuing and real actions were taken to secure CDM status for the project in parallel with its implementation is summarized below:

- E-mail to State bank of India on scheduling of meeting, inviting SBI to be the leading bank for financial the FaL-G project, dated 4 January 2005 and Note to SBI on carbon activity between World Bank and Eco Carbon Pvt. Ltd., through FaL-G brick/block production in India and potential for CDM revenue/20/.
- New draft Methodology and PDD for the FaL-G project activity has been submitted by World Bank to EB-CDM: SSC_014 and subsequent recommendation by CDM EB to use AMS-II.D on 13 February 2006 /21/.
- Emission reduction purchase agreement between Eco Carbon Private Limited and International Bank for Reconstruction and Development, as Trustee of the Community Development Carbon Fund, dated 28 June 2006 /3/.
- Validation started by the PDD for the project activity “India-FaL-G Brick and Blocks Project No.2” being webhosted with methodology AMS-II.D, version 07 on 17 November 2006 /22/.
- Request for deviation was submitted by DNV for the applied methodology of the project activity on 15 February 2008 and the response from CDM EB to apply for revision in the methodology on 18 March 2008 /23/.



- Revision of AMS-II.D to include energy-efficient project activities that involve changes in raw materials and/or production processes: SSC_228, submitted on 05 September 2008 and the response from small-scale working group, dated 12 November 2008 to submit request for deviation /25/.
- Request for deviation submitted by DNV on 16 December 2008 (M-DEV0219) to the response to the deviation request by SSC_WG /26/ to which it was advised by SSC_WG to consider using AMS-III.Z that was approved at the EB48 in March 2009 /26/.
- SSC_297 and SSC_298: Revision of AMS-III.Z regarding demonstration of abundance of raw materials and quality of bricks, submitted on 03 April 2009 and the response from SSC WG /27/ subsequent to which methodology version was revised and AMS-III.Z, version 2 was published.
- SSC_322: Revision of AMS-III.Z, version 02 to provide clarity on nationally approved laboratories and product service life, submitted on 18 June 2009 to which the SSC_WG provided the clarification on the procedure accepted for the service level testing as per the methodology /28/.
- CDM SSC PDD for the “India-FaL-G Brick and Blocks Project No.2” with methodology AMS-III.Z, version 2 was webhosted on 25 November 2009.

Since there were no gaps of more than two years between actions to secure CDM status, it was concluded that sufficient efforts were taken to secure CDM status for the project activity.

4.6.2 Barrier analysis

The additionality of the project activity has been demonstrated with the following:

- Barrier due to prevailing practice: It has been verified from the study on “Cost Effective Building Materials & Technologies” /31/, undertaken by Holtec Consulting Private Limited in the year 2004 on behalf of the Building Materials Technology Promotion Council, a Government of India, that the clay burnt bricks contributes for 95.3% of total market size of the walling material and thus dominates the brick market. The clay bricks are manufactured in the small units in conventional process and these clay brick units do not have any incentives to introduce the FaL-G technology, which requires additional investment. The raw materials, lime and/or cement and gypsum, used in FaL-G bricks/blocks makes it cost intensive in comparison to clay brick. It has been verified from the technical report on fly ash-lime-phosphogypsum cementitious binder: A new trend in bricks, by S. Kumar from Department of civil engineering, BIET, Jhansi /40/, that due to the process of beneficiation of raw materials for FaL-G bricks, the cost of the same is increased considerably in comparison to the clay bricks. The FaL-G bricks have hence to be sold at a higher price. This acts as a significant barrier to the project activity and has been considered at the 42nd Governing Body meeting of INSWAREB at FaL-G Mansion, Visakhapatnam, dated 20 September 2003 /17/. To encourage the FaL-G bricks, the union government did exempt FaL-G from excise duties until 2006 /41/; however, the same was merged with the similar level of sector, which includes the clay brick industries. From the fiscal year 2006, the excise duty exemption on this was withdrawn /41/. Further, it has been verified from the website of Indian Concrete Journals /42/ that the clay brick industry, being an unorganised sector does not strictly



follow the tax regime, whereas, the FaL-G brick industries are in an organised sector and shall follow the tax regime. The same has also been reflected from the letter to the Editor of Economic Times on 10 May 2006 /43/, as available in the website of Institute for Solid Waste Research & Ecological Balance (INSWAREB). This leads to continuance of burnt clay bricks production, which results in higher emission. Thus, it can be concluded that the project activity encounters barrier due to prevailing practice.

The CDM revenue shall be used for the technological upgradation, market development and the meeting the price competition with the clay bricks, thus alleviating the barrier.

- Technological barrier: Technological barrier has been established based on two factors: Sourcing of suitable quality of raw materials and correct application of FaL-G technology.

FaL-G brick/block production uses the patented technology /10/ and this is not a business as usual scenario in brick industry of India. The main raw materials used in the process of FaL-G brick manufacturing are fly ash, lime and/or cement (OPC) and gypsum. The strength of the product depends on the purity and the mixing proportions of these materials. The sourcing and the right mixture (recipe) of the raw materials to get the commensurate hydration chemistry are the technological risks of the project. The starting materials have to be tested and selected for sourcing and, in case of change in the source of starting materials, the chemistry needs to be optimised to get the adequate service level. This fact has been further substantiated by Dr. P. Kumar Mehta, Professor in Civil Engineering department at University of California, Berkeley at Sixth CANMET/ACI international conference on fly ash, silica fume, slag in natural pozzolans in concrete at Bangkok in the article “*Role of Pozzolan and Cementitious Material in Sustainable Development of Concrete Industry*”/46/, which explains the variation in the quality of raw materials like fly ash and how FaL-G technology imparts tailor made solutions for such non-standard starting materials in producing consistent quality of bricks, that is crucial for success of the FaL-G technology.

Furthermore, even though FaL-G is a patented technology /10/, the licensors have not invoked the patent to facilitate the proliferation of technology. However some unlicensed FaL-G brick units operate on the pirated technology and are likely to produce low- grade fly ash bricks which is not in control of the technology provider. The low quality of fly ash bricks produced in the unlicensed plants may have customer-complaints and hamper the overall brick market of FaL-G. This fact has been noticed by DNV through some of news articles in India’s leading newspaper “The Hindu” on the challenges related to quality assurance of FaL-G bricks, dated 26 March 2009/30/ which were based on the incidences of reporting usage of poor quality fly ash bricks. It was also verified from another article in the same newspaper dated 11 April 2009 /30/ in which, as a response, the technology providers INSWAREB explained that the quality control of bricks in the market can be assured only through conducting awareness in the brick users on the random quality checks and use of bricks from the licensed manufacturers only.

The revenue from CDM shall facilitate the brick unit to afford for the technology fee to the FaL-G patent holder and to receive ‘Improvement Information’ of the



technology from technology provider. Also this would offset the effort required to promote this technology, thus alleviating the barrier.

The project activity encounters barrier due to prevailing practice and technological risk that prevents the project from happening without CDM funding, and the emissions reductions occurring from the project are deemed additional to those that would occur in the absence of the project activity. DNV is able to confirm this conclusion.

4.7 Monitoring

The selected monitoring plan is as per the applied methodology, AMS-III.Z, version 03.

The baseline has been calculated as the product of annual production specific emission factor and the net production of FaL-G bricks. The electricity consumption and diesel consumption by the project activity have been accounted as project emissions. The emission due to the transportation of raw materials and usage of cement (OPC) and/or lime in the process have been accounted as leakage as per the methodology, AMS-III.Z, version 03.

The net production of FaL-G bricks shall be monitored and recorded at the individual unit level. The electricity consumed by the project activity is monitored by the energy meters and, the latter shall be calibrated as per the national regulation of India.

The monitoring plan is in accordance with the monitoring methodology. The monitoring plan will give opportunity for real measurements of achieved emission reductions.

The application of the monitoring methodology is transparent and DNV considers the project participants would be able to implement the monitoring plan.

4.7.1 Parameters determined ex-ante

The parameters determined ex ante are:

- Annual production specific emission factor of $0.2683 \text{ tCO}_2/\text{m}^3$ has been determined from the data sourced from the emission standards for brick kilns by TERI /32/. (as described in Section 4.7)
- Emission factor of electricity of $1.3 \text{ tCO}_2/\text{MWh}$ has been sourced from the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”. This data has been used for calculation of project emissions. The default data has been accepted based on the conservativeness and inline with guidance provided in scenario A, option A2 of “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.
- Emission factor of diesel of $74.8 \text{ ton CO}_2/\text{TJ}$ has been sourced from 2006 IPCC Guidelines on National GHG Inventories /57/. Default value at the upper limit of the uncertainty at a 95% confidence interval has been considered. Net calorific value of diesel has been sourced from IPCC 2006 and shall be updated as per the revision of the IPCC values. The density of diesel of 0.820 kg/L has been sourced from Society of Indian Automobile Manufactures /45/.
- Emission factor of cement of $0.82 \text{ tCO}_2/\text{ton of cement}$ has been sourced and verified from the technical article by Press Information Bureau, Government of India: Indian Cement Industry /34/.



- Emission factor of lime of 0.42 tCO₂/ton of lime has been used for the calculation of leakage. This has been verified from the IPCC 2006 default value of 0.40 tCO₂/ton of lime. This has been accepted based on the conservativeness.

All other data shall be monitored *ex-post*. IPCC default values shall be updated as per the latest IPCC values at the upper limit of the uncertainty at 95% confidence interval.

4.7.2 Parameters monitored ex-post

The parameters determined *ex post* are:

- Net quantity of brick produced in m³ by the project activity. This shall be monitored based on the number of bricks/ blocks produced and recorded in the stock register at the unit level on daily basis.
- The electricity consumption by each unit of the project activity. This shall be measured with the energy meters and monthly electricity bills shall be provided by the state electricity board at each unit level.
- Diesel consumption by each unit of the project activity shall be monitored and recorded in the stock register. This shall be cross verified from the purchase bills.
- Cement and lime purchased by each unit of the project activity shall be monitored and recorded from the purchase bills.
- The FaL-G brick or block shall be tested in a Compressive strength Testing Machine (CTM) in any of the laboratories of polytechnics, engineering colleges, building centers, national laboratories etc. once in six months and the test certificates are provided by the laboratory.

In view of the above mentioned monitoring procedure for each of *ex-post* monitored parameters /53/, DNV concludes that monitoring plan is feasible for the project activity design and project proponent is considered able to implement the monitoring plan.

4.7.3 Management system and quality assurance

All the necessary data as per the methodology shall be monitored and recorded. The day to day data shall be compiled on monthly basis and the same shall be reviewed by the project entity. All the data shall be kept for two years after the end of crediting period.

The electricity meters shall be calibrated at least once in every three years in line with the CDM SSC guidelines though it is stipulated by Central Electricity Authority, Ministry of Power, Government of India: Clause 18 of Gazette Notification No. 502/70/CEA/DP&D, dated 17 March 2006 /33/ as once in five years.

The periodic inspection of the FaL-G brick units of the project activity shall be conducted by the project entity to ensure the data accuracy and recording consistency.

4.8 Estimation of GHG emissions

The calculations and formulae as addressed in the approved baseline and monitoring methodology AMS-III.Z, version 03, have been applied. All aspects related to the direct and indirect GHG emissions as relevant to the project activity have been addressed and are presented in a transparent manner, in line with the approved methodology. No other project



emission or leakage sources contributing more than 1% and not mentioned by the methodology have been found.

4.7.1: Baseline emission: Baseline emission has been calculated as per the formula provided in the applied methodology, AMS-III.Z, version 03. As mentioned in section 4.4 of the report, 95.3% of the walling material market is being contributed by the clay burnt bricks /31/. It has been verified from the emission standards for brick kilns by TERI /32/ that coal is used as fuel for the above mentioned systems used in the clay brick production. In view of the fact that different technical systems are used in clay burnt brick manufacturing process (as described in section 4.4), weighted average energy used by these technologies has been used for the baseline emission calculation as per the methodology AMS-III.Z, version 03. The report by TERI /32/, “Emission standards for brick kilns: An opportunity for technology up gradation, 1999” is the latest data available at the time of the start date of the project activity, June 2004, and during the validation of the project activity. DNV had verified that the TERI report had also been referred in the publication “Prospect and problem of Brick Industry” (2008) /48/, which demonstrates the relevance of the TERI report in 2008 also. This is indicative of the fact that the TERI report /32/ of 1999 was valid at the time of validation of the project activity. Furthermore, the brick manufacturing in India is an old technology. The different type of technology used for brick manufacturing has been considered for the specific emission calculation. It has been verified from the website of TERI on “Energy Efficiency Improvements in the Indian Brick Industry” by TERI in association with UNDP /47/ that traditional technologies are used in the brick manufacturing process and due to various technological, financial and socio-logistic barriers, that technological up-gradation in the brick manufacturing sector has not taken place in India. Thus, the data from report by TERI /32/, “Emission standards for brick kilns: An opportunity for technology up gradation, 1999” has been considered relevant and acceptable for the specific emission factor calculation by DNV.

Baseline emission has been calculated as the product of annual production specific emission factor and annual net production by the project activity. Specific emission factor of production of $0.2683 \text{ tCO}_2/\text{m}^3$ has been calculated based on the specific energy consumption, calorific value of coal and emission factor of coal /32/. The total clay brick production per year and the corresponding coal consumption and calorific value of coal have been sourced from the emission standards for brick kilns by TERI /32/. It has been verified and concluded from the document on “Regional Wood Energy Development Programme in Asia” by Food and Agriculture Organization of the United Nations /35/ that biomass contributes less than 2% of the total fuel consumption in the brick industry in India. In absence of any specific data on the percentage of renewable biomass and non renewable biomass consumption, an adjustment factor of 5% has been considered on the conservative basis. Thus, the net baseline emission shall be calculated after factoring 5% from the gross baseline emission computed by formula (1) of the methodology. The specific emission factor of production has been fixed *ex ante*.

The production of bricks shall be monitored *ex post* at the unit level on daily basis.

4.7.2: Project emission: The project emission due to the usage of electricity and/or diesel consumption by the project activity has been calculated as per “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”. In line with the mentioned tool, emission due to electricity consumption has been calculated as per scenario A of “Tool



to calculate baseline, project and/or leakage emissions from electricity consumption”. As explained in section 4.6.1, a default emission factor of 1.3 tCO₂/MWh has been considered as stipulated by option A 2 of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”. Since, this factor shall be used for project emission calculation, option A 2 has been accepted by DNV on basis of guidance given in the tool and conservativeness. It has been verified from the *ex ante* estimate that the project emission from electricity consumption ranges from 2% to 2.36%.

Since the requisite data, as per option A of “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” is not available, option B as per the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” has been used for calculating the project emission from diesel consumption by the project activity. The net calorific value and emission factor of diesel has been sourced and verified from the IPCC 2006 default value at the upper limit of the uncertainty at a 95% confidence interval has been considered. The IPCC default values shall be revised as per the revision in the IPCC default value. The density of diesel of 0.820 kg/L has been sourced from Society of Indian Automobile Manufacturers /45/. Diesel consumption shall be monitored during the crediting period.

4.7.3: Leakage: The emission due to the transportation of raw materials (at the rate of 4 500 m³ brick production per year) in the project scenario is 34% to 68% higher than the emission in the baseline. The emission of 35 tCO₂/year to 44 tCO₂/year (based on the OPC or lime route) for 4 500 m³ production per year in project scenario is 0.53% of the net annual emission reduction by the project activity unit generating 4 500 m³ of bricks and thus has been considered as insignificant and neglected for simplicity.

The leakage due to the usage of cement (OPC) and/or lime has been calculated as required by the applied methodology. Emission factor of cement and lime has been considered as discussed in Section 4.6.1. The quantities of cement (OPC) and lime purchased for the project activity shall be monitored for the calculation of project emission during the crediting period.

DNV is of the opinion that the baseline and project emissions estimate can be replicated using data and parameter values provided in the PDD and supporting files submitted for registration. The data sources mentioned have been verified by DNV.

In summary, the GHG calculations are complete and transparently documented by the spreadsheet /39/ and data accuracy has been verified.

4.9 Environmental impacts

The proposed project activity contributes to towards avoiding of coal fossil fuel in the brick manufacturing units and is expected to benefit the economic development of the region. Thus, the project activity is expected to have only beneficial impacts and no adverse impacts are foreseen. There is no legislative mandate for carrying out an environmental impact assessment study, as brick manufacturing units fall under small scale industries and are exempted from such requirement. The clearances from the pollution control board /13/ and small-scale industries certificate by Director of Industries /14/ for all the individual units under the project activity have been provided and verified by DNV. The project activity is in compliance with all current, applicable legislations.



4.10 Comments by local stakeholders

The local stakeholders include the owners of brick manufacturing units, consumers, local residents, workers at FaL-G plants and the suppliers of raw materials. Minutes of the meeting conducted with local stakeholders at various location /36/ have been provided and verified by DNV. The evidence on conducting the work shops at Hyderabad and Cuddapah on FaL-G technology in September 2003 has been provided to DNV /37/. The feedback from the local stakeholders has been adequately documented in the PDD. No negative feed back has been received. DNV considers that the local stakeholder consultation process is adequate for the proposed project activity.

4.11 Comments by Parties, stakeholders and NGOs

The PDD, version 01 dated 11 August 2009, was made publicly available on the CDM website

(http://cdm.unfccc.int/Projects/Validation/DB/MRSZEJRVVC7YZWWCRQGTS3ALLBK_S8/view.html) and Parties, stakeholders and NGOs were through the CDM website invited to provide comments during a 30 days period from 25 November 2009 to 24 December 2009. Prior to this, PDD for the project activity “India-FaL-G Brick and Blocks Project No.2” was webhosted with methodology AMS-II.D, version 07 on 17 November 2006 /22/.

There were no comments on the project.

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APPENDIX A

CDM VALIDATION PROTOCOL

Table 1 Mandatory requirements for Clean Development Mechanism (CDM) project activities

Requirement	Reference	Conclusion
About Parties		
1. The project shall assist Parties included in Annex I in achieving compliance with part of their emission reduction commitment under Art. 3.	Kyoto Protocol Art.12.2	OK
2. The project shall assist non-Annex I Parties in contributing to the ultimate objective of the UNFCCC.	Kyoto Protocol Art.12.2.	OK
3. The project shall have the written approval of voluntary participation from the designated national authority of each Party involved.	Kyoto Protocol Art. 12.5a, CDM Modalities and Procedures §40a	CAR-1 OK
4. The project shall assist non-Annex I Parties in achieving sustainable development and shall have obtained confirmation by the host country thereof.	Kyoto Protocol Art. 12.2, CDM Modalities and Procedures §40a	CAR-1 OK
5. In case public funding from Parties included in Annex I is used for the project activity, these Parties shall provide an affirmation that such funding does not result in a diversion of official development assistance and is separate from and is not counted towards the financial obligations of these Parties.	Decision 17/CP.7, CDM Modalities and Procedures Appendix B, § 2	No involvement of ODA has been identified during the validation.
6. Parties participating in the CDM shall designate a national authority for the CDM.	CDM Modalities and Procedures §29	OK
7. The host Party and the participating Annex I Party shall be a Party to the Kyoto Protocol.	CDM Modalities §30/31a	OK
8. The participating Annex I Party's assigned amount shall have been calculated and recorded.	CDM Modalities and Procedures §31b	OK
9. The participating Annex I Party shall have in place a national system for estimating GHG emissions and a national registry in accordance with Kyoto Protocol Article 5 and 7.	CDM Modalities and Procedures §31b	OK

Requirement	Reference	Conclusion
About additionality		
10. Reduction in GHG emissions shall be additional to any that would occur in the absence of the project activity, i.e. a CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity.	Kyoto Protocol Art. 12.5c, CDM Modalities and Procedures §43	CL OK
About forecast emission reductions and environmental impacts		
11. The emission reductions shall be real, measurable and give long-term benefits related to the mitigation of climate change.	Kyoto Protocol Art. 12.5b	CL OK
About small-scale project activities		
12. The proposed project activity shall meet the eligibility criteria for small scale CDM project activities set out in § 6 (c) of the Marrakech Accords and shall not be a debundled component of a larger project activity.	Simplified Modalities and Procedures for Small Scale CDM Project Activities §12a,c	OK
13. The proposed project activity shall confirm to one of the project categories defined for small scale CDM project activities and use the simplified baseline and monitoring methodology for that project category.	Simplified Modalities and Procedures for Small Scale CDM Project Activities §22e	OK
14. If required by the host country, an analysis of the environmental impacts of the project activity is carried out and documented.	Simplified Modalities and Procedures for Small Scale CDM Project Activities §22c	NA
About stakeholder involvement		
15. Comments by local stakeholders shall be invited, a summary of these provided and how due account was taken of any comments received.	CDM Modalities and Procedures §37b	OK
16. Parties, stakeholders and UNFCCC accredited NGOs shall have been invited to comment on the validation requirements for minimum 30 days, and the project design document and comments have been made publicly available.	CDM Modalities and Procedures §40	OK. The PDD has been webhosted in UNFCCC from 25 November 2009 to 25 December 2009. No comments were received on the project

Requirement	Reference	Conclusion
Other		
17. The baseline and monitoring methodology shall be previously approved by the CDM Executive Board.	CDM Modalities and Procedures §37e	OK
18. A baseline shall be established on a project-specific basis, in a transparent manner and taking into account relevant national and/or sectoral policies and circumstances.	CDM Modalities and Procedures §45c,d	OK
19. The baseline methodology shall exclude to earn CERs for decreases in activity levels outside the project activity or due to force majeure.	CDM Modalities and Procedures §47	OK
20. Provisions for monitoring, verification and reporting shall be in accordance with the modalities described in the Marrakech Accords and relevant decisions of the COP/MOP.	CDM Modalities and Procedures §37f	OK

Table 2 Requirements checklist

Checklist Question	Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
A General description of project activity					
A.1 Title of the project activity (VVM para 55-57)					
A.1.1 Does section A.1 of the PDD include a clearly identifiable project title, version number of the PDD and date of the PDD?	/1/ /53/	DR/I	<input checked="" type="checkbox"/> Clearly identifiable title of the project activity <input checked="" type="checkbox"/> Version number of the PDD is included <input checked="" type="checkbox"/> Date of the PDD is included.		OK
A.1.2 Is the PDD is in accordance with the applicable requirements for completing PDDs?	/1/ /53/	DR/I	<input checked="" type="checkbox"/> Yes <i>If no, list where the PDD is not in accordance:</i>		OK
A.2 Description of the project activity (VVM para 58-64)					
A.2.1 How was the design of the project assessed?	/1/ /53/	DR/I	<i>What type is the project?</i> <input type="checkbox"/> Project in existing facility or utilizing existing equipment(s) <input type="checkbox"/> Large scale project <input checked="" type="checkbox"/> bundled small scale projects, each with emission reductions not exceeding 15 000 tCO ₂ e per year <input type="checkbox"/> individual small scale project activity with emission reductions not exceeding 15 000 tCO ₂ e per year <input checked="" type="checkbox"/> Greenfield project <i>How was the design of the project assessed?</i> <input checked="" type="checkbox"/> Physical site inspection		OK

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Checklist Question	Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
			<input type="checkbox"/> Reviewing available designs and feasibility studies <i>If a physical site inspection is not undertaken, justify why no site visit was undertaken:</i>		
A.2.2 If a greenfield project, describe the physical implementation of the project when the validation was commenced.	/1/ /53/	DR/I	<p>The project activity is bundled project of 11 FaL-G units which are newly implemented and considered as green field project.</p> <p>The PDD does not address the details on project implementation. The chronology of the project activity needs to be added in the PDD.</p>	CL1	OK
A.2.3 If physical site visits were performed based on sampling (only applicable for bundled small scale projects, each with emission reductions not exceeding 15 000 tCO ₂ e per year), justify the sampling through a statistical analysis:	/1/ /53/	DR/I	Physical site inspection of all 6 out of 11 units have been conducted which forms more than 50% of the total units.		OK
A.2.4 Is the description of the proposed CDM project activity as contained in the PDD sufficiently covers all relevant elements, is accurate and that it provides the reader with a clear understanding of the nature of the proposed CDM project activity?	/1/ /53/	DR/I	<p>The project activity involves the installation of the new FaL-G technology for the manufacture of bricks/blocks, which works with the chemical strength of fly ash, lime and gypsum.</p> <p>The technology does not require any thermal energy for brick preparation. The raw materials used in FaL-G technology for brick preparation are fly ash, lime or cement, gypsum and stone dust.</p> <p>The raw materials are mixed in to homogeneous mortar in the roller mixture and moulded into blocks which are compacted under vibration or vibro-press or hydraulic compression. Subsequently, the bricks are dried under sun and subjected to periodical water spray.</p>		OK

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Checklist Question		Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
				The accuracy of the description in the PDD with the actual project technology have been be verified during the site visit.		
A.2.5	Does the project activity involve alteration of existing installations? If so, have the differences between pre-project and post-project activity been clearly described in the PDD?	/1/ /53/	DR/I	The project activity is a bundled activity of all green field units.		OK
A.2.6	Does the project design engineering reflect current good practices?	/1/ /53/	DR/I	The technology of the project activity has been developed by Dr N Bhanumathidas and N Kalidas. The Copy of the patent and applicable countries covered under this patent for FaL-G technology needs to be provided.	CL-2	OK
A.2.7	Would the technology result in a significantly better performance than any commonly used technologies in the host country? Is any transfer of technology from any Annex-I Party involved?	/1/ /53/	DR/I	The validation does not reflect any transfer of technology from Annex I country. The proposed project technology eliminates the thermal treatment, and does not require combustion of any fossil fuel.		OK
A.2.8	Does the project qualify as a small scale CDM project activity as defined in paragraph 6(c) of decision 17/CP.7 on the modalities and procedures for the CDM?	/1/ /53/	DR/I	The project activity involves the installation of an alternative bricks/blocks making process and eliminating the fossil fuel combustion. The total emission reduction by the project activity in 9 954 tCO ₂ per year average. The project activity qualifies as Type III category Z of the small scale CDM projects as the annual emission reductions are within the small scale limit of 60kCO ₂ e per year.		OK
A.2.9	Is the small scale project activity a de-bundled component of a larger project activity?	/1/ /53/	DR/I	The project activity is a bundled project covering 11 units of Andhra Pradesh and Tamilnadu States. Bundling capacity is with in the limits of small scale activity.		OK

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Checklist Question	Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
A.3 Participation requirements (VVM para 51-54, 123-125)					
A.3.1 Do all participating Parties fulfil the participation requirements as follows:	/1/ /53/	DR	Yes		OK
a) Party has ratified the Kyoto Protocol			India (host) <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Italy <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Netherlands <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
b) Party has designated a Designated National Authority			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
c) The assigned amount has been determined			<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
A.3.2 Do the letters of approval meet the following requirements?	/1/ /53/	DR/I	The LoA from the DNA of host country and the Annex I parties are yet to be provided.	CAR-1	OK
a) LoA confirms that Party has ratified the Kyoto Protocol			India (host) <input type="checkbox"/> Yes <input type="checkbox"/> No	Italy <input type="checkbox"/> Yes <input type="checkbox"/> No	Netherlands <input type="checkbox"/> Yes <input type="checkbox"/> No
b) LoA confirms that participation is voluntary			<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
c) The LoA confirms that the project contributes to the sustainable development of the host country?			<input type="checkbox"/> Yes <input type="checkbox"/> No	NA	NA
d) The LoA refers to the precise project activity title in the PDD			<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
e) The LoA is unconditional with respect to (a) to (d) above			<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
f) The LoA is issued by the respective Party's DNA			<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
g) The LoA was received directly by the DNA or the PP			<input type="checkbox"/> DNA <input type="checkbox"/> PP	<input type="checkbox"/> DNA <input type="checkbox"/> PP	<input type="checkbox"/> DNA <input type="checkbox"/> PP
h) In case of doubt regarding the authenticity of the letter of approval, describe how it was verified that the letter of approval is authentic					
A.3.3 Have all private/public project participants been authorized by an involved Party?	/1/ /53/	DR/I	The LoA from the DNA of host country and the Annex I parties are yet to be provided.	CAR-1	OK

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Checklist Question	Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
A.4 Technical description of the project activity (VVM para 58-64)					
A.4.1 Is the project's location clearly defined?	/1/ /53/	DR/I	The project activity is a bundled activity of 11 units located in one district in the state of Tamil Nadu and 10 districts in the state of Andhra Pradesh, India. The details of locations of the districts have been provided in the PDD. The geographical coordinates of the individual facilities need to be provided in the PDD as per the UNFCCC's requirement. Serenity	CL3	OK
A.5 Public funding of the project activity					
A.5.1 In case public funding from Parties included in Annex I is used for the project activity, have these Parties provided an affirmation that such funding does not result in a diversion of official development assistance and is separate from and is not counted towards the financial obligations of these Parties?	/1/ /53/	DR/I	The validation does not reflect the involvement of ODA. The CDCF includes funding from several Annex I Party governments and the project thus includes public funding. Section A.4.5 and Annex 2 will have to be revised and an affirmation has to be provided by at least the Annex I Party that eventually will authorize IBRD's participation in which this Annex I Party confirms that funding used does not represent a diversion of ODA:	CL4	OK
B Application of a baseline and monitoring methodology					
B.1 Methodology applied (VVM para 65-76)					
B.1.1 Does the project apply an approved methodology and the correct version thereof?	/1/ /53/	DR/I	Yes. The project activity correctly applies approved methodology AMS III Z, version 02.		OK

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Checklist Question	Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
B.2 Applicability of methodology (and tools) (VVM para 65-76)					
B.2.1 How was it validated that project complies with the following applicability criteria: Para 1 of the methodology AMS IIIZ, version 02?	/1/ /53/	DR/I	The project activity involves the installation of an alternative brick manufacturing process. It is to be demonstrated in line with methodology with the analysis and documented studies that the quality parameters of the brick from FaL-G technology are better or comparable to the conventional bricks. It is also required to demonstrate that the project meets the requirements of paragraph 8 of methodology.	CL-5	OK
B.2.2 How was it validated that project complies with the following applicability criteria: Para 2 of the methodology AMS IIIZ, version 02?	/1/ /53/	DR/I	The project activity involves the installation of a new system in new units for bricks/blocks manufacturing. This is has been confirmed during the site visit through verification of various regulatory clearance certificates like small scale industrial approval from department of Industries, etc.		OK
B.2.3 How was it validated that project complies with the following applicability criteria: Para 3 of the methodology AMS IIIZ, version 02?	/1/ /53/	DR/I	The project activity is a Greenfield project and the total emission reduction is 9 954 tCO ₂ e average per year. However the project activity has to demonstrate that it meets the relevant requirements of green field activities as per general guidance of the SSC methodologies.	CL-6	OK
B.2.4 How was it validated that project complies with the following applicability criteria: Para 4 of the methodology AMS IIIZ, version 02?	/1/ /53/	DR/I	The project activity is Greenfield activity, thus, demonstration of the remaining life is deemed not required.		OK
B.2.5 How was it validated that project complies with the following applicability criteria: Para 5 of the methodology	/1/ /53/	DR/I	The project activity is a Greenfield activity, thus demonstration of usage of fossil fuel in the past		OK

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[illegible]

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Checklist Question		Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
				The national standards used for the baseline brick strength assessment and project brick performance needs to be provided.		
B.2.8	How was it validated that project complies with the following applicability criteria: Para 8 of the methodology AMS IIIZ, version 02?	/1/ /53/	DR/I	It has been addressed in the project design document that even though there is a local regulation for the usage of fly ash for the brick production, there is wide spread non compliance. This non compliance needs to be demonstration. All the applicability criteria defined in applied methodology are to be specifically addressed in the PDD, preferable in the tabular format, in section B.2 of the PDD.	CL-9	
B.2.9	Is the selected baseline on of the baseline(s) described in the methodology and this hence confirms the applicability of the methodology?	/1/ /53/	DR/I	The baseline of the project activity is the energy use of the facilities that would otherwise be built in the absence of the project in order to meet the demand of bricks of comparable quality and utility to that of bricks and blocks produced through FaL-G technology. The applicability of the methodology is to be confirmed subjected to the satisfactory response to CL 5.	CL-5	
B.3 Project boundary (VVM para 77-79)						
B.3.1	What are the project's system boundaries (components and facilities used to mitigate GHGs)? Are they clearly defined and in accordance with the methodology?	/1/ /53/	DR/I	The project boundary includes the physical and geographical site of the brick production facilities. The boundary includes storage yard for raw materials, pan mixer for mortar preparation, casting machine, drying yard and curing yard.		OK

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Checklist Question		Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
B.3.2	Which GHG sources are identified for the project? Does the identified boundary cover all possible sources linked to the project activity? Give reference to documents considered to arrive at this conclusion.	/1/ /53/	DR/I	GHG sources identified for the project activity are: 1) Baseline CO ₂ emission from the fossil fuel in absence of the project activity. 2) CO ₂ emission from the electricity combustion. 3) CO ₂ from the usage of diesel. 4) Leakage due to consumption of cement and lime.		OK
B.3.3	Does the project involve other emissions sources not foreseen by the methodologies that may question the applicability of the methodology? Do these sources contribute with more than 1% of the estimated emission reductions of the project?	/1/ /53/	DR/I	All the emissions as per the methodology have been considered.		OK
B.4 Baseline scenario determination (VVM para 80-87, 103-105)						
B.4.1	Which baseline scenarios have been identified? Is the list of baseline scenarios complete?	/1/ /53/	DR/I	The baseline of the project activity is the energy use of the facilities that would otherwise be built in the absence of the project to meet the demand of bricks of comparable quality and utility to that of bricks and blocks produced through FaL-G technology. This is as per the methodology. Assessments of alternative baseline scenarios are not required as per the methodology.		OK
B.4.2	How have the other baseline scenarios been eliminated in order to determine the baseline?	/1/ /53/	DR/I	Assessments of alternative baseline scenarios are not required as per the methodology.		Ok
B.4.3	What is the baseline scenario?	/1/ /53/	DR/I	The baseline of the project activity is the energy use of the facilities that would otherwise be built in the absence of the project to meet the demand of bricks of comparable quality and utility to		OK

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Checklist Question		Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
				that of bricks and blocks produced through FaL-G technology.		
B.4.4	Is the determination of the baseline scenario in accordance with the guidance in the methodology?	/1/ /53/	DR/I	Yes, the baseline scenario has been selected as per the methodology.		OK
B.4.5	Has the baseline scenario been determined using conservative assumptions where possible?	/1/ /53/	DR/I	The baseline scenario has been selected as per the methodology.		OK
B.4.6	Does the baseline scenario sufficiently take into account relevant national and/or sectoral policies, macro-economic trends and political aspirations?	/1/ /53/	DR/I	The baseline scenario has been determined by considering the relevant policies.		OK
B.4.7	Is the baseline scenario determination compatible with the available data and are all literature and sources clearly referenced?	/1/ /53/	DR/I	The evidences supporting the energy consumption in the brick production in India need to be provided. Consideration of 5% of total energy inputs from biomass needs to be justified.	CL-10	OK
B.4.8	Is the baseline determination adequately documented in the PDD? <ul style="list-style-type: none"> All assumptions and data used by the project participants are listed in the PDD and related document to be submitted for registration. The data are properly referenced. All documentation is relevant as well as correctly quoted and interpreted. Assumptions and data can be deemed reasonable Relevant national and/or sectoral policies and circumstances are considered and listed in the PDD. The methodology has been correctly applied to identify what would occurred in the absence of the proposed CDM project activity 	/1/ /53/	DR/I	The evidences supporting the energy consumption in the brick production in India need to be provided. Consideration of 5% of total energy inputs from biomass needs to be justified. The baseline scenario has been determined by considering the relevant policies.	CL-10	OK

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Checklist Question	Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
B.5 Additionality determination (VVM para 93-119)					
B.5.1 What approach/tool does the project use to assess additionality? Is this in line with the methodology?	/1/ /53/	DR/I	The project activity follows the Appendix B of the simplified modalities and procedures for small-scale CDM project activities, Attachment A to Appendix B for the demonstration of additionality of the project activity.		OK
B.5.2 Have the regulatory requirements correctly been taken into account to evaluate the project activity and the alternatives?	/1/ /53/	DR/I	As per the methodology and SSC guidance, evaluation and negation of alternatives is not required.		OK
B.5.3 Is sufficient evidence provided to support the relevance of the arguments made?	/1/ /53/	DR/I	As per the methodology and SSC guidance, evaluation and negation of alternatives is not required.		
B.5.4 What is the project additionality mainly based on (Investment analysis or barrier analysis)?	/1/ /53/	DR/I	The project activity demonstrates the additionality with barrier and technological barrier.		OK
Prior consideration of CDM (VVM para 96-102)					
B.5.5 What is the evidence for serious consideration of CDM prior to the time of decision to proceed with the project activity?	/1/ /53/	DR/I	The evidence for the serious CDM consideration has to be provided.	CAR-2	OK
B.5.6 If the starting date is after 2 August 2008 and before the global stakeholder consultation, has the DNA and UNFCCC confirmed that the project participants have informed in writing of the project's intention to seek CDM status?	/1/ /53/	DR/I	The start date of the project activity has been stated to be 1 May 2004. The evidence for the state date of the project activity needs to be provided and the relevance of the choice of start date has to be demonstrated as per EB41 annex 67 guidelines.	CAR-3	OK
Continuous efforts to secure CDM status (only to be completed if starting date is before 2 August 2008)					
B.5.7 What initiatives were taken by the project participants from the starting date of the project activity to the start of validation in parallel with the physical implementation of the	/1/ /53/	DR/I	The continuous and realistic effort for securing the CDM status for the project activity needs to be demonstrated with supporting evidences as	CAR-4	OK

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Checklist Question	Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
project activity?			per EB41 Annex 46 guidelines. The complete chronology of the event related to the project activity needs to be included in section B.5 of the PDD.		
B.5.8 When did the construction of the project activity start?	/1/ /53/	DR/I	The start date of the project activity is 1 May 2004. The complete chronology of the event related to the project activity needs to be included in section B.5 of the PDD.	CAR-4	OK
B.5.9 When was the project commissioned?	/1/ /53/	DR/I	The chronology of the project activity is yet to be provided.	CAR-4	OK
B.5.10 Does the timeline of the project confirm that continuous actions in parallel with the implementation were taken to secure CDM status?	/1/ /53/	DR/I	The continuous and realistic effort for securing the CDM status for the project activity needs to be demonstrated with supporting evidences. The complete chronology of the event related to the project activity needs to be included in section B.5 of the PDD.	CAR-4	OK
Investment analysis (VVM para 106-112)					
B.5.11 Does the project activity or any of the remaining alternatives generate revenues apart from CDM? Is this reflected in the PDD?	/1/ /53/	DR/I	The Investment analysis option has not been chosen by the project proponent to demonstrate the additionality.		OK
Barrier analysis (VVM para 113-116)					
B.5.12 Are the barriers identified complimentary to a potential investment analysis? Does the barrier have a clear impact on the financial returns so that it can be assessed in an investment analysis? Each barrier is discussed separately.	/1/ /53/	DR/I	The investment analysis has not been considered by the project proponent. Thus, barrier analysis being complimentary to investment analysis is deemed not applicable here.		OK
B.5.13 How were the <u>investment barriers</u> assessed to be real? Are the investment barriers substantiated by a source independent of the project participants?	/1/ /53/	DR/I	Investment barrier has not been discussed in the PDD.		OK

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Checklist Question	Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
B.5.14 How does CDM alleviate the investment barriers?	/1/ /53/	DR/I	Investment barrier has not been discussed in the PDD.		OK
B.5.15 Is the project activity prevented by the investment barriers and at least one of the possible alternatives to the project activity is feasible under the same circumstances?	/1/ /53/	DR/I	Investment barrier has not been discussed in the PDD.		OK
B.5.16 How were the <u>technological barriers</u> assessed to be real? Are the technological barriers substantiated by a source independent of the project participants?	/1/ /53/	DR/I	<p>The technological barrier have been discussed on the following aspects:</p> <p>Sourcing of raw materials: It has been addressed that the raw materials for the project brick making technology needs to be tested, selected and sourced from the industries. Thus, the brick making facilities needs to be carefully located. The proponent needs to demonstrate how the CDM revenue shall alleviate the technological barrier. Furthermore, in accordance with the applicability of the methodology, it has been demonstrated that adequate supply of raw is available. The barrier due to supply of raw material needs to be justified in this line.</p> <p>Operating within the specified limits for right chemistry: It has been addressed that the project technology requires the raw material control and any change in the source of the raw material will result to interruption in the plant operation. The likelihood of occurrence of the same needs to be explained in more detail.</p>	CL-11	OK
B.5.17 How does CDM alleviate the technological barriers?	/1/ /53/	DR/I	The proponent needs to demonstrate how the CDM revenue shall alleviate the technological barrier.	CL-12	OK

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Checklist Question	Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
B.5.18 Is the project activity prevented by the technological barriers and at least one of the possible alternatives to the project activity is feasible under the same circumstances?	/1/ /53/	DR/I	The additionality of the project activity has been demonstrated by technological and barrier due to prevailing practice.		OK
B.5.19 How were the <u>barriers due to prevailing practise</u> assessed to be real? Are the barriers due to prevailing practise substantiated by a source independent of the project participants?	/1/ /53/	DR	It has been addressed that FaL-G technology bricks constitute 1.4% of the total walling materials in contrast to 95.3 of burnt clay bricks and 3.3 % of the cement concrete blocks. The evidence for the data needs to be provided. It needs to be justified that how major share of burnt clay bricks is the barrier to the implementation and operation of units under project activity. The proponent needs to demonstrate how the CDM revenue shall alleviate the above discussed barrier.	CL-13	OK
B.5.20 How does CDM alleviate the barriers due to prevailing practise?	/1/ /53/	DR	The proponent needs to demonstrate how the CDM revenue shall alleviate the above discussed barrier.	CL-13	OK
B.5.21 Is the project activity prevented by the barriers due to prevailing practise and at least one of the possible alternatives to the project activity is feasible under the same circumstances?	/1/ /53/	DR	Assessment of alternative is not required as per the methodology. The barrier due to major amount of burnt clay bricks to the project activity needs to be justified and substantiated.	CL-13	OK
B.5.22 How were the <u>other barriers</u> assessed to be real? Are the other barriers substantiated by a source independent of the project participants?	/1/ /53/	DR	Other barriers have not been discussed.		OK
B.5.23 How does CDM alleviate the other barriers?	/1/ /53/	DR	Other barriers have not been discussed.		OK
B.5.24 Is the project activity prevented by the other barriers and at	/1/	DR	Other barriers have not been discussed.		OK

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Checklist Question	Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
least one of the possible alternatives to the project activity is feasible under the same circumstances?	/53/				
Common practice analysis (VVM para 117-119)					
B.5.25 What is the geographical scope of the common practice analysis? Is this justified?	/1/ /53/	DR	As per the Appendix B of the simplified modalities and procedures for small-scale CDM project activities, Attachment A to Appendix B, common practice is not required to be performed for small scale project activity.		OK
Conclusion					
B.5.26 What is the conclusion with regard to the additionality of the project activity?	/1/ /53/	DR	Further demonstration and justification of the technological barrier and barrier due to prevailing practice needs to be provided. The issues raised in CL 12 and CL 13 to be addressed.	CL-12 CL-13	OK
B.6 Calculations of GHG emission reductions					
Data and parameters that are available at validation and that are not monitored (VVM para 198-200)					
B.6.1 How was the thermal energy required for the brick making process verified?	/1/ /53/	DR/I	The thermal energy in GWh _{th} used for baseline brick making process has been sourced from TERI. While source data is provided from (http://www.brickindia.com/article/detail.asp?id=36&cat=5 website, it is to be justified how the data of year 1999 is still relevant for the current period of project activity. The details of these estimations need to be made part of PDD and also the excel calculation sheet in a reproducible manner.	CL-14	OK
B.6.2 How was the Emission from electricity consumption verified?	/1/ /53/	DR/I	Electricity consumption will be the metered electricity supply from the electricity board		OK

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Checklist Question	Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
			supply meter. For the ex ante calculation, the emission from the electricity consumption of 1.3 ton CO ₂ per MWhe has been sourced from the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”. The back up calculations in excel format and the source of data used in arriving at the used emission factor has to be provided verification.	CL-15	
B.6.3 How was the emission from diesel consumption verified?	/1/ /53/	DR/I	The diesel consumption is for units which use diesel based power for their equipment operations apart from grid electricity. This is monitored by generator operators on daily basis from the diesel tank level indicator.		OK
B.6.4 How was the cement/lime consumption available at validation verified?	/1/ /53/	DR/I	This has been estimated based on the number of bricks generated by the project activity.		OK
Baseline emissions (VVM para 88-92)					
B.6.5 Are the calculations documented according to the approved methodology and in a complete and transparent manner?	/1/ /53/	DR/I	The baseline calculation and the formula used in the PDD needs to be done as per the methodology. The baseline is to be calculated on the net production of the brick and not on the acceptable scale of the bricks.	CAR-5	OK
B.6.6 Have conservative assumptions been used when calculating the baseline emissions?	/1/ /53/	DR/I	The baseline calculation and the formula used in the PDD needs to be done as per the applied baseline methodology AMS-III.Z.	CAR-5	OK
B.6.7 Are uncertainties in the baseline emission estimates properly addressed?	/1/ /53/	DR/I	The baseline calculation and the formula used in the PDD needs to be done as per the	CAR-5	OK

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Checklist Question	Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
			methodology.		
Project emissions (VVM para 88-92)					
B.6.8 Are the calculations documented according to the approved methodology and in a complete and transparent manner?	/1/ /53/	DR/I	The project emission includes emission due to electricity consumption and diesel consumption. The ex ante estimation, the formula given in the relevant tool is to be used. The formula for the ex ante calculation of project emission from electricity and diesel needs to be in line the tool available for estimation of project emissions.	CAR-6	OK
B.6.9 Have conservative assumptions been used when calculating the project emissions?	/1/ /53/	DR/I	The project emissions in the PDD need to be calculated as per the formula given in the tool used.	CAR-6	OK
B.6.10 Are uncertainties in the project emission estimates properly addressed?	/1/ /53/	DR/I	The project emissions in the PDD need to be calculated as per the formula given in the tool used.	CAR-6	OK
Leakage (VVM para 88-92)					
B.6.11 Are the leakage calculations documented according to the approved methodology and in a complete and transparent manner?	/1/ /53/	DR/I	The leakage due to the consumption of cement and lime has been accounted for. A default of 4% of cement and 8% of lime in the total FaL – G brick weight of production. The actual consumption of the cement and lime shall be monitored during the crediting period. The applicability and conservativeness of 4% and 8% of cement and lime respectively needs to be substantiated. The leakage due to the transportation needs to be addressed as per the methodology.	CL-16	OK
B.6.12 Have conservative assumptions been used when calculating the leakage emissions?	/1/ /53/	DR/I	The applicability and conservativeness of 4% and 8% of cement and lime respectively needs to	CL-16	OK

MoV = Means of Verification, DR= Document Review, I= Interview, CC= Cross-Checking

Checklist Question	Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
			be substantiated.		
B.6.13 Are uncertainties in the leakage emission estimates properly addressed?	/1/ /53/	DR/I	It has been stated that in case of uncertainty in the purchase bills of cement and lime, default values will be used. The proponent needs to demonstrate the conservativeness of the default values.	CL-16	OK
Emission Reductions (VVM para 88-92)					
B.6.14 Algorithms and/or formulae used to determine emission reductions: <ul style="list-style-type: none"> All assumptions and data used by the project participants are listed in the PDD and related document submitted for registration. The data are properly referenced All documentation is correctly quoted and interpreted. All values used can be deemed reasonable in the context of the project activity The methodology has been correctly applied to calculate the emission reductions and this can be replicated by the data provided in the PDD and supporting files to be submitted for registration. 	/1/ /53/	DR/I	The baseline calculation formula needs to be inline with the methodology. The project emission calculation needs to be done inline with the tool. The conservativeness of the applied default value for cement and lime needs to be demonstrated.	CAR-5 CAR-6 CL-7	OK
B.7 Monitoring plan (VVM para 120-122)					
Data and parameters monitored					
B.7.1 Do the means of monitoring described in the plan comply with the requirements of the methodology?	/1/ /53/	DR/I	The monitoring plan needs to address the following: The production of project brick needs to be monitored on daily basis as per the methodology. The consumption of fossil fuel that will be used for the project activity needs to be monitored and the cross checking can be done with the	CAR-7	OK

MoV = Means of Verification, DR= Document Review, I= Interview, CC= Cross-Checking

Checklist Question	Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
			purchase invoices. The monitoring plan needs to include in section B.7.1 that the project brick shall be tested for performance every six months.		
B.7.2 Does the monitoring plan contains all necessary parameters, and are they clearly described?	/1/ /53/	DR/I	The monitoring plan needs to address the following: The production of project brick needs to be monitored on daily basis as per the methodology. The consumption of fossil fuel that will be used for the project activity needs to be monitored and the cross checking can be done with the purchase invoices. The monitoring plan needs to include in section B.7.1 that the project brick shall be tested for performance every six months.	CAR-7	OK
B.7.3 In case parameters are measured, is the measurement equipment described? Describe each relevant parameter.	/1/ /53/	DR/I	The electricity shall be recorded from the monthly electricity bill. The monitoring equipment for each parameter needs to be described in the PDD monitoring plan.	CAR-8	OK
B.7.4 In case parameters are measured, is the measurement accuracy addressed and deemed appropriate? Describe each relevant parameter.	/1/ /53/	DR/I	The monitoring equipment for each parameter needs to be described, along with the accuracy class, calibration frequency of the equipment as applicable in the PDD monitoring plan.	CAR-8	OK
B.7.5 In case parameters are measured, are the requirements for maintenance and calibration of measurement equipment described and deemed appropriate? Describe each relevant parameter.	/1/ /53/	DR/I	The monitoring equipment for each parameter needs to be described, along with the accuracy class, calibration frequency of the equipment in the PDD monitoring plan.	CAR-8	OK
B.7.6 Is the monitoring frequency adequate for all monitoring parameters? Describe each parameter.	/1/ /53/	DR/I	The monitoring plan needs to address the following:	CAR-7	OK

MoV = Means of Verification, DR= Document Review, I= Interview, CC= Cross-Checking

Checklist Question	Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
			<p>The production of project brick needs to be monitored on daily basis as per the methodology.</p> <p>The consumption of fossil fuel that will be used for the project activity needs to be monitored and the cross checking can be done with the purchase invoices.</p> <p>The monitoring plan needs to include in section B.7.1 that the project brick shall be tested for performance every six months.</p>		
B.7.7 Is the recording frequency adequate for all monitoring parameters? Describe each parameter.	/1/ /53/	DR/I	The data recording frequency for each of the parameters need to be included in the PDD.	CAR-9	OK
Ability of project participants to implement monitoring plan					
B.7.8 How has it been assessed that the monitoring arrangements described in the monitoring plan are feasible within the project design?	/1/ /53/	DR/I	<p>The monitoring plan needs to address the following in line with the methodology:</p> <p>The production of project brick needs to be monitored on daily basis as per the methodology.</p> <p>The consumption of fossil fuel that will be used for the project activity needs to be monitored and the cross checking can be done with the purchase invoices.</p> <p>The monitoring plan needs to include in section B.7.1 that the project brick shall be tested for performance every six months.</p>	CAR-8	OK
B.7.9 Are procedures identified for day-to-day records handling (including what records to keep, storage area of records and how to process performance documentation)?	/1/ /53/	DR/I	The procedure for day to day record handling needs to be addressed in the PDD.	CAR-10	OK

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Checklist Question		Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
B.7.10	Are the data management and quality assurance and quality control procedures sufficient to ensure that the emission reductions achieved by/resulting from the project can be reported ex post and verified?	/1/ /53/	DR/I	The reviewing of the data and data storage needs to be addressed in the PDD.	CAR-10	OK
B.7.11	Will all monitored data required for verification and issuance be kept for two years after the end of the crediting period or the last issuance of CERs, for this project activity, whichever occurs later?	/1/ /53/	DR/I	It has not been addressed if the data will be stored for 2 years after the completion of the crediting period.	CAR-11	OK
Monitoring of sustainable development indicators/ environmental impacts						
B.7.12	Is the monitoring of sustainable development indicators/ environmental impacts warranted by legislation in the host country?	/1/ /53/	DR/I	The DNA of India does not warrant monitoring of sustainable development indicators.		OK
B.7.13	Does the monitoring plan provide for the collection and archiving of relevant data concerning environmental, social and economic impacts?	/1/ /53/	DR/I	NA		OK
B.7.14	Are the sustainable development indicators in line with stated national priorities in the host country?	/1/ /53/	DR/I	Project activity is in line with social, economical, environmental and technological well being.		OK
C Duration of the project activity / crediting period						
C.1.1 Start date of project activity (VVM para 96-97, 102)						
C.1.2	How has the starting date of the project activity been determined? What are the dates of the first contracts for the project activity? When was the first construction activity?	/1/ /53/	DR/I	The start date of the project activity has stated to be 1 May 2004. The evidence for the start date of the project activity is to be provided.	CAR-3	OK
C.1.3	Is the stated expected operational lifetime of the project activity reasonable?	/1/ /53/	DR/I	The expected life time of the project activity has been considered to be 15 years.		OK
C.1.4	Is the start date, the type (renewable/fixed) and the length of	/1/	DR/I	Fixed crediting period of 10 years has been		OK

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Checklist Question	Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
the crediting period clearly defined and reasonable?	/53/		selected. The start date of the crediting period has been stated to be 1 February 2010 or the date of registration, which ever is later.		
D Environmental Impacts (VVM para 129-131)					
D.1.1 Are there any host country requirements for an Environmental Impact Assessment (EIA), and if yes, is an EIA approved? Does the approval contain any conditions that need monitoring?	/1/ /53/	DR/I	The units covered under this projects are under small scale category hence does not come under requirement of EIA.		OK
D.1.2 Does the project comply with environmental legislation in the host country?	/1/ /53/	DR/I	The copies of all statutory clearances related to the project activity needs to be provided.	CL-17	OK
D.1.3 Will the project create any adverse environmental effects?	/1/ /53/	DR/I	The project activity eliminates the usage of fossil fuel in the brick making process. The project activity is not envisaged to have any negative environmental impact.		OK
D.1.4 Have identified environmental impacts been addressed in the project design?	/1/ /53/	DR/I	The project activity is not envisaged to have any negative environmental impact.		OK
E Stakeholder Comments (VVM para 126-128)					
E.1.1 Have relevant stakeholders been consulted?	/1/ /53/	DR/I	The local stakeholder consultation has been conducted in 2001 and 2003. The participants for the stakeholder consultation are The entrepreneurs, consumers, local residents, workers, manufacturing FaL-G blocks at FaL-G plants and suppliers of raw materials. The evidence for the local stakeholder consultation needs to be provided.	CL-18	OK
E.1.2 Have appropriate media been used to invite comments by	/1/	DR/I	The media used for inviting the local	CL-19	OK

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Checklist Question		Ref	MoV	Assessment by DNV	Draft Concl.	Final Concl.
local stakeholders?		/53/		stakeholder needs to be clarified and the supporting evidence is to be provided.		
E.1.3	If a stakeholder consultation process is required by regulations/laws in the host country, has the stakeholder consultation process been carried out in accordance with such regulations/laws?	/1/ /53/	DR/I	This is not mandatory for small scale industries.		OK
E.1.4	Is a summary of the stakeholder comments received provided?	/1/ /53/	DR/I	The summary of the stakeholder meeting has been provided in the PDD. The summary given in the PDD does not reflect any negative comment by the local stakeholder. The minute of the meeting is to be provided.	CL-19	OK
E.1.5	Has due account been taken of any stakeholder comments received?	/1/ /53/	DR/I	The summary of the stakeholder meeting has been provided in the PDD. The summary given in the PDD does not reflect any negative comment by the local stakeholder. The minute of the meeting is to be provided.	CL-19	OK

Table 3 Resolution of corrective action requests and clarification requests

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Validation conclusion
<p>CAR 1 The LoA from the DNA of host country and the Annex I parties are yet to be provided.</p>	<p>A.3.2 A.3.3</p>	<p>LoA from Netherlands and Host country Approvals given as soft copies in CD - Annx 1 (a & b). LOA from Italy is also received and attached as Annx 1 (a to d)</p> <p>One more letter of Host Country Approval is also attached. Annx 1 (a to d)).</p> <p>Color scan of the original LOA from Netherlands is attached as Annx 1 (a to d)</p>	<p>Letter of Approval from India, Netherlands and Italy has been provided. OK. CAR 1 is closed.</p>
<p>CAR 2 The evidence for the serious CDM consideration has to be provided.</p>	<p>B.5.5</p>	<p>Please refer Table on chronology of events in B.5 of PDD.</p> <p>Evidence is provided with respective numbers to all the events in the chronology of events. Please refer the folder “References for Chronology of Events” in CD.</p>	<p>Chronology of events has been included in section B.5 of PDD.</p> <p>It has been demonstrated with the supporting evidence that Project Concept Note (PCN) along with financial workings, considering CDM revenue was submitted to CDCF for FaL-G Brick. Evidence of the chronology of events has been provided to DNV.</p> <p>OK. CAR 2 is closed.</p>

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Validation conclusion
<p>CAR 3</p> <p>The evidence for the starting date of the project activity needs to be provided and the relevance of the choice of the event chosen for start date has to be demonstrated as per EB41 annex 67 guidelines.</p>	B.5.6	<p>List of SSI regn-dates and dates of commencement of production are provided – Annex 2</p> <p>The start date of the project is taken as the earliest date of commencement of production occurred out of 11 SPE units; that is June 1, 2004. Accordingly the change is effected in C.1.1 of PDD.</p> <p>The start date is included in the revised PDD as suggested (Annex 7 of PDD)</p>	<p>The start date of the project activity has been selected to be 1 June 2004, which is the earliest of date of commencement of production of all the individual brick manufacturing facility in the bundled. The production unit does not require construction and contracts to buy equipment.</p> <p>The evidence for the same has been provided and all the dates of has been included in the PDD.</p> <p>OK. CAR 3 is closed.</p>
<p>CAR 4</p> <p>The continuous and realistic effort for securing the CDM status for the project activity needs to be demonstrated with supporting evidences as per EB41 Annex 46 guidelines.</p> <p>The complete chronology of the event related to the project activity needs to be included in section B.5 of the PDD.</p>	B.5.7	<p>Please refer Table on chronology of events in B.5 of PDD</p> <p>Soft Copies of ERPA and one model copy of ERTA in CD Annex 3 (a & b)</p>	<p>The chronology of events has been included in the PDD. The evidence for the same has been provided.</p> <p>It has been assessed from the chronology of events and supporting documents that continuous effort has been taken for securing CDM status in line with the EB guidance.</p> <p>OK. CAR 4 is closed.</p>
<p>CAR 5</p> <p>The baseline calculation and the formula used in the PDD needs to be done as per the methodology. The baseline is to be calculated on the net production of the brick and not on the acceptable scale of the bricks.</p>	B.6.5	<p>PDD has been corrected. Please refer 6.2 of PDD.</p> <p>As discussed the equation 9 in PDD is changed as per the methodology.</p>	<p>The baseline emission has been corrected as per the methodology. The data used of the calculation of specific emission factor has been verified from the article “Emission Standards for brick kilns- An opportunity for Technology upgradation” by Sameer</p>

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Validation conclusion
			Maithel, The Energy Research Institute (TERI), India. Since, the data is publicly available and from a third party source this has been accepted by DNV. OK. CAR 5 is closed.
<p>CAR 6</p> <p>The formula for the <i>ex ante</i> calculation of project emission from electricity and diesel needs to be in line the tool available for estimation of project emissions.</p>	B.6.8	Formulae are taken as per tool. Pl. refer 6.2 of PDD.	<p>The project emission due to the usage of electricity and fossil fuel has been revised as per the “Tool to calculate baseline, project and /or leakage emissions from electricity consumption” allowed by the methodology.</p> <p>The project emission from the usage of fossil fuel has been revised in line with “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion”.</p> <p>OK. CAR 6 is closed.</p>
<p>CAR 7</p> <p>The monitoring plan needs to address the following:</p> <p>The production of project brick needs to be monitored on daily basis as per the methodology.</p> <p>The consumption of fossil fuel that will be used for the project activity needs to be monitored and the cross checking can be done with the purchase invoices.</p> <p>The monitoring plan needs to include in</p>	B.7.1	<p>Please Ref. B.7.1 of PDD</p> <p>This aspect is taken care and one more box is added for Diesel purchases. Please refer B.7.1 of PDD.</p> <p>As per discussion the box for Fuel Purchases is</p>	<p>The monitoring plan has been adequately revised to include production of project brick to be monitored on daily basis.</p> <p>The diesel consumption shall be maintained in the stock register and shall be cross check from the purchase receipts.</p> <p>The monitoring plan has been revised to</p>

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Validation conclusion
section B.7.1 that the project brick shall be tested for performance every six months.		This is taken care in PDD by adding one more box. Please refer B7.1 of PDD.	include the brick tested for performance every six months. OK. CAR 7 is closed.
CAR 8 The monitoring equipment for each parameter needs to be described, along with the accuracy class, calibration frequency of the equipment as applicable in the PDD monitoring plan.	B.7.3 B.7.4 B.7.5	There is no equipment for monitoring Diesel, fly ash, cement and/or lime which are charged in to the production by using traditional measuring systems such as cans and head loads, or random volumetric doses using respective vessels. Electricity is monitored by the Service Provider's meter for which the latter is responsible for calibration. Calibration of CTM for strength test is taken care by respective labs and outside the project boundary.	It has been explained that apart from the energy meter for the electricity consumption, no other measuring equipments are used in the project activity. The calibration of the electricity meter shall be performed by the service provider as per the requirements of SSC guidelines and national regulations. OK. CAR 8 is closed.
CAR 9 The data recording frequency for each of the parameters need to be included in the PDD.	B.7.7	This is taken care in PDD. Please refer B.7.1 of PDD.	The PDD has been revised to include the recording frequency of each of the parameters. OK. CAR 9 is closed.
CAR 10	B.7.9		The day to day record handling

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Validation conclusion
The procedure for day to day record handling and the reviewing of the data and data storage needs to be addressed in the PDD.	B.7.10	Day to day records are taken care by the Sub-Project Entity, who sends monthly statements to PE who reviews the diligence of data and archives the same. Such archived data would be stored for 2 years after completion of crediting period. Please refer B7.2 of PDD.	procedure has been included in the monitoring plan of the PDD. OK. CAR 10 is closed.
CAR 11 It has not been addressed if the data will be stored for 2 years after the completion of the crediting period.	B.7.11	This has been addressed in B.7.2 of PDD.	The data shall be stored for 2 years after the crediting period. OK. CAR 11 is closed.
CL 1 The PDD does not address the details on project implementation. The chronology of the project activity needs to be added in the PDD.	A.2.2	Please refer table of chronology of events under B.5 of PDD. Initial discussions with the World Bank are for enrolment of suitable number of SPEs which are later identified and included in the bundles. The start date of the project is included in the PDD under chronology of events.	The chronology of the events has been included in the PDD. OK. CL 1 is closed.
CL 2 The copy of the patent and applicable countries covered under this patent for FaL-G technology needs to be provided.	A.2.6	Soft copy of the patent included in CD (Annex 4).	Patent letter, dated 30 January 2006, by the Controller of patent has been provided by the proponent. OK. CL 2 is closed.
CL 3	A.4.1		The indicative geo coordinates of the of

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Validation conclusion
<p>The geographical coordinates of the individual facilities need to be provided in the PDD as per the UNFCCC's requirement.</p>		<p>Please specify the requirements. The VVM 1.1 does not include any specific requirements to provide geographical coordinates of the individual facilities. We have tried to use Google Earth to map the locations but due to the remoteness of these units and small areas occupied by them, we are unable to do so.</p> <p>Indicative geographical coordinates are included in the list of SPEs vide Annex 6 of PDD. Exact coordinates are not available due to lack of clear cut landmark to identify the units.</p>	<p>Each of the bundle elements have been included in the PDD, annex 6. OK. CL 3 is closed.</p>
<p>CL 4</p> <p>The CDCF includes funding from several Annex I Party governments and the project thus includes public funding. Section A.4.5 and Annex 2 will have to be revised and an affirmation has to be provided by at least the Annex I Party that eventually will authorize IBRD's participation in which this Annex I Party confirms that funding used does not represent a diversion of ODA:</p>	<p>A.5.1</p>	<p>CDCF funds from Annex I country-participants are in the form of contribution to a carbon fund and are specifically for purchase of emission reductions. They are neither public funds nor can be considered as ODA funds.</p> <p>The required information is available in LOA from Netherlands. Separate letter is obtained from Italy. Annex 1 (a to d) of CD</p>	<p>The letter of affirmation on diversion of ODA by the Ministry of Environment and Territory, dated 9 September 2005 has been provided by the proponent. It has been verified from the LoA of Netherlands that no ODA from the State of Netherlands is involved in the project activity. OK. CL 4 is closed.</p>

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Validation conclusion
<p>CL 5</p> <p>It is to be demonstrated in line with methodology with the analysis and documented studies that the quality parameters of the brick from FaL-G technology are better or comparable to the conventional bricks. It is also required to demonstrate that the project meets the requirements of paragraph 8 of methodology.</p>	B.2.1	<p>The strength classification vide IS: 12894: is very well complied by FaL-G bricks.</p> <p>There are no local regulations to use FaL-G bricks. This is explained in Section B.1 of PDD.</p> <p>The compressive strength certificates of SPEs are shown to DOE.</p>	<p>Test reports for a sample of FaL-G bricks is requested to be provided to demonstrate that project activity bricks comply with the strength classification standard.</p> <p>OK. CL 5 is closed.</p>
<p>CL 6</p> <p>The project activity has to demonstrate that it meets the relevant requirements of greenfield activities as per general guidance of the SSC methodologies.</p>	B.2.3	<p>This has been updated and addressed. Please refer B.2 of PDD.</p> <p>Copies of SSI of SPEs indicate that the project activity is a green field activity. The soft copies are provided to DOE.</p>	<p>It has been verified from the SSI registration certificate and No objection certificate from the pollution control board that the each brick manufacturing units in the bundle is Greenfield.</p> <p>OK. CL 6 is closed.</p>
<p>CL 7</p> <p>The abundant availability of each of the starting materials needs to be demonstrated in line with requirements referred in Para 6 of the methodology.</p>	B.2.6	<p>The project does not involve change of raw materials since this is green field project. Hence para 6 is not applicable. However availability of each of raw material is demonstrated vide clause B2 of PDD.</p> <p>The abundant availability of raw material is sufficiently demonstrated. Please follow the below link which is</p>	<p>The availability of starting material (fly ash) has been verified from the article on R&D and technology development/ application in Fly Ash area by Ministry of Science & Technology, Department of Science & Technology.</p> <p>Cement/lime and gypsum is available in the market as per the demand.</p> <p>OK. CL 7 is closed.</p>

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Validation conclusion
		<p>duly incorporated in PDD.</p> <p>http://www.dst.gov.in/whats_new/what_new08/fly-ash.pdf</p>	
<p>CL 8</p> <p>It is to be addressed and clarified the national standard being used for identifying the strength class of the bricks in general.</p> <p>It is to be clarified if the density (tonnes/m³) is the only and adequate parameter that will be monitored during the crediting period to assess the performance level of the project brick as methodology also refers to parameters like dry compressive strength, wet compressive strength.</p> <p>The national standards used for the baseline brick strength assessment and project brick performance needs to be provided.</p>	B.2.7	<p>IS: 12894: Pulverised fuel ash – Lime Bricks</p> <p>Density is monitored to arrive to the conservative estimate of production based on fly ash consumption, and in turn baseline emissions. This is clarified in B 7.1</p> <p>Performance is judged in terms of compressive strength vide IS 516: Method of Test for Strength of Concrete.</p> <p>The compressive strength of clay brick ie., baseline brick is assessed by IS 3495 : Methods of tests of Burnt Clay Building Bricks (Part I). The project brick performance is assessed by IS</p>	<p>The copy of the standards has been provided by the proponent. The test results of sample Fal-G bricks has been provided.</p> <p>The performance test shall be performed for the project activity bricks once in six months and the test certificates are provided by the laboratory.</p> <p>The PDD has been adequately revised to address the same.</p> <p>OK. CL 8 is closed.</p>

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Validation conclusion
		<p>516- Method of Test for Strength of Concrete.</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>Soft copies are above BIS codes are provided in CD - Annex 5(a to c)</p>	
<p>CL 9</p> <p>It has been addressed in the project design document that even though there is a local regulation for the usage of fly ash for the brick production, there is wide spread non compliance. This non compliance needs to be demonstrated.</p> <p>All the applicability criteria defined in applied methodology are to be specifically addressed in the PDD, preferable in the tabular format, in section B.2 of the PDD.</p>	B.2.8	<p>This is already addressed earlier in detailed in B.2</p> <p>For further justification for non-compliance below data from Gazette of MOEF is added in B.2 of PDD:</p> <p>Ministry of Environment and Forests, Government of India came out with a Gazette Notification No. 2804 dated 3rd 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 1.51% on national demand for the bricks.</p> <p>These figures show that the penetration is very meagre demonstrating the non-</p>	<p>Ministry of Environment and Forests, Government of India came out with a Gazette Notification No. 2804 dated 3 November 2009 has been provided to DNV.</p> <p>The PDD has been revised to address each of the applicability criteria of methodology.</p> <p>OK. CL 9 is closed.</p>

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Validation conclusion
		<p>compliance of the national regulation.</p> <p>Soft copy of Gazette notification in CD – Annex 6</p> <p>Please ref. table in PDD under B.2.</p>	
<p>CL 10</p> <p>The evidences supporting the energy consumption in the brick production in India need to be provided.</p> <p>Consideration of 5% of total energy inputs from biomass needs to be justified.</p>	<p>B.4.7</p> <p>B.4.8</p>	<p>Pl. ref. TERI document referred in the PDD.(soft copy in CD – Annex 7)</p> <p>The weblink for TERI document has already been provided in B.4 of PDD. The same may please be referred.</p> <p>Pl. ref. FAO document that mentioned about 2% of biomass used for clay bricks (Soft copy in CD – Annex 8). Thus 5% is the robust conservative figure.</p>	<p>The energy consumption by various type for brick production in India has been sourced from TERI documents.</p> <p>It has been verified from the FAO that biomass contributes for 2% fuel in the brick manufacturing process. In view of this, 5% usage of biomass has been accepted on the conservative basis.</p> <p>OK. CL 10 is closed.</p>
<p>CL 11</p> <p>Sourcing of raw materials: It has been addressed that the raw materials for the project brick making technology needs to be</p>	B.5.33	The justification is clearly provided in PDD. The barrier is in sourcing right quality of raw material out of the	The burnt bricks dominate 95% of the market, where as Fal-G bricks contributes to 1.4% of the total brick market.

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Validation conclusion
<p>tested, selected and sourced from the industries. Thus, the brick making facilities needs to be carefully located. The proponent needs to demonstrate how the CDM revenue shall alleviate the technological barrier. Furthermore, in accordance with the applicability of the methodology, it has been demonstrated that adequate supply of raw is available. The barrier due to supply of raw material needs to be justified in this line.</p> <p>Operating within the specified limits for right chemistry: It has been addressed that the project technology requires the raw material control and any change in the source of the raw material will result to interruption in the plant operation. The likelihood of occurrence of the same needs to be explained in more detail.</p>		<p>abundant supply.</p> <p>This has been explained clearly under B.5 of PDD.</p> <p>The interruption of production on account of change in RM may arise in the case of non-licensed plants. In case of licensed plants the production would be suitably altered under guidance from INSWAREB to result in non-interruption of the production. This technology-interaction is possible because of CDM project and relevant tie-up.</p> <p>Non-licensed plant in this context is the one which is set up with pirated technology but not by getting the technology officially from INSWAREB.</p> <p>This is explained under B.5 of PDD</p>	<p>The strength of the product depends on the purity and the mixing proportions of these materials. The sourcing and the right mixture (recipe) of the raw material to get the correct bonding chemistry are the technological risks of the project. The raw materials are to be tested and selected for sourcing and in case of change in the source of raw material, the chemistry needs to be reworked to get the adequate mixture. Furthermore, even though FaL-G is a patent technology, the licensors has not invoked the patent to facilitate the proliferation of technology. This has resulted to the unlicensed FaL-G brick units, operates on the pirated technology and is likely to produce low grade of FaL-G bricks. The low quality of FaL-G bricks produced in the unlicensed plants are likely have customer complaints and hampers the overall brick market of FaL-G. Above mentioned has been verified from Article in The Hindu news paper on the challenge related to quality assurance of FaL-G bricks, dated 26 March 2009 and 11 April 2009</p> <p>OK. CL 11 is closed.</p>
<p>CL 12</p> <p>The proponent needs to demonstrate how the</p>	B.5.34	As explained above	The FaL-G brick manufacturing units, to participate in the CDM project

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Validation conclusion
CDM revenue shall alleviate the technological barrier.		This is explained under B.5 of PDD	activity, needs to be a licence of the technology and practice this with methodical manner and manufacture the product with quality standards. The technological fee and the primary interact with the manufacturing units are taken care by the CDM revenue. OK. CL 12 is closed.
<p>CL 13</p> <p>It has been addressed that FaL-G technology bricks constitute 1.4% of the total walling materials in contrast to 95.3% of burnt clay bricks and 3.3% of the cement concrete blocks.</p> <p>The evidence for the data needs to be provided. It needs to be justified that how major share of burnt clay bricks is the barrier to the implementation and operation of units under project activity.</p> <p>The proponent needs to demonstrate how the CDM revenue shall alleviate the above discussed barrier.</p>	B.5.36	<p>Please refer INSWAREB's inputs to MOEF for enriching the GO on fly ash, as available through the link below. http://fal-g.com/SuggestionstoDNonFAdt_6-11-08.pdf</p> <p>Soft copy of Review of GO with track changes is put in CD (Annex 9).</p> <p>Please refer Holtec Report Please refer B.5 of PDD.</p> <ul style="list-style-type: none"> Part of the CDM revenue is used for technological upgradation and support from INSWAREB who also conduct programs for market development and capacity building. 	<p>The weblink for the market share of FaL-G bricks for the total walling material in Indian market has been provided.</p> <p>The colour of the Fal-G brick and the raw material used results to the negative sentiments of the consumers. To encourage the FaL-G bricks, the union government has exempted FaL-G from taxes until 2005, however, the same was merged with the similar level of sector which includes the clay brick industries. The clay brick industry, being an unorganised sector does not strictly follow the tax regime, whereas, the FaL-G brick industries is a organised sector and shall follow the tax regime. The CDM revenue shall be used for the technological up gradation, market development and the meeting the price competition with the clay bricks.</p> <p>The raw material, lime or cement and</p>

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Validation conclusion
		<ul style="list-style-type: none"> 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. 	<p>gypsum, used in FaL-G brick makes it cost intensive in comparison to clay brick. Since the manufacturing cost of FaL-G bricks are higher than the clay bricks, market price of FaL-G is higher and cannot match the price of clay brick and thus losses market in price front with clay brick.</p> <p>It has been addressed in the PDD that CDM revenue shall help in alleviating the barrier due to technology and prevailing practice.</p> <p>OK. CL 13 is closed.</p>
<p>CL 14</p> <p>The thermal energy in GWh_{th} used for baseline brick making process has been sourced from TERI. While source data is provided from http://www.brickindia.com/articledetail.asp?id=36&cat=5 website, it is to be justified how the data of year 1999 is still relevant for the current period of project activity. The details of these estimations need to be made part of PDD and also the Excel calculation sheet in a reproducible manner.</p>	B.6.1	<p>Baseline of brick manufacturing process is same as that of 500 years back. New technologies in clay brick such as VSBK, that would have caused reduction in energy consumption, could not penetrate and not in use widely. Hence the applicability of thermal energy data can very well be accepted.</p> <p>More over, as conservative approach, baseline with weighted average thermal energy is taken as basis out of various technological options available in clay brick production. Therefore the energy baseline continues to be same.</p>	<p>In view of the fact that brick industry in an age old small scale industry and not much changes happened in the industry, the data from TERI has been accepted. Furthermore, in line with the methodology, weighted average energy consumption has been considered thus, taking care of the mixture of technology in the industry in India.</p> <p>OK. CL 14 is closed.</p>

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Validation conclusion
		This is already taken care in PDD under B.4. Further Excel calculation is attached -Annex 10	
<p>CL 15</p> <p>The back up calculations in Excel format and the source of data used in arriving at the used emission factor has to be provided verification.</p>	B.6.2	<p>EF for power is the default value as option A.2 in the Tool to calculate emissions from electricity consumption (EB.39 Annex. 7)</p>	<p>Excel sheet has been provided by the proponent and verified by DNV. OK. CL 15 is closed.</p>
<p>CL 16</p> <p>The leakage due to the consumption of cement and lime has been accounted for. A default of 4% of cement and 8% of lime in the total FaL – G brick weight of production. The actual consumption of the cement and lime shall be monitored during the crediting period.</p> <p>The applicability and conservativeness of 4% and 8% of cement and lime respectively needs to be substantiated.</p> <p>The leakage due to the transportation needs to be addressed as per the methodology.</p>	B.6.11	<p>Default values on cement and lime are withdrawn. Actual purchase is only taken as the basis vide 15.B of methodology. The corrections are carried in B 6.1(c)</p> <p>The leakage due to transportation is negligible as explained in calculations vide B.6.1.c in PDD.</p> <p>The relevant calculations in excel are attached – Annex 11</p>	<p>Emission factor of cement of 0.82 tCO₂/ ton of cement has been sourced and verified from the technical article by Press Information Bureau, Government of India: Indian Cement Industry.</p> <p>Emission factor of lime of 0.42 tCO₂/ton of lime has been used for the calculation of leakage. This has been verified from the IPCC 2006 default value of 0.40 tCO₂/ton of lime. This has been accepted based on the conservativeness.</p> <p>The leakage due to the usage of cement (OPC) and lime has been calculated as required by the applied methodology. Emission factor of cement and lime has been considered as discussed in section</p>

Corrective action and/ or clarification requests	Reference to Table 2	Response by project participants	Validation conclusion
			4.6.1. The quantity of cement (OPC) and lime consumed by the project activity shall be monitored for the calculation of project emission during the crediting period. OK. CL 16 is closed.
CL 17 The copies of all statutory clearances related to the project activity needs to be provided.	D.1.2	Soft copies in CD – Annex 12	All the statutory clearance has been provided and verified by DNV. OK. CL 17 is closed.
CL 18 The evidence for the local stakeholder consultation needs to be provided. The media used for inviting the local stakeholder needs to be clarified and the supporting evidence is to be provided. The minute of the meeting is to be provided.	E.1.	Stakeholders have been invited through brochures, through letters and sometimes through telephone. Soft copies of couple of brochures and invitations are included. CD submitted with relevant information – Annex 13	Minutes of the meeting conducted with local stakeholders at various location has been provided and verified by DNV. The evidence on conducting the work shops at Hyderabad and Cuddapah on FaL-G technology on September 2003 has been provided to DNV . The feed back from the local stakeholder has been adequately documented in the PDD. OK. CL 18 is closed.
CL19 The crediting period in the PDD has to start at least 4 weeks after the project is submitted for registration. The project participants are therefore requested to update the PDD.		The start date of the crediting period has been revised to 1 May 2011.	The PDD has been updated adequately to revise the start date of the crediting period to 1 May 2011. OK. CL 19 is closed.

Table 4 Forward action requests

Forward action request	Reference to Table 2	Response by project participants
No FAR has been identified.		NA

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APPENDIX B

CURRICULA VITAE OF THE VERIFICATION TEAM MEMBERS

Sharmistha Shome, Auditor, DNV India, holds a Master Degree in Energy Systems. Her educational qualification covers the fields of sustainable development, power plant technology, renewable energy technology, performance of thermal & electrical utilities and project financing.

She has experience in validation and verification of several CDM projects/JI and other 3rd party validation/verification services. She has completed the ISO14001 EMS Lead Auditor course.

Astakala Vidyacharan, Auditor, DNV, India. He is a chemical engineer and prior to joining DNV in 2005, has had 11 years of direct work experience in various chemical industries. His work experience covers 4 years in project implementations in pesticide and fine chemical industries, including environment management activities; 7 years in process operations of pesticide, natural products and fine chemical industries.

He has received extensive training in the CDM validation and verification process. He is an appointed validator for the CDM validation and verification program of DNV and has performed validation of several CDM projects. He is also a trained auditor for GHG accounting standards and involved audit of Corporate GHG accounting. He is a qualified ISO9001, ISO 14001 Lead auditor and OHSAS 18001 auditor who has performed several audits for various industrial sectors under these management systems.

His qualification, industrial experience and experience in CDM facilitate him to assess renewable energy based on Hydro and Biomass, Energy Efficiency sectors, in particular to sufficient degree.

Matteo Faggin holds a Master Degree in Business Administration and a Master Degree in Mechanical Engineering.

He has an overall experience of around 8 years. Prior to joining DNV having 7 years experience in the cement, construction and aluminum industries covering industrial operations and new project implementation for cement plants, quarries, energy and thermal distribution projects. He has experience of around 1 year in validation and verification of numerous CDM projects. His qualification, industrial experience and experience in CDM demonstrate him sufficient sectoral competence in Cement Industry, Electricity Distribution, Heat Distribution, Mining and Mineral processes. Expertise in Project Management for the execution of large projects aimed at reducing the greenhouse gasses emissions and increasing the energy efficiency of manufacturing plants.

Mr. Yang Xiao Shan, Alan holds a Bachelor Degree in Material Science and Engineering. He has an overall experience of around four years. Prior to joining DNV, he has around four years experience in cement manufacturing industry covering production, process optimization, quality assurance, waste heat recovery and energy efficiency improvement. His experience also covers the fields of environmental management and resource conservation including alternative fuels, cheap coal, and solid waste disposal in clinker kiln. He has also been actively involved in implementation of Quality Management System, ISO 9001 standard in cement manufacturing industry for more than three years.

He has experience of around 1 year in validation and verification of CDM and VCS projects.

His qualification, industrial experience and experience in CDM demonstrate his sufficient sectoral competence in "Cement Manufacturing".

Hendrik Brinks holds a Master Degree in Inorganic Chemistry & Material Science and a Dr. Scient Degree in Inorganic Chemistry & Material Science. He has an overall experience of around 16 years. Prior to joining DNV, he has 7 years of working experience at a research institute by scientific research on future energy systems with hydrogen as an energy carrier and project management for monitoring system design. He has published >50 papers in international journals with peer reviews. His experience also covers teaching and research at University of Oslo, Norway.

He has 4 years extensive experience in validation and verification of >400 CDM projects worldwide and also experience from other 3rd party validation/verification schemes. Technical Director for CDM, Hendrik W. Brinks is the service line responsible for CDM in DNV and is qualified for approval of CDM projects.

His qualification and experience in CDM demonstrate his sufficient sectoral competence in "Waste Handling and Disposal" and quality control (technical review) competence for projects within renewable energy, biomass power, waste heat recovery, energy efficiency, waste handling, wastewater, coal mine methane, transport, charcoal and flare reduction.