



VERIFICATION / CERTIFICATION REPORT

“HAPUGASTENNE AND HULU GANGA SMALL HYDROPOWER PROJECTS” IN SRI LANKA

(UNFCCC Registration Ref. No. 0085)

Monitoring Period:
1 January 2007 to 30 September 2008

REPORT No. 2010-0427

REVISION No. 06

DET NORSKE VERITAS



VERIFICATION / CERTIFICATION REPORT

Date of first issue: 18 May 2008	Project No.: PRJC-98887-2008-CCS-IND	DNV CLIMATE CHANGE SERVICES AS Veritasveien 1, 1322 HØVIK, Norway Tel: +47 67 57 99 00 Fax: +47 67 57 99 11 http://www.dnv.com Org. No: NO 994 774 352 MVA
Approved by: Michael Lehmann	Organisational unit: Accredited Climate Change Services	
Client: C-Quest Capital, LLC	Client ref.: Ms.Isabel Alegre	
Summary: DNV Climate Change Services AS (DNV) has performed the verification of the emission reductions reported for the project activity "Hapugastenne and Hulu Ganga Small Hydropower Projects" in Sri Lanka (UNFCCC Registration Ref. No. 0085) for the period 1 January 2007 to 30 September 2008. In our opinion, the GHG emission reductions reported for the project in the monitoring report (version 06) of 1 April 2014 are fairly stated. The GHG emission reductions were calculated correctly on the basis of the approved monitoring methodology AMS-I.D (version 05) and the monitoring plan contained in the revised Project Design Document, version 04 of 27 November 2013 approved on 18 March 2014. DNV Climate Change Services AS is able to certify that the emission reductions from the project activity "Hapugastenne and Hulu Ganga Small Hydropower Projects" in Sri Lanka during the period 1 January 2007 to 30 September 2008 amount to 75 014 tonnes of CO ₂ equivalent.		

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Report title: "Hapugastenne and Hulu Ganga Small Hydropower Projects" in Sri Lanka		Key words Climate Change Kyoto Protocol Validation Clean Development Mechanism	Service Area Verification	
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Work carried out by: Murali Govindarajulu, Kakaraparthi Venkataraman, Astakala Vidyacharan, Ricardo Diaz, Ravi Kumar Prabhu		<input checked="" type="checkbox"/> No distribution without permission from the client or responsible organisational unit <input type="checkbox"/> free distribution within DNV after 3 years <input type="checkbox"/> Strictly confidential <input type="checkbox"/> Unrestricted distribution		
Work verified by: S. Ranganathan				
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***Abbreviations***

CAR	Corrective Action Request
CDM	Clean Development Mechanism
CEF	Carbon Emission Factor
CEB	Ceylon Electricity Board
CER	Certified Emission Reduction(s)
CL	Clarification request
CMP	Conference of Parties serving as the meeting of the parties to the Kyoto Protocol
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
DNV	Det Norske Veritas
DNA	Designated National Authority
EPL	Eco Power (Private) Limited
FAR	Forward Action Request
GHG	Greenhouse gas(es)
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
MP	Monitoring Plan
PDD	Project Design Document
PPA	Power Purchase Agreement
PLF	Plant Load Factor
PS	Clean Development Mechanism Project Standard
UNFCCC	United Nations Framework Convention on Climate Change
VVS	Clean Development Mechanism Validation and Verification Standard



1 INTRODUCTION

C-Quest Capital, LLC has commissioned DNV Climate Change Services AS (DNV) to carry out the verification and certification of emission reductions reported for the CDM project activity 0085 “Hapugastenne and Hulu Ganga Small Hydropower Projects” in Sri Lanka (the project) for the period 1 January 2007 to 30 September 2008. This report contains the findings from the verification and a certification statement for the certified emission reductions.

1.1 Objective

Verification is the periodic independent review and *ex post* determination by a Designated Operational Entity (DOE) of the monitored reductions in GHG emissions that have occurred as a result of the registered CDM project activity during a defined monitoring period.

Certification is the written assurance by a DOE that, during a specific period in time, a project activity achieved the emission reductions as verified.

The objective of this verification was to verify and certify emission reductions reported for the “Hapugastenne and Hulu Ganga Small Hydropower Projects” for the period 1 January 2007 to 30 September 2008.

1.2 Scope

The scope of the verification is to verify that:

- The project activity has been implemented and operated in accordance with the PDD;
- The monitoring plan complies with the monitoring methodology and the actual monitoring complies with the monitoring plan, including compliance with any guidance provided by the Board regarding deviations from the provisions of a registered plan and/or methodology;
- The data and calculation of GHG emission reductions have been assessed to correctly support the emission reductions being claimed.

1.3 Description of the project activity

Project Parties:	Sri Lanka (host)
Title of project activity:	Hapugastenne and Hulu Ganga Small Hydropower Projects
UNFCCC registration No:	0085
Baseline and monitoring methodology	AMS-I.D version 5
Sectoral scope(s):	1
Project Participants:	Eco Power (Private) Limited from host Party Sri Lanka
Location of the project activity:	The Hapugastenne Phase I and Phase II projects are located in Sabaragamuwa Province, Ratnapura District



and the Hulu Ganga I and Hulu Ganga II projects is in Central Province, Kandy District.

Project's crediting period: 1 January 2003 to 31 December 2012 (fixed crediting period)

Period verified in this verification: 1 January 2007 to 30 September 2008

1.4 Methodology for determining emission reductions

According to the applied methodology AMS-I.D, version 05, the emission reductions for the project are determined as the difference between the baseline emissions, project emissions and leakage:

$$ER_y = BE_y - PE_y - L_y$$

PE_y and L_y are considered as to be zero as stated in the the revised PDD /16/. However for this monitoring period, project emission of 299 tCO₂e that occurred during the construction phase is being deducted. Therefore, the emission reductions are accounted as:

$$ER_y = BE_y - PE_y = EG_y \times EF_y - PE_y$$

where,

EF_y is the emission factor of the grid to which the project is connected, and was determined and validated *ex-ante* as 0.8496 tCO₂/MWh /16/ and will not be updated during the crediting period.

EG_y is the net electricity generation delivered to the grid, which is determined by the electricity exported to the grid minus the electricity imported from the grid.

2 METHODOLOGY

DNV has assessed and determined that the implementation and operation of the project activity, and the steps taken to report emission reductions comply with the CDM criteria and relevant guidance provided by the Board.

The assessment involved a desk review of relevant documentation as well as an on-site visit(s).

The verification of the emission reductions has assessed all factors and issues that constitute the basis for emission reductions from the project. These include:

- i) Review of project documentation;
- ii) The net electricity supplied by the project to the grid which is multiplied with a fixed grid baseline combined emission factor of 0.8496 tCO₂e/MWh;
- iii) The actual installed capacity of the 13.568 MW (*renewable type*) power plant to ensure the conformance with the descriptions in the PDD /16/;

**Verification team**

Role	Last Name	First Name	Country	Type of involvement					
				Desk review	Site visit	Reporting	Supervision of work	Technical review	TA 1.2 competence
Team leader (Verifier) until 24 October 2013	Astakala	Vidyacharan	India	✓	✓	✓	✓		✓
Verifier	Govindarajulu	Murali	India	✓	✓	✓			✓
Verifier	Kakaraparthi	Venkataraman	India	✓	✓	✓			✓
Team leader (Verifier) from 24 October 2013	Prabhu	Ravi Kumar	India	✓		✓			✓
Sector expert	Diaz	Ricardo	Mexico	✓		✓			✓
Technical reviewers	Seshan	Ranganathan	India					✓	✓

Duration of verification

Monitoring report publication: 11 May 2009

Desk review: 11 May 2009

On-site assessment: 12 May 2009 to 13 May 2009

Reporting, calculation checks and QA/QC: 1 December 2012 to 22 April 2014

2.1 Desk review

The monitoring report, version 01 dated 15 June 2009, has been made publicly available on the CDM website. In addition to the monitoring report /1/ (version 01 dated 15 June 2009 and final version 06 dated 1 April 2014), the verification has been performed based on the review of the following documentation provided by the project participants:

- The PDD version 04 dated 27 November 2013, including the monitoring plan /16/ and the corresponding validation opinion on the revised PDD and post registration changes dated 27 November 2013 /18/ and validation report /17/.
- The previous verification reports /15/.
- The approved baseline and monitoring methodology AMS-I.D, version 05 /22/ applied by the project.
- Relevant decisions, clarifications and guidance from the CMP and the CDM Executive Board /19/.
- Other information and references relevant to the project activity's resulting emission reductions /2/.



During the desk review, DNV has applied standard auditing techniques to assess the quality of information provided. The following activities were performed:

- A review of the data and information presented to verify their completeness;
- A review of the monitoring plan and monitoring methodology, paying particular attention to the frequency of measurements, the quality of metering equipment including calibration requirements, and the quality assurance and quality control procedures; and
- An evaluation of data management and the quality assurance and quality control system in the context of their influence on the generation and reporting of emission reductions.

2.2 On-site assessment

During 12-13 May 2009, DNV performed on-site assessments. The key personnel of the project were interviewed or assisted the verification team /23/-/25/.

During the on-site assessment, DNV has applied standard auditing techniques to assess the quality of information provided. The following aspects of the CDM project activity have been verified:

- The implementation and operation of the CDM project activity ;
- The information flow for generating, aggregating and reporting of the monitoring parameters; and
- The operational and data collection procedures are implemented in accordance with the monitoring plan in the PDD

Further, the following activities were performed:

- A cross-check between information provided in the monitoring report and data from other sources;
- A check of the monitoring equipment including calibration performance and observations of monitoring practices against the requirements of the PDD and the selected methodology;
- A review of calculations and assumptions made in determining the GHG data and emission reductions; and
- An identification that quality control and quality assurance procedures in place to prevent or identify and correct any errors or omissions in the reported monitoring parameters.

The data presented in the monitoring report was assessed by review of the detailed project documentation and production records, as well as by interviews with personnel at the project sites /23/-/25/, and observation of collection of measurements, observation of established monitoring and reporting practices and assessment of the reliability of monitoring equipment. This has enabled the verification team to assess the accuracy and completeness of reported monitoring results; to verify the correct application of the approved monitoring methodology and the determination of the emission reductions.

In addition, all parameters required by the monitoring methodology AMS-I.D, version 05, and the management system were assessed during the site visit.



2.3 Closing out of verification findings

The objective of this phase of the verification was to resolve any issues which needed to be clarified prior to DNV's conclusion that i) the project activity has been implemented and operated in accordance with the registered PDD or any approved revised PDD, ii) the monitoring plan complies with the monitoring methodology and the actual monitoring complies with the monitoring plan and iii) the data and calculation of GHG emission reductions are correct.

A corrective action request (CAR) is issued, where:

- i. Non-conformities with the monitoring plan or methodology are found in monitoring and reporting and has not been sufficiently documented by the project participants, or if the evidence provided to prove conformity is insufficient;
- ii. Modifications to the implementation, operation and monitoring of the registered project activity has not been sufficiently documented by the project participants;
- iii. Mistakes have been made in applying assumptions, data or calculations of emission reductions which will impair the estimate of emission reductions;
- iv. Issues identified in a FAR during validation to be verified during verification have not been resolved by the project participants.

A clarification request (CL) shall be 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 issued for actions if the monitoring and reporting require attention and/or adjustment for the next monitoring period.

The verification identified three CARs, no CL and no FARs. The Project participant addressed the CARs by among others revising the monitoring report (please refer to Appendix A for further details). In addition to the changes made to the monitoring report as a result of the verification findings, the following changes to the monitoring report (version 06 dated 1 April 2014) were made compared to the initial version of the monitoring report received for verification (version 01 dated 15 June 2009):

- The MR template has been changed to the version 03.2
- The MR updated in line with the revised PDD approved on 18 March 2014.
- Project emissions/leakage due to construction activities have been taken into account
- Correction factor has been applied for the delay in calibration of the meters



3 VERIFICATION FINDINGS

This section summarises the findings from the verification of the emission reductions reported for the “Hapugastenne and Hulu Ganga Small Hydropower Projects” for the period 1 January 2007 to 30 September 2008.

3.1 Remaining issues, CARs, FARs from previous validation / verification

According to the validation report /17/ and the previous verifications report /15/, no issues were required to be closed out during the current verification. This has been confirmed by DNV.

3.2 Post registration changes

The post registration changes described in Appendix B were identified by DNV during this verification. These post registration changes were assessed by DNV.

The post registration changes required prior approval by the CDM EB in accordance with Appendix 1 to the CDM Project Standard /20/. The changes obtained approval by the CDM EB prior to the request for issuance for this monitoring period.

The assessment of compliance with the project description and the monitoring plan contained in the PDD, as described in the following sections, is based on the revised PDD (version 04 of 27 November 2013).

3.3 Project implementation

As part of the site visit DNV was able to confirm that the project implementation is in accordance with the project description contained in the PDD (version 04 of 27 November 2013) /16/.

Project component	Implementation in accordance with PDD	Description of how implementation was assessed by verification team
The capacity of the Turbo-generator at Hapugastenne I 5.052 MW (2.526 MW*2)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	The capacity has been verified during the site visit and from the PPA /7/.
The capacity of the Turbo-generator at Hapugastenne II 2.526 MW	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	The capacity has been verified during the site visit and from the PPA /7/.
The capacity of the Turbo-generator at Hulu Ganga I 3 MW (1.5*2)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	The capacity has been verified during the site visit and from the PPA /7/.
The capacity of the Turbo-generator at Hulu Ganga II 2.99 MW (1.495*2)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	The capacity has been verified during the site visit and from the PPA /7/.

As part of the site visit, DNV was able to confirm that the project implementation is in accordance with the project description contained in the revised PDD (version 04 of 27 November 2013) /16/. The verification team confirmed through visual inspection and document review that all physical features of the proposed CDM project activity including data collection systems and storage systems have been implemented in accordance with the



revised PDD (version 04 of 27 November 2013) /16/. DNV confirmed during the on-site visit that the CDM project is completely operational.

The project is a bundle of four small-scale run-of-river hydro power plants in Sri Lanka. The projects are Hapugastenne I&II and Huluganga I&II Mini hydro projects. Electricity generated is supplied to the national grid through Ceylon Electricity Board (CEB) /7/.

The Hapugastenne I&II projects are located in Sabaragamuwa Province, Ratnapura District. Hapugastenne I consist of two units each of 2.526 MW Pelton turbo-generators and the Hapugastenne II has one unit of 2.526 MW Pelton turbo-generator. The Hulu Ganga I&II projects are located near the village of Panwila, north of the town of Kandy. The Hulu Ganga I consist of two units each of 1.5 MW Francis type turbo-generator and Hulu Ganga II consists of two units each of 1.495 MW Francis type turbo-generators /7/. Thus the installed capacity of the project activity is 13.568 MW (5.052+2.526+ 3+2.99 MW).

The projects were commissioned and connected to the CEB grid on the following dates:

Site	Date of Commissioning
Hapugastenne Phase I	14/08/2001
Hapugastenne Phase II	09/09/2002
Hulu Ganga Phase I	03/06/2003
Hulu Ganga Phase II	25/10/2006

The project's emission reductions are determined as the product of the net electricity generated and exported to the grid by the project and the validated *ex-ante* fixed grid emission coefficient of 0.8496 tCO₂/MWh /16/. Thus it has been verified that the implementation is line with the project design indicated in the revised PDD dated 27 November 2013 /16/.

The electricity generated is supplied to national grid of Sri Lanka and the net electricity supplied to the grid by the project activity is measured using bidirectional meters installed at the grid interconnection points. All meters installed at the grid interconnection points are of either 1% or 0.5% accuracy, all of which are used for measuring the electricity exported to and imported from the grid. The electricity meters are locked by the state utility CEB to guarantee the integrity of the instruments. This is in line with the monitoring plan of revised PDD dated 27 November 2013 /16/.

3.4 Information (data and variables) provided in the monitoring report that is different from that stated in the registered PDD

The net electricity generation reported in this monitoring period is 88 647 MWh for the period of 1 January 2007 to 30 September 2008 (i.e. 639 days). This consists of 29 265 MWh from Hapugastenne I, 29 039 MWh from Hapugastenne II and 30 343 MWh from Hulu Ganga I&II. The expected annual generation in the PDD is 58 611 MWh, which corresponds to 102 609 MWh in 639 days that constitutes the monitoring period. Hence, actual generation is considerably lower than expected. The variation is due to the lower PLF achieved during the verification period due to lesser water availability in the rivers for power generation.

As a result of lower electricity generation, actual emission reductions are also lower than the emission reductions estimated in the PDD.



3.5 Compliance of monitoring plan with monitoring methodology

DNV is able to confirm that the monitoring plan contained in the revised PDD (version 04 of 27 November 2013) is in accordance with the approved methodology applied by the project activity, i.e. AMS-I.D (version 05).

3.6 Compliance of monitoring with the monitoring plan

The monitoring has been carried out in accordance with the monitoring plan contained in the PDD of 27 November 2013 /16/. All parameters stated in the validated monitoring plan are monitored and reported appropriately. The monitoring report lists each parameter required by the monitoring plan and the information flow (i.e. from data generation, aggregation, to recording, calculation and reporting) for these parameters is provided in the monitoring report. The information flow for the each parameter is further verified in the following sections..

3.6.1 Monitoring parameters

According to the monitoring plan of the revised PDD /16/, there are 3 parameters to be monitored:

- Hapugastenne Phase I project net electricity output (H1-mmyy-kWh)
- Hapugastenne Phase II project net electricity output (H2-mmyy-kWh)
- Hulu Ganga Phase I and Hulu Ganga Phase II project net electricity output (HG1-mmyy-kWh) and (HG2-mmyy-kWh)

Since the emission factor of the national grid of Sri Lanka has been fixed *ex-ante*, monitoring of the emission factor is not necessary.

The below tables describe for each parameter, which is to be measured according to the monitoring plan, how DNV has verified that i) the actual monitoring complies with the monitoring plan and that ii) data have been assessed to correctly support the emission reductions being claimed.

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	Hapugastenne Phase I project net electricity output (H1-mmyy-kWh)
Measuring frequency:	Continuous
Reporting frequency:	Monthly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment:	Bi-directional electricity meter.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	The monitoring plan does not indicate the accuracy of the meters /16/. However the meters installed in the project activity are of accuracy 1% and 0.5% /3/. The meters are installed and maintained by CEB and represents the good practice in the region and thereby complying with the requirements of CEB.



Is the accuracy valid for the entire measuring range or do different accuracy levels apply to different measuring ranges?	Yes, the accuracy is valid for the entire measuring range.		
Calibration frequency /interval:	Annual		
Is the calibration interval in line with the monitoring plan and/or methodology? If the monitoring plan does not specify the frequency of calibration, is the selected frequency in accordance with the local/national standards, or as per the manufacturer's specifications	As per the monitoring plan, the meters installed as part of the project activity will be calibrated annually. The details of calibration /3/ are given below:		
	Meter and Accuracy	Calibrated on	Valid Till
	Meter – 0.5% Serial number 81394347	9 May 2006	8 May 2007
		21 September 2007	20 September 2008
	Meter - 1% Serial Number: 207501155	05 January 2008	4 January 2009
		6 November 2008	5 November 2009
Meter with serial number 207501155 is online from 5 January 2008. Calibration was delayed during 9 May 2007 to 20 September 2007. Since the subsequent calibration shows that the error of the meter was within limits, maximum permissible error of the meter was applied on the measured values for the period of May 2007 to September 2007. This is in compliance with the guidelines of VVS /19/.			
Is the calibration of measuring equipment carried out by an accredited person or institution?	The calibration was done by the state utility CEB /3/.		
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. Calibration confirmed functioning of the meter within the specified accuracy range.		
Is(are) calibration(s) valid for the whole reporting period?	Yes		
If applicable, has the reported data been cross-checked with other available data?	Yes, the reported data has been cross checked with the monthly invoices raised by the project developer on CEB /5/ and the monthly bill for imports /6/.		
Is the calibration carried out for a measuring range comparable with the range for which measurements have been carried out?	Yes /3/.		
How were the values in the monitoring report verified?	The values were verified from the monthly bills of import issued by CEB /6/ and the monthly meter reading statements /4/.		
Does the data management ensure correct	Yes		



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transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Not applicable

	Assessment/ Observation		
Data / Parameter: (as in monitoring plan):	Hapugastenne Phase II project net electricity output (H2-mmyy-kWh)		
Measuring frequency:	Continuous		
Reporting frequency:	Monthly		
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes		
Type of monitoring equipment:	Bi-directional electricity meter.		
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer’s specification?	The monitoring plan does not indicate the accuracy of the meters /16/. However the meters installed in the project activity are of accuracy 1% and 0.5% /3/. The meters are installed and maintained by CEB and represents the good practice in the region and thereby complying with the requirements of CEB.		
Is the accuracy valid for the entire measuring range or do different accuracy levels apply to different measuring ranges?	Yes, the accuracy is valid for the entire measuring range.		
Calibration frequency /interval:	Annual		
Is the calibration interval in line with the monitoring plan and/or methodology? If the monitoring plan does not specify the frequency of calibration, is the selected frequency in accordance with the local/national standards, or as per the manufacturer’s specifications	As per the monitoring plan, the meters installed as part of the project activity will be calibrated annually. The details of calibration /3/ are given below:		
	Meter and Accuracy	Calibrated on	Valid Till
	Meter – 0.5% Serial Number: 81394360	9 May 2006	8 May 2007
		21 September 2007	20 September 2008
		3 June 2009	2 June 2010
	Meter - 1% Serial Number: 207501184	05 January 2008	4 January 2009
		6 November 2008	5 November 2009
Meter with serial number 207501155 is online from 5 January 2008. Both the old and new			



	meter were calibrated on 5 January 2008. Calibration was delayed during 9 May 2007 to 20 September 2007. Since the subsequent calibration shows that the error of the meter was within limits, maximum permissible error of the meter was applied on the measured values for the period of May 2007 to September 2007. This is in compliance with the guidelines of VVS /19/.
Is the calibration of measuring equipment carried out by an accredited person or institution?	The calibration was done by the state utility CEB /3/.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
Is(are) calibration(s) valid for the whole reporting period?	No, correction factor was applied for the period of delay, as stated above.
If applicable, has the reported data been cross-checked with other available data?	Yes, the reported data has been cross checked with the monthly invoices raised by the project developer on CEB /5/ and the monthly bill for imports /6/.
Is the calibration carried out for a measuring range comparable with the range for which measurements have been carried out?	Yes /3/.
How were the values in the monitoring report verified?	The values were verified from the monthly bills of import issued by CEB /6/ and monthly meter reading statements /4/.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Until April 2009 CEB did not issue monthly bills for the imported electricity regularly. For Hapugastenne Phase II, the import readings for the months of July and August 2008 were issued together through the bill dated 30 August 2008. The project participant has used a value of 356 kWh (monthly average electricity imported for the months of July and August 2008). Further, the monthly bills for electricity import for a period of January 2007 to June 2008 have not been issued by CEB. Hence PP has used a value of 2 254 kWh conservatively as quantity of electricity imported every month for the period of January 2007 to June 2008, which is the highest monthly consumption of



	Hapugastenne II during the period 2007-2012. Further, 10% correction factor was added for the months where monthly import bills were not provided by CEB. The estimation is in accordance with post registration changes approved on 18 March 2014 /18/.
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	Assessment/ Observation															
Data / Parameter: (as in monitoring plan):	Hulu Ganga Phase I and Hulu Ganga Phase II project net electricity output (HG1-mmyy-kWh) and (HG2-mmyy-kWh)															
Measuring frequency:	Continuous															
Reporting frequency:	Monthly															
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes															
Type of monitoring equipment:	Bi-directional electricity meter.															
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	The monitoring plan does not indicate the accuracy of the meters /16/. However the meters installed in the project activity are of accuracy 2% and 1% /3/. The meters are installed and maintained by CEB and represents the good practice in the region and thereby complying with the requirements of CEB.															
Is the accuracy valid for the entire measuring range or do different accuracy levels apply to different measuring ranges?	Yes, the accuracy is valid for the entire measuring range															
Calibration frequency /interval:	Annual															
Is the calibration interval in line with the monitoring plan and/or methodology? If the monitoring plan does not specify the frequency of calibration, is the selected frequency in accordance with the local/national standards, or as per the manufacturer's specifications	<p>As per the revised PDD, the meters installed as part of the project activity will be calibrated annually. The details of calibration /3/ are given below:</p> <table><tr><td>Meter and Accuracy</td><td>Calibrated on</td><td>Valid Till</td></tr><tr><td>Meter - 2%</td><td>26 April 2006</td><td>25 April 2007</td></tr><tr><td>Serial Number: 59801518</td><td>1 March 2007</td><td>29 February 2008</td></tr><tr><td>Meter - 1%</td><td>27 November 2008</td><td>26 November 2009</td></tr><tr><td>Serial Number: 9200208</td><td></td><td></td></tr></table> <p>Meter with serial number 9200208 is online from 27 November 2008. Calibration was delayed during 1 March 2008 to 27 November 2008. Since the subsequent calibration shows that the error of the meter was within limits, maximum permissible error of the</p>	Meter and Accuracy	Calibrated on	Valid Till	Meter - 2%	26 April 2006	25 April 2007	Serial Number: 59801518	1 March 2007	29 February 2008	Meter - 1%	27 November 2008	26 November 2009	Serial Number: 9200208		
Meter and Accuracy	Calibrated on	Valid Till														
Meter - 2%	26 April 2006	25 April 2007														
Serial Number: 59801518	1 March 2007	29 February 2008														
Meter - 1%	27 November 2008	26 November 2009														
Serial Number: 9200208																



	meter was applied on the measured values for the period of March 2008 to November 2008. This is in compliance with the guidelines of VVS /19/.
Is the calibration of measuring equipment carried out by an accredited person or institution?	The calibration was done by the state utility CEB /3/.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
Is(are) calibration(s) valid for the whole reporting period?	No, correction factor was applied for the period of delay, as stated above.
If applicable, has the reported data been cross-checked with other available data?	Yes, the reported data has been cross checked with the monthly invoices raised by the project developer on CEB /5/ and the monthly bill for imports /6/.
Is the calibration carried out for a measuring range comparable with the range for which measurements have been carried out?	Yes /3/.
How were the values in the monitoring report verified?	The values were verified from the monthly bills of import issued by CEB /6/ and the monthly meter reading statements /4/.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	<p>Until April 2009 CEB did not issue monthly bills for the imported electricity regularly.</p> <p>For Hulu Ganga I & II, the monthly import readings for the period from February 2007 to September 2008 have been sourced from the letter issued by CEB dated 26 June 2009 /14/. The total consumption of 19 560 kWh during this period was apportioned by CEB for each of the months. The monthly bill for electricity import was not issued by CEB for the month of January 2007. Hence PP has used a value of 4 917 kWh for the month of January 2007, which is the highest monthly consumption of Hulu Ganga I&II during 2007-2012. Further, 10% correction factor was added for the months where monthly import bills were not provided by CEB. The estimation is in accordance with post registration changes approved by EB on 18 March 2014 /18/.</p>



Calibration records /3/ have been provided to the verification team. DNV can confirm that the meters were calibrated covering this monitoring period as per the monitoring plan.

As per the Appendix 5 of the revised PDD of version 04 of 27 November 2013 /16/ the following project social benefit indicators are also monitored

- Project employment benefits at Hapugastenne I&II and Hulu Ganga I&II mini hydro power projects.
- Community development project financing at Hapugastenne I&II and Hulu Ganga I&II mini hydro power projects.

Under the project social benefit indicators, the total short and long-term employment positions created and project sponsor financial contributions to local development projects are being monitored and have been evidenced by DNV during the site visit /12/.

The project participant also monitors environmental parameters such as surface water phosphates, total inorganic nitrogen, BOD and COD levels; flora and fauna; river bank erosion and sediment deposits at the project sites. The monitoring of these parameters have been evidenced by DNV during the site visit /8//9//10//11/.

3.7 Assessment of data and calculation of emission reductions

DNV confirms that appropriate methods and formulae for calculating baseline emissions, project emissions and leakage have been followed, and the assumptions, emission factors and default values that are applied in the calculation have been justified.

As stated in the section 1.4, the emission reductions ER_y by the project activity during the monitoring period is the difference between the baseline emission, project emissions or leakage.

$$ER_y = BE_y - PE_y - L_y$$

3.7.1 Baseline emissions

Baseline emissions (BE_y in tCO_2) are the product of the baseline emission factor (EF_y in tCO_2/MWh) times the net electricity supplied by the project activity to the grid (EG_y in MWh).

EF_y is emission factor of the grid, which was calculated *ex-ante* and will not be updated during the crediting period. EF_y of the proposed project in the PDD is $0.8496 tCO_2/MWh$ /16/, which has been verified by DNV to be correct based on the availability of grid data.

EG_y is the net electricity generation supplied to the grid, which is determined by the electricity supplied to the grid minus the imported electricity from the grid. The electricity exported to and imported from the grid was derived from the main meters in the period 1 January 2007 to 30 September 2008, which was verified by DNV and cross-checked with the invoices raised for sale of power /5/.

$$BE_y = EF_y * EG_y = 75\,313 tCO_2e$$

3.7.2 Project emissions

The project emissions are regarded as zero according to the methodology AMS-I.D ver 5.

However, the PDD indicates that the project emissions accrued during the site preparation and construction stage of the project will be deducted during the first verification of the project



activity. Since these emissions were not accounted in earlier verifications /15/, DNV raised a CAR and the project emissions related to site preparation and construction have been deducted in this monitoring period. As per the PDD, it was estimated that the site preparation and construction activities contribute to 298.7 tonnes of CO₂ equivalent. These emissions have not been deducted during first three monitoring periods. The Hulu Ganga Phase II plant was commissioned 25 October 2006, after completion of validation of the project activity. The Hapugastenne I& II and Hulu Ganga Phase I was commissioned before the validation. It has been verified that the estimation of the project emissions for site preparation and construction has been added as part of response to the finding issued during validation. The closing of the validation finding indicates that the project emission estimate for the Hapugastenne I & II plants has been assessed to be 160.7 tCO₂e, Hulu Ganga I as 67.8 tCO₂e and Hulu Ganga II as 70.2 tCO₂e and the same has been included in the PDD. Since Hulu Ganga II was commissioned after the validation, DNV verified the details of material transported for the site preparation and construction of the Hulu Ganga II and the diesel consumption for the transportation has been certified by Square Mech Engineering (Pvt) Ltd, in its letter dated 23 July 2013 /13/. It has been verified that the diesel consumption for site preparation and transportation of material for construction was 26 203 litres, same quantity estimated in the PDD. Thus emissions due to construction activities of Hulu Ganga II (70.2 tCO₂e) and the total of 298.7 tCO₂e is same as the details have been included in the PDD.

DNV verified the calculations and the data used and confirm the same to be in order.

3.7.3 Leakage

There are no leakages that need to be considered in applying the methodology AMS-I.D ver 5.

3.7.4 Emission reductions

Therefore, the emission reductions in this monitoring period are:

$$ER_y = BE_y - PE_y - L_y = 75\,313 - 299 - 0 = 75\,014 \text{ tCO}_2\text{e (rounded down)}$$

The yearly expected emission reductions in the revised PDD /16/ are 49 796 tonnes of CO₂ equivalents, which correspond to the emission reductions of 87 177 tonnes of CO₂ equivalents in 639 days for the verification period, the reported emission reductions are considerably lower than the expected (ref section 3.4).

As outlined above, the input data for calculating the emission reductions, the calculating process and the result are complete and transparent. Therefore, DNV is able to confirm the accuracy of the emission reductions.

3.8 Quality of evidence to determine emission reductions

DNV confirms that a complete set of data for this monitoring period was available to be verified and was in accordance with the PDD.

All necessary documentation were collected, referenced and aggregated and were easily accessible in hard-copy and electronic format. Measurements are performed by calibrated equipment, and the key data were cross-checked via other sources /5//6/. No assumptions are used that have any material influence on reported emission reductions.

3.9 Management system and quality assurance

Eco Power (Private) Limited. is responsible for the operation and maintenance of the project, the monitoring equipments and data collection. The management system and the data storage for the project has been verified to be in place by DNV on site. The organization structure



with the responsibilities, personnel competencies, monitoring procedure and monitoring management have been properly identified and put into operation.

DNV confirms that the responsibilities and authorities in the management and operational system for monitoring and reporting are in accordance with the responsibilities and authorities stated in the PDD and monitoring plan /16/.



4 CERTIFICATION STATEMENT

DNV Climate Change Services AS (DNV) has performed the verification of the emission reductions that have been reported for the CDM project activity 0085 “Hapugastenne and Hulu Ganga Small Hydropower Projects” in Sri Lanka for the period 1 January 2007 to 30 September 2008.

The project participants are responsible for the collection of data in accordance with the monitoring plan and the reporting of GHG emissions reductions from the project activity.

It is DNV’s responsibility to express an independent verification statement on the reported GHG emission reductions from the project activity. DNV does not express any opinion on the selected baseline scenario for the project activity.

DNV conducted the verification on the basis of the baseline and monitoring methodology AMS-I.D (version 05), the monitoring plan contained in the PDD (version 04 of 27 November 2013) and the monitoring report (version 06) dated 1 April 2014. The verification included i) checking whether the provisions of the monitoring methodology and the monitoring plan were consistently and appropriately applied and ii) the collection of evidence supporting the reported data.

DNV’s verification approach draws on an understanding of the risks associated with reporting of GHG emission data and the controls in place to mitigate these. DNV planned and performed the verification by obtaining evidence and other information and explanations that DNV considers necessary to give reasonable assurance that reported GHG emission reductions are fairly stated.

In our opinion the GHG emissions reductions reported for the project activity for the period 1 January 2007 to 30 September 2008 are fairly stated in the monitoring report (version 06) dated 1 April 2014.

The GHG emission reductions were calculated correctly on the basis of the approved baseline and monitoring methodology AMS-I.D (version 05) and the monitoring plan contained in the PDD (version 04 of 27 November 2013).

DNV Climate Change Services AS is able to certify that the emission reductions from the CDM project activity 0085 “Hapugastenne and Hulu Ganga Small Hydropower Projects” in Sri Lanka during the period 1 January 2007 to 30 September 2008 amount to 75 014 tonnes of CO₂ equivalent.

Bangalore and Oslo, 22 April 2014

Ravi Kumar Prabhu
Verifier
DNV India, Bangalore

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



5 REFERENCES

Documentation provided by the project participants

- /1/ C-Quest Capital, LLC: *CDM monitoring report for project activity 0085 "Hapugastenne and Hulu Ganga Small Hydropower Projects" for the monitoring period 1 January 2007 to 30 September 2008*, Version 01 dated 15 June 2009, version 02 dated 19 December 2009 and version 06 dated 1 April 2014.
- /2/ C-Quest Capital, LLC: Emission reduction calculations Version 01 dated 15 June 2009 and version 06 dated 1 April 2014.
- /3/ CEB: Calibration certificates of the Hapugastenne I & Hapugastenne II done on 9 May 2006, 21 September 2007, 5 January 2008 and 6 November 2008; certificates of the Hulu Ganga I&II done on 26 April 2006, 1 March 2007 and 27 November 2008.
- /4/ CEB: Monthly meter reading reports of Hapugastenne I & Hapugastenne II and Hulu Ganga I&II for the verification period 1 January 2007 to 30 September 2008
- /5/ EPL: Records of Invoices raised by the project participant for the sale of power of both Hapugastenne I & Hapugastenne II and Hulu Ganga I&II covering the current monitoring period 1 January 2007 to 30 September 2008
- /6/ CEB : Monthly bills of electricity exported and consumed (imported) in the plants Hapugastenne I & Hapugastenne II and Hulu Ganga I&II covering the current monitoring period 1 January 2007 to 30 September 2008
- /7/ EPL: Power Purchase Agreement dated 24 April 2001 for Hapugastenne I & Hapugastenne II and Hulu Ganga I&II
- /8/ EPL: River bank erosion and sedimentation records done by plant operating personnel.
- /9/ Devaka K Weerakoon: Ecological Flora and Fauna monitoring report "Consultancy Services Report on the Post Construction Monitoring of 6 Mini hydro Projects Operated by Eco Power Pvt Ltd." April 2009.
- /10/ EPL: Reports of Surface water analysis for BOD and COD done by National Technology Institute (NTI), August 2008 and September 2009.
- /11/ EPL: Reports of Surface Water nutrient levels done by National Technology Institute (NTI), August 2008 and September 2009.
- /12/ EPL: Employment registers at site and receipts of expenditure made towards community development dated 29 March 2007, 15 August 2007, 16 August 2007, 3 December 2007, 13 March 2008, 15 May 2007, 19 September 2007 and 9 October 2008 for Hapugastenne I & Hapugastenne II; 30 April 2007, 29 May 2008, 11 August 2008 and 24 November 2008 for Hulu Ganga I&II.
- /13/ Squire Mech Engineering (Pvt) Ltd: Letter indicating the details of material and transportation for the site preparation and construction of the Hulu Ganga plant, dated 23 July 2013.
- /14/ CEB: The consolidated import monthly readings for the period from February 2007 to September 2008 of Hulu Ganga I&II, letter dated 26 June 2009.

**Other project documents or documents used by DNV to verify the information provided by the project participants**

- /15/ DNV Climate Change Services AS: Previous *Verification / Certification report for project activity, no. 2007-9001/1, rev 01B*.
- /16/ EPL: *CDM-PDD for project activity "Hapugastenne and Hulu Ganga Small Hydropower Projects*, version 3 dated 27 November 2013
- /17/ SGS: Validation Report No. CDM Val 0023
- /18/ DNV: Validation opinion on the revised PDD and Post registration changes, dated 27 November 2013 approved on 18 March 2014.

Methodologies, tools and other guidance by the CDM Executive Board

- /19/ CDM Executive Board: *Clean Development Mechanism Validation and Verification Standard*, version 05.0
- /20/ CDM Executive Board: *Clean Development Mechanism Project Standard*, version 05
- /21/ CDM Executive Board: *Clean Development Mechanism Project Cycle Procedure*, version 05.0
- /22/ CDM Executive Board: *Baseline and monitoring methodology AMS-I.D ver 5*

Persons interviewed during the verification

- /23/ Dr. Romesh Dias Bandarnaike, Chief Executive Officer, Eco Power (Private) Limited.
- /24/ Mr. Meneka Kithsiri Seneviratne Operations Engineer, Eco Power (Private) Limited.
- /25/ Mr. Lionel, Operation Manager, Eco Power (Private) Limited.

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APPENDIX A

CORRECTIVE ACTION REQUESTS, CLARIFICATION REQUESTS AND FORWARD ACTION REQUESTS

Corrective action requests

CAR ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CAR 1	The Monitoring period indicated in the web hosted monitoring report is up to 31 August 2008, while the table indicates the values of September 2008 also. The date in the monitoring period in the report needs to be corrected.	The revised monitoring report as per VVS template has been submitted to DoE.	Accepted based on the documents provided and the revised monitoring report /1/. DNV confirms that in the revised monitoring report the data are consistent. The CAR is closed.
CAR 2	As per the registered PDD, the parameters to be monitored are the electricity output supplied to the grid. The initial monitoring report only considers the export to the grid as the net electricity. The net electricity has to be calculated as the difference of the electricity exported and the electricity imported from the grid.	The revised monitoring report as per VVS template has been submitted to DoE.	Accepted based on the documents provided and the revised monitoring report /1/. Further, electricity imports have been adjusted as per the Post registration changes approved by EB on 18 March 2014 /2//18/. The CAR is closed.
CAR 3	As per the registered PDD, meter for measuring the electricity supplied to the grid needs to be calibrated annually. The gap in the calibration period needs to be substantiated with required documents.	There is a gap between calibration periods of four months in two of the meters and a gap of eight months in the third meter. All the meters are under the purview of CEB and request for calibration has been submitted to CEB in time. The maximum permissible error of the meters has been applied on the measured values and the revised MR and emission reduction sheet have been submitted to DoE.	DNV checked and confirms that the maximum permissible error of the meters has been applied on the measured values through out the period for which there is delay in calibration. This is in compliance with VVS /19/. Thus accepted. The CAR is Closed.

Clarification requests

CL ID	Clarification request	Response by Project Participants	DNV's assessment of response by Project Participants
	No CL was issued		

Forward action requests from previous verification

FAR ID	Forward action request	Summary of how FAR has been addressed in this reporting period	Assessment of how FAR has been addressed
	No FAR was raised		

Forward action requests from this verification

FAR ID	Forward action request	Response by Project Participants
	No FAR raised	

APPENDIX B

POST REGISTRATION CHANGES

Type of post registration change	Description of post registration change*	Is prior approval by CDM EB required**?	In case prior approval by CDM EB is required, when was post registration change approved?
Corrections	<p>Three corrections have been done in the registered PDD and the corrected details have been included revised PDD version 04 dated 27 November 2013 approved by EB on 18 March 2014 /18/. The details of the corrections in the registered PDD are as follows:</p> <p>a. Under Table 1, section A.4.3 and E.1.2.5, the registered PDD was indicating the estimated emission reductions as per the capacity of 13.15 MW. The revised PDD, version 04 dated 27 November 2013 has included the actual capacity of the project activity and related emissions estimate.</p> <p>b. Under section D.3 of the registered PDD no procedures for quality assurance and quality control was included and the same has been included in the revised PDD, version 04 dated 27 November 2013.</p> <p>The Annex 1 of the registered PDD has been corrected to reflect the actual details of the contact persons for the project activity as per the latest modalities of communication available in the project interface. Also, the details under section B.5.3 of the registered PDD indicating the contact persons of the entity working out the baseline have been removed.</p> <p>c. Under section E.1.2.1 of the registered PDD, the equations for calculating the emission reductions related to transportation and small engine related emissions have been corrected.</p> <p>d. The revised PDD, version 4 dated 27 November 2013 has included the actual construction related emissions under section B.6.3, which is same as the 298.7 tCO₂ indicated in the registered PDD.</p>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable	<p>The revised PDD version 04 dated 27 November 2013 and the post registration changes were approved by EB on 18 March 2014 /18/.</p>
Temporary deviations from the registered monitoring plan and/or monitoring methodology (Applicable for the period of 1 January 2007 and 30 April 2009)	<p>CEB did not issue the readings of electricity imported through the meters of Hapugastenne II and Hulluganga I & II at monthly intervals as indicated in the monitoring plan until May 2009. For Hapugastenne Phase II, the import readings for the months of July and August 2008 were issued together through the bill dated 30 August 2008. The project participant has used a value of 356 kWh (monthly average electricity imported for the months of July and August 2008). Further, the monthly bills for electricity import for a period of January 2007 to June 2008 have not been issued by CEB. Hence PP has used a value of 2 254 kWh conservatively as quantity of electricity imported every month for the</p>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable	<p>The revised PDD version 04 dated 27 November 2013 and the post registration changes were approved by EB on 18 March 2014 /18/.</p>

Type of post registration change	Description of post registration change*	Is prior approval by CDM EB required**?	In case prior approval by CDM EB is required, when was post registration change approved?
	<p>period of January 2007 to June 2008, which is the highest monthly consumption of Hapugastenne II during the period 2007-2012.</p> <p>For Hulu Ganga I & II, the monthly import readings for the period from February 2007 to September 2008 have been sourced from the letter issued by CEB dated 26 June 2009 /14/. The total consumption of 19 560 kWh during this period was apportioned by CEB for each of the months. The monthly bill for electricity import was not issued by CEB for the month of January 2007. Hence PP has used a value of 4 917 kWh for the month of January 2007, which is the highest monthly consumption of Hulu Ganga I&II during 2007-2012.</p> <p>Further, 10% correction factor was added for the months where monthly import bills were not provided by CEB.</p>		
Permanent changes from the registered monitoring plan or applied methodology	<p>As per the monitoring plan in the registered PDD, the electricity output from Hapugastenne phase I, Hapugastenne Phase II, Hulu Ganga I and Hulu Ganga II need to be monitored through 4 individual meters. At the time of project commissioning, Ceylon electricity board decided that the Hullu Ganga I and Hullu Ganga II plants being located next to each other can be considered as a single plant complex, and hence only one meter was installed.</p> <p>Thus, there are only three meters installed to measure the electricity supplied to the grid from the project activity. DNV could check and confirm that the meters are installed and operated by the CEB and the PP does not have any control on the installation and operation of the meters and it could also be verified that the changes in the monitoring plan can be categorised under clause 5 of the Appendix 1 of CDM Project Standard.</p>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable	The revised PDD version 04dated 27 November 2013 and the post registration changes were approved by EB on 18 March 2014 /18/.
Changes to the project design of a registered project activity	<p>As per the registered PDD, the rated capacities of the Hapugastenne phase I and II turbines is 2.4 MW each and rated capacity of Hulu Ganga phase II is 2.95 MW. But as evidenced during the verification site visit and also as reported in the first verification report, in Hapugastenne phase I & II the installed turbines are of 2.526 MW capacity each and in Hullu Ganga phase II the installed capacity is 2.99 MW. The details of the actual</p>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable	The revised PDD version 04 dated 27 November 2013 and the post registration changes were approved by EB on 18 March 2014 /18/.

Type of post registration change	Description of post registration change*			Is prior approval by CDM EB required**?	In case prior approval by CDM EB is required, when was post registration change approved?
	installed capacities and the capacities in the registered PDD are indicated below:				
	Power Plant	Capacity indicated in the registered PDD (MW)	Actual installed capacity (MW)		
	Hapugattenne I	4.8	5.052		
	Hapugastenne II	2.4	2.526		
	Hulu Ganga I	3.0	3.000		
	Hulu Ganga II	2.95	2.990		
	Total capacity	13.15	13.568		

* For further details refer to the “Post-registration changes request form” (F-CDM-PRC) and DNV’s assessment opinion on the changes

** Refer to Appendix 1 Appendix 1 to the CDM Project Standard /21/

APPENDIX C

CURRICULA VITAE OF THE VERIFICATION TEAM MEMBERS

Murali Govindarajulu holds a Bachelor's Degree in Chemical Engineering and has done a Short term diploma course in Management. Having an overall experience of around thirteen years. Prior to joining DNV having around seven years experience in Chemical process industry covering production, energy efficiency improvement and erection and commissioning of projects in the plant. His experience also covers the fields of environmental management and resource conservation including identification of alternative fuels. He has also been actively involved in implementation of Management Systems such as ISO 14001 and OHSAS 18001 standards in chemical process industry for more than three years.

He has experience of around 6 years in validation and verification of numerous CDM projects in DNV, both in India & abroad. He has completed national training on "Wind Energy Technology" conducted by Center for Wind Energy Technology, Ministry of New and Renewable Energy. His qualification, industrial experience and experience in CDM demonstrate his sufficient sectoral competence in energy generation from renewable energy sources.

Mr.Astakala Vidyacharan 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 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."

Mr.Kakaraparthi Venkata Raman holds a bachelor degree (B.Tech) in Chemical Engineering and a Diploma in Management. He has an overall experience of 18 years in the Chemical Process Industry - Fertilisers and Chemicals industry (FACT). His main areas of work include a) Technical Services (for Ammonia, Urea, Co-generation thermal power plants (captive), and complex fertilizers plants)- 10 years b) Erection, commissioning and hands-on operation of state of art HTAS Ammonia plant - 4 years c) Management and operation of Sulphuric acid plant as Plant Manager- 2 years and d) two years in management Information System operation and assisting of top management in planning of operations.. While in FACT he has completed the ISO14001 EMS LA course and also involved in implementation of Environmental Management Systems and in conducting internal audits. Experience prior to joining Fertiliser industry include six months experimental work on charcoal manufacture in Karnataka Regional Engineering college.

He has experience of around 5 years in validation and verification of numerous CDM projects. His qualification, industrial experience and experience in CDM demonstrate him sufficient sectoral competence in areas of (a) 1.1 Thermal energy generation from fossil fuels and Biomass as well as thermal electricity from solar (b) 1.2 Energy Generation from renewable energy sources (c) 5.1/4.13/11.1/12.1 Chemical Processes Industries and (d) 13.1 Waste handling and disposal.

Ricardo Díaz, holds a Bachelor's Degree in Mechanical Engineering and has done a Energy Savings Systmes Master Degree and a Business Administration Master Degree. Having an overall experience of around 10 years. Prior to joining DNV having 8.5 years experience in Power generation facilities (thermo power plants, wind and hydro power plants, energy efficiency process and energy demand. Responsible for operation, maintenance, project management and evaluation for energy facilities (fossil fuel and renewable sources) as well as energy efficiency improves. In addition, experience with limited scope to operation and maintenance duty for hospitality facilies and water treatment process. He has experience of around 1.5 years in validation and verification of numerous CDM projects. His qualification, industrial experience and experience in CDM demonstrate him sufficient sectoral competence in 1.1 Thermal energy generation from fossil fuels as well as thermal electricity from solar 1.2 Energy Generation from renewable energy sources and 3.1 Energy demand

Seshan Ranganathan, holds a Bachelor's Degree in Chemical Engineering and has done diploma course in Management and completed the graduate ship course in Industrial Engineering and has an overall working experience of around twenty nine years. Prior to joining DNV has around twenty four years experience in Chemical process industry (fertilizer & petrochemical manufacturing) covering production, technical services including energy audits and efficiency studies, waste heat recovery, efficiency studies of boilers ,power plants , safety audits and pollution control activities including waste water treatment, project management, corporate planning, sales, logistics in fertilizer & petrochemical industry . With respect to the thermal power plant the job assignment included the monitoring of flue gas exit temperatures, excess air used efficiency of fuel additives, condition of boiler refractory, insulation of steam lines etc. The experience also includes 5 years in process design & engineering for chemical process industry. He is qualified validator and verifier for CDM projects. He has completed the EMS lead auditor course. His qualification, industrial experience and experience in CDM demonstrate his sufficient sectoral competence in areas of (a) 1.1 Thermal energy generation from fossil fuels and Biomass including thermal electricity from solar (b) 1.2 Energy generation from renewable energy sources (c) 2.2 Heat distribution (d) 5.1/11.1/12.1 Chemical Processes Industries and (e) 13.1 Waste handling and disposal.

Ravi Kumar Prabhu holds Bachelor's Degree in Chemical Engineering and has done Post Graduate Diploma course in Management and has an overall working experience of around twenty five years. Prior to joining DNV has around twenty three years of experience in Chemical process industry (fertilizer & petrochemical manufacturing) covering production, technical services including energy audits and efficiency studies, waste heat recovery, efficiency studies of boilers, power plants, safety audits, pollution control activities and waste water treatment. With respect to the Thermal Power Plant, the job assignment included the monitoring of flue gas stack temperatures and excess air, efffiacy of fuel additives, condition of boiler refractory and insulation of steam lines, residual life assessment of boilers etc. His experience also includes 7 years in the Process design of fertilizer & petrochemical plants, wherein he was involved in the development of process flow diagrams, development of P&IDs, equipment design, HAZOP studies, procurement and commissioning activities. He has over five years of experience in validation and verification of CDM projects in DNV and is also an EMS lead auditor. His qualification, industrial experience and experience in CDM projects demonstrate sufficient sectoral competence in Chemical Process Industries (TA 5.1), Thermal Energy Generation from fossil fuels (TA1.1), Heat distribution (TA 2.2), Energy

generation from Renewable Energy sources (TA 1.2) and Waste handling and disposal (TA 13.1).

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