VERIFICATION / CERTIFICATION REPORT

PAKARAB FERTILISER CO-GENERATION POWER PROJECT IN PAKISTAN

(UNFCCC Registration Ref. No.2687)

Monitoring Period:
1 June 2010 to 31 December 2010

REPORT NO. 2011- 1003

REVISION NO. 02

DET NORSKE VERITAS

VERIFICATION / CERTIFICATION REPORT

Date of first issue: 2011-07-15	Project No.: PRJC-283537-2010-CCS-NOR
Approved by: Ole A. Flagstad	Organisational unit: Accredited Climate Change Services
Client: Pakarab Fertiliser Limited	Client ref.: Mr. Mati-ur-Rab

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Summary:

DNV Climate Change Services AS (DNV) has performed the verification of the emission reductions reported for the "Pakarab Fertiliser Co-generation Power Project " in Pakistan (UNFCCC Registration Ref. No. 2687) for the period 1 June 2010 to 31 December 2010.

In our opinion, the emission reductions for the period from 1 June 2010 to 31 December 2010, as reported in the monitoring report, version 5 of 28 January 2013, are fairly stated.

The GHG emission reductions were calculated correctly on the basis of the approved monitoring methodology AM0014 (version 04) and the monitoring plan contained in the revised Project Design Document of 13 July 2012, which was approved on 29 August 2012.

Hence, DNV Climate Change Services AS is able to certify that the emission reductions from the "Pakarab Fertiliser Co-generation Power Project " during the period 1 June 2010 to 31 December 2010 amount to 34 119 tonnes of CO_2 equivalents.

Report No.: 2011-1003	Subject Group: Environment	
Report title: Pakarab Fertiliser Co-generation Power Project in Pakistan		
Work carried out by: Akira Sekine, Lumír Nemecek, Astakala Vidyacharan		
Work verified by: Murali Govindarajulu, Kakaraparthi Venkata Raman		
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Indexing terms

Key words Climate Change Kyoto Protocol Validation Clean Development Mechanism	Service Area Verification Market Sector Process Industry

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Abbreviations

CAR	Corrective Action Request
CDM	Clean Development Mechanism
CEF	Carbon Emission Factor
CER	Certified Emission Reduction(s)
CH_4	Methane
CL	Clarification request
CO_2	Carbon dioxide
CO_{2e}	Carbon dioxide equivalent
DNV	Det Norske Veritas Climate Change Services AS.
DNA	Designated National Authority
FAR	Forward Action Request
GHG	Greenhouse gas(es)
GTG	Gas Turbine Generator(s)
HRSG	Heat Recovery Steam Generator(s)
IPCC	Intergovernmental Panel on Climate Change
MP	Monitoring Plan
N_2O	Nitrous oxide
PDD	Project Design Document
PFL	Pakarab Fertiliser Limited
PS	CDM Project standard
UNFCCC	United Nations Framework Convention on Climate Change
GWP	Global Warming Potential
VVS	CDM Validation and Verification Standard

1 INTRODUCTION

DNV Climate Change Services AS (DNV) has been contracted by Pakarab Fertilizer Limited to carry out verification and certification of the emission reductions reported for the "Pakarab Fertiliser Co-generation Power Project " (hereafter the project) for the period 1 June 2010 to 31 December 2010. This report contains the findings from this verification assignment 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 "Pakarab Fertiliser Co-generation Power Project " for the period 1 June 2010 to 31 December 2010.

1.2 Scope

The verification scope is to verify that :

- The project activity has been implemented and operated in accordance with the registered PDD and any approved revised 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.

The verification shall ensure that reported emission reductions are complete and accurate in order to be certified.

The verification team has based the verification on the recommendations in the Validation and Verification Standard /6/.

1.3 Description of the project activity

Project Parties:	*Pakistan (Host) and Germany (Sponsor)*
Title of project activity:	*Pakarab Fertiliser Co-generation Power Project*
UNFCCC registration No:	*UNFCCC registration No.2687*
Baseline and monitoring methodology	*AM0014 (version 04)*
Project Participants:	***Pakarab Fertilizer Limited (Host)*** *Address: 2nd Floor, Trust Plaza, L. M. Q. Road, Multan, Pakistan* *Mr. Mati-ur-Rab* *Telephone: +92 (61) 9220022* *e-mail: mati@fatima-group.com* ***Fichtner GmbH & Co. KG (Sponsor)*** *Address: Sarwey strasse 3/ POB 101454, 3, Stuttgart, Germany* *Dr. Ole Langniss* *Telephone: +49 (711) 8995 584* *e-mail: ole.langniss@fichtner.de*
Location of the project activity:	*The project is located on L.M.Q. Road in Multan, Punjab Province, Pakistan.*
Project's crediting period:	*21 December 2009 to 20 December 2016*
Period verified in this verification:	*1 June 2010 to 31 December 2010*

The project activity consists of the installation of three natural gas co-generation systems which generate power and heat (steam) and supply them to the fertilizer complex of the project participant to replace the existing natural gas fired boilers and steam turbine generation systems. In the project activity, the power is generated by the gas turbine driven generator sets and the waste heat of the gas turbines is used by heat recovery steam generators (HRSGs) to produce the steam. The HRSGs needs a small amount of supplementary fuel (natural gas) to obtain the maximum thermal efficiency. On the other hand the respective HRSGs can be stopped when the heat demand is low in the fertilizer complex. Despite the supplementary fuel consumption, overall thermal efficiency is higher than the existing heat and power generation system, thus the fossil fuel consumption is expected to be reduced and the greenhouse gas emission will be reduced accordingly.

1.4 Methodology for determining emission reductions

As per the approved monitoring methodology (AM0014 Version 04) applicable to the project, the emission reduction (ER_y) by the project activity during a given period *y* is the difference

between the baseline emissions (BE_y) and the project emissions (PE_y) including the leakage emissions (LE_y), as follows:

$$ER_y = BE_y – PE_y – LE_y$$

where:

ER_y is the emissions reductions of the project activity during the year *y* (tCO_2e)
BE_y is the baseline emissions during the year y (tCO_2e)
PE_y is the project emissions during the year y (tCO_2e)
LE_y is the leakage emissions in year y (tCO_2e)

According to AM0014 version 04, baseline emissions consist of the following emissions;

- CO_2 emissions from baseline fuel combustion
- CH_4 emissions from baseline fuel combustion
- N_2O emissions from baseline fuel combustion
- CH_4 emissions due to leaks during production of baseline fuel
- CO_2 emissions from baseline electricity generation

Among the above, CH_4 and N_2O emission are proportional to the amount of baseline fuel consumption of the plants those are offset by heat supplied by the natural gas co-generation system. As per the registered PDD, the baseline fuel and the project fuel are identical and thus these emissions have been eliminated from both the baseline emission and the project emission in a conservative manner.

- Baseline CO_2 emissions from baseline fuel combustion are given by the following equation:

$$BE_{th} = ABEC_{BF,th} * EF_{BF} = (CAHO * FR_{th}) * EF_{BF}$$

where:

- BE_{th} is baseline emission for heat supply (tCO_2)
- $ABEC_{BF,t}$ is baseline energy consumption for heat supply
- CAHO is the cogeneration system heat output in monitoring period to be monitored (TJ). CAHO is calculated as the heat content of the steam output minus heat content of the condensate return minus heat content of the makeup water.
- FR_{th} is the fuel rate for steam generation in heat only mode determined ex-ante as 91% (GJ_{NCV}/GJ_{th}) in the registered PDD.

- Baseline CO_2 emissions from electricity supply to industrial plant that are offset by electricity supplied from the cogeneration system are given by the following equation:

$$BE_{elec} = CEO * BEF_{elec\ fossil\ fuel} * 10^{-3} = CEO * (FR_{elec} * EF_{BF} * 10^{-3})$$

where:

- BE_{elec} is baseline emission for electricity supply (tCO_2e)
- CEO is the cogeneration system electricity output in monitoring period (MWh)
- $BEF_{elec\ fossil\ fuel}$ is the baseline CO_2 factor for electricity from the dedicated fossil fuel power plant determined ex-ante ($kgCO_2e/MWh$)

- FR_{elec} is fuel rate for electricity of the existing steam turbine power station determined ex-ante as 15.38 GJ/MWh in the registered PDD
- EF_{BF} is emission factor of the fuel used to generate heat determined ex-ante as 56.1 tCO_2/TJ in the registered PDD.

- Project CO_2 emissions are given by the following equation:

$$PE_{CS} = AEC_{NG} * EF_{NG} = (V_{NG} * NCV_{NG} * 10^{-9}) * EF_{NG}$$

where:

- PE_{CS} is project emissions related to the heat and power generation by the project activity in the monitoring period (tCO_2e)
- AEC_{NG} is the natural gas consumption in the monitoring period, calculated in energy units (TJ) from the measured total consumption (V_{NG}) and the net calorific value of natural gas.
- V_{NG} is the total natural gas (sum of GTG & HRSG) consumption in the monitoring period to be monitored (Nm^3)
- NCV_{NG} is the net calorific value of the natural gas determined ex-post (kJ/Nm^3)
- EF_{NG} is CO_2 emission factor of natural gas determined ex-ante (tCO_2e/TJ)

As described in the applied methodology, AM0014 version 04, the principle sources of "leakage" in the sense of emissions of GHG emission outside the project boundary and attributable to the CDM project are the emission of methane from natural gas production and pipeline leakage, associated with gas consumption of cogeneration system. The baseline scenario and the project scenario use the fuel of the same type and the baseline fuel consumption is higher than the project fuel consumption. Thus the leakage is not to be accounted for.

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).

Verification team

				Type of involvement						
Role	***Last Name***	***First Name***	***Country***	TA 4.other competence	Desk review	Site visit	Reporting	Supervision of work	Technical review	TA 1.1 competence
Team leader	Astakala	Vidyacharan	India		✓		✓	✓		
Verifier	Sekine	Akira	Japan	✓	✓	✓	✓			
Expert	Nemecek	Lumír	Czech Republic		✓	✓	✓			✓
Technical reviewer	Govindarajulu	Murali	India	✓					✓	
Person with sectoral competence assisting technical reviewer	Kakarapparthi	Venkata Raman	India						✓	✓

Duration of verification

Publishing of MR: *17 January 2011*

Preparations: *From 20 January 2011 to 31 January 2011*

On-site verification: *2 and 3 February 2011*

Reporting, calculation checks and QA/QC*: From 4 February 2011 to 3 September 2013*

2.1 Desk Review

The basis for the verification has been the monitoring report of the project Version 2 dated 12 January 2011, and the revised monitoring report, Version 5 dated 28 January 2013 /1/, the registered project design document (PDD) dated 8 December 2009 and its revised version 3 dated 13 July 2012 /2/, and the approved baseline and monitoring methodology applied by the project, i.e. AM0014, version 4 /8/. The project operator has in addition supplied the

verification team with procedures from its management system as well as other documentation and spread sheets with all data necessary for verification of the emission reductions /3/, /4/, and /10/-/14/

2.2 On-site assessment

Detailed verification of all data contained in the monitoring report was performed during a site visit at Pakarab Fertilizer Ltd on 2-3 February 2011. During the site visit, the following personnel were interviewed or assisted the verification team:

Name	***Organization***	***Position***
Mr. Tariq Faiz	Pakarab Fertilizers Limited	Unit Manager, CDM Unit
Mr. Mati-ur-Rab	Pakarab Fertilizers Limited	Unit Manager, Utilities
Mr. Abdul Rauf	Pakarab Fertilizers Limited	Assistant Production Manager
Mr. Ijaz Ahmed Ghauri	Pakarab Fertilizers Limited	Day Engineer, Utility
Mr. Adnan Mahmood	Pakarab Fertilizers Limited	Process Engineer, Utilities
Mr. Ali Raza Soomro	Pakarab Fertilizers Limited	Section Head, Instrument.
Mr. Mohtashim Ali	Pakarab Fertilizers Limited	Instrument Engineer, Utilities
Mr. Salman Akhtar	Pakarab Fertilizers Limited	Electrical Engineer, Utilities
Mr. Sohail Ahmed	Pakarab Fertilizers Limited	Field Maintenance Technician

During the site visit and interviews, the following topics have been discussed and verified:

- An assessment of the implementation and operation of the registered project activity is as per the PDD for the project activity /2/
- A review of information flows for generating, aggregating and reporting the monitoring parameters;
- Interviews with relevant personnel to determine whether the operational and data collection procedures are implemented in accordance with the monitoring plan in the PDD;
- A cross check between information provided in the monitoring report and logbooks, inventories, purchase records or similar data sources;
- A check of the monitoring equipment including calibration performance and observations of monitoring practices against the requirements of monitoring plan.

2.3 Closing out of verification findings

The objective of this phase of the verification was to resolve any issues which needed 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, 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.

Two CARs and two CLs were raised during this 2nd verification (refer to Appendix A). The project participants adequately addressed the CARs and CLs raised and provided a corrected monitoring report., Version 4 dated 28 January 2013.

Furtheron, this issuance request received an incomplete message on 12 April 2012, and a post registration change was requested and it was approved 29 august 2012 in order to address the issue raised by UNFCC. The monitoring report was updated (version 05 of 28 January 2013) in line with the monitoring plan included in the revised approved PDD, and using the latest monitoring template form version 3.1.

The difference of 1 tCO_2 emission reduction between the first and second submission is due to rounding in the calculation.

3 VERIFICATION FINDINGS

This section summarises the findings from the verification of the emission reductions reported for the "Pakarab Fertiliser Co-generation Power Project " (the project) in the period 1 June 2010 to 31 December 2010.

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

According to the final validation report (report number 1173531 dated 15 December 2009), the validator TÜV SÜD had accordingly raised a FAR as follows;

The verifying DOE shall confirm that the low caloric value gas (process gas) from the fertiliser process is not used for supplementary firing of the HRSGs.

DNV confirmed during at the site visit hat there was no piping connection between the low caloric fuel offgas line and the NG fuel feed line to the HRSGs. at the times of verification site-visits. Although there is a possibility of installing temporary pipeline for the purpose, the verification team evaluated and conducted the crosscheck by means of evaluating thermal efficiency of the co-generation units for the period. The overall thermal efficiency during the 2nd monitoring period was 77.4% and lower than one stated in the registered PDD of 92.2%. If the PP utilized the low calorific gas through the temporary pipeline and did not accounting for the amount, the actual efficiency would have been higher. The verification team confirmed the absence of the piping connection between fuel feed line to the HRSG and the low calorific gas line. Thus it is confirmed that the low calorific gas had not been used during the 2nd monitoring period.

There are no CARs or FARs from previous verification remaining to be discussed.

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 and obtained approval by the CDM EB on 29 August 2012 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 3 of 29 August 2012).

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 approved revised PDD, version 3 of 13 July 2012 /2/.

The verification team inspected and confirmed the installation of the three sets of the package co-generation systems and all instrumentation necessary to monitor the emission reductions.

The project was implemented and has been in full operation since July 2009 for Pakarab Fertilizer Limited. Guarantee test runs of the GTG No. 1, No. 2 and No. 3 were started since April 2009, June 2009 and July 2009 respectively and completed with guaranteed performance as confirmed from the test operation reports of the supplier, UMAG Technologie GmbH /9/.

No request for notification or request for approval of changes from the project activity as described in the registered PDD is necessary.

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

As confirmed in section 3.6, the emission reductions achieved during this monitoring period are 48% lower than estimated in the approved revised PDD.

The monitored parameters for this verification period have been compared with the estimates in the PDD as follows:

- The consumption of natural gas (V_{NG}) was 60.689 10^6 Nm^3 for the monitoring period, which 79% of the ex-ante estimate. This is mainly due to shortage of natural gas supply to the plant.
- The electricity produced by the cogeneration plant (CEO) achieved 77 862 MWh during the monitoring, which is 72% of the estimate in the PDD. This is due to the limitation of gas supply, which resulted in 3 prolonged shut down of the gas turbines. Furthermore, the electricity demand was lower than expected, because the PDD had anticipated a plant extension which is not yet implemented. The maximum load observed (daily average) reached 17.3 MW, while the expected consumption was 22.2 MW in the PDD after the plant extension.
- The cogeneration system heat output (CAHO) reached 1 170 TJ during the monitoring period, which is only 55% of the estimated value in the PDD. The lower heat output is partly explained by shortage of natural gas and associated shutdown. The remaining difference with PDD estimate is explained by the lower heat demand from the plant than expected, because the plant extension forecasted in the PDD has not been implemented yet.

In summary, the lower emission reductions than estimated are due to external contingency (fuel supply), and lower electricity and heat demand from the fertiliser plant than expected as no extension has been done. Thus it is not likely to increase the estimates of emission reductions in the future monitoring periods.

3.5 Compliance of monitoring plan with monitoring methodology

DNV is able to confirm that the monitoring plan contained in the revised PDD dated 13 July 2012 is in accordance with the approved methodology applied by the project activity, i.e. AM0014 (version 04).

3.6 Compliance of monitoring with the monitoring plan

The monitoring has been carried out in accordance with the monitoring plan contained in the revised PDD of 13 July 2012. All parameters were monitored and determined as per the monitoring plan.

All parameters, i.e. project emission parameters and baseline emission parameters, stated in the monitoring plan are monitored and reported appropriately. Leakage need not be considered as the nature of the fuel used in the baseline scenario and the project scenario are

identical and the consumption quantity in the project scenario is lower than in the baseline scenario.

The monitoring report lists each parameter required by the monitoring plan and the information flow (i.e. from data generation, aggregation, recording, calculation and reporting) for these parameters is provided in the monitoring report. The information flow for each parameter is further verified in the following sections. The monitoring report and supporting sustaining records are sufficient to enable verification of emission reductions.

The accuracy of equipment used for monitoring is controlled and calibrated in accordance with the monitoring plan;

(i) Monitoring results are consistently recorded as per approved frequency;

(ii) Quality assurance and quality control procedures have been applied in accordance with the monitoring plan;

(iii) Calibration records were provided and they are appropriate /13/.

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.

Note: As explained in section 1.4, CAHO is the cogeneration system heat output during the monitoring period (TJ). In the approved monitoring methodology, the cogeneration system heat ouput is called MCHO, which is the monthly reported value. In the registered PDD and the monitoring report, the heat output is only called CAHO (although reported monthly like MCHO), which is the name used in this report.

The heat output (CAHO) is calculated as follow: Heat ouput = steam heat value – condensate heat value – make up water heat value. In tables below, the monitoring of the steam, returned condensate and make up water is presented separately for clarity.

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	Cogeneration system heat output used to calculate heat output CAHO (TJ)
Measuring frequency:	Measured continuously and recorded every 2 hours and daily (cumulative)
Reporting frequency:	Calculated from daily cumulative data and reported monthly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, AM0014 version 04 requires monthly recording (named MCHO in the methodology). The monitoring plan in the registered PDD specifies only “measuring frequency” as continuous.
Type of monitoring equipment:	Flow, temperature and pressure are measured by orifice and differential pressure sensor type with pressure and temperature compensation function. The heat content is determined from standard

	enthalpy tables.
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	Accuracy: ±2.5% The above is in line with the accuracy specified in the registered PDD: ±2.5%. Vendor specification: Flow sensor: ±0.13% Temperature sensor: ±0.1% Pressure sensor: ±0.1% The combined uncertainty of the measurement is ±0.19% and better than the description in the PDD.
Calibration frequency /interval:	Monthly
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	Yes, it is in line with the interval specified in the registered PDD.
Company performing the calibration:	In-house calibration
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
Is (are) calibration(s) valid for the whole reporting period?	Differential pressure transmitter (FT-08) Calibration date: 5 May, 4 June, 4 July, 3 August, 2 September, 2 October, 1 November, 1 December, 31 December 2010 Validity: 31 January 2011 Steam pressure sensor (PT-05) Calibration date: 5 May, 4 June, 4 July, 3 August, 2 September, 2 October, 1 November, 1 December, 31 December 2010 Validity: 31 January 2011 Steam temperature sensor (TT-05) Calibration date: 5 May, 4 June, 4 July, 3 August, 2 September, 2 October, 1 November, 1 December, 31 December 2010 Validity: 31 January 2011
If applicable, has the reported data been cross-checked with other available data?	Cross-checked with formal monthly data maintained by the plant manager /14/.
How were the values in the monitoring report verified?	Comparing the values in the spreadsheet with the daily operation log book by sampling
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The utility plant operators transfer the data in the log book to the spreadsheet and they are checked and approved by the Unit Manager, Utilities.
In case only partial data are available because activity levels or non-activity	Full data are available

parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	Cogeneration system return condensate heat value used to calculate heat output CAHO (TJ)
Measuring frequency:	Measured continuously and recorded every 2 hours and daily (cumulative)
Reporting frequency:	Calculated from daily cumulative data and reported monthly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, AM0014 version 04 requires monthly recording (named MCHO in the methodology).
Type of monitoring equipment:	The condensate flow and temperature are measured with flow meter with temperature sensor. The heat content is determined from standard enthalpy table.
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	Accuracy specified in the registered PDD was ±2.5%. Vendor specification: ±0.13% (flow meter itself) The above is better than accuracy specified in the registered PDD
Calibration frequency /interval:	Monthly
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	Yes, it is in line with the interval specified in the registered PDD.
Company performing the calibration:	In-house calibration
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
Is (are) calibration(s) valid for the whole reporting period?	Condensate flow meter (FT-09) Calibration date: 7 May, 7 June, 7 July, 6 August, 5 September, 5 October, 4 November, 4 December 2010 Validity: 4 January 2011 Condensate pressure sensor (PT-06) Calibration date: 5 May, 4 June, 4 July, 3 August, 2 September , 2 October,1 November, 1 December, 31 December 2010

	Condensate temperature sensor (TT-06) Calibration date: 3 May, 2 June, 2 July, 1 August, 31 August, 30 September, 30 October, 29 November, 29 December 2010 Validity: 29 January 2011
If applicable, has the reported data been cross-checked with other available data?	Cross-checked with formal monthly data
How were the values in the monitoring report verified?	Comparing the values in the spreadsheet with the daily operation log book by sampling
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The utility plant operators transfer the data in the log book to the spreadsheet and they are to be checked and approved by the Unit Manager, Utilities.
In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	Full data are available.

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	Cogeneration system demineralised make-up water heat value used to calculate heat output CAHO (TJ)
Measuring frequency:	Measured continuously and recorded every 2 hours and daily (cumulative)
Reporting frequency:	Calculated from daily cumulative data and reported monthly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, AM0014 version 04 requires monthly recording (named MCHO in the methodology).
Type of monitoring equipment:	Make up water flow and temperature measured with flow meter with temperature sensors. Heat content is determined with standard enthalpy table.
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	Vendor specification: Flow meter:±0.13% Pressure: ±0.10% Temperature: ±0.10% Calculated combined uncertainty: ±0.19% The above is better than accuracy specified in the registered PDD, i.e. ±2.5%.

Calibration frequency /interval:	Monthly
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	Yes, it is in line with the interval specified in the registered PDD.
Company performing the calibration:	In-house calibration
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
Is(are) calibration(s) valid for the whole reporting period?	Demineralised make-up water flow meter (FT-05) Calibration date: 7 May, 7 June, 7 July, 6 August, 5 September, 5 October, 4 November, 4 December 2010 Validity: 4 January 2011 Demineralised make-up water temperature sensor (TT-02) Calibration date: 3 May, 3 June, 3 July, 2, August, 1 September, 1 October, 31 October, 30 November, 30 December 2010 Validity: 30 January 2011
If applicable, has the reported data been cross-checked with other available data?	Cross-checked with formal monthly data
How were the values in the monitoring report verified?	Comparing the values in the spreadsheet with the daily operation log book by sampling
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The utility plant operators transfer the data in the log book to the spreadsheet and they are to be checked and approved by the Unit Manager, Utilities.
In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	Full data are available

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	Power output from cogeneration systems, emergency generator and transformer stations to obtain net cogeneration electricity output: CEO (MWh)
Measuring frequency:	Gross electricity generation and auxiliary consumption are measured continuously The net electricity output is calculated as the gross generation less the auxiliary consumption
Reporting frequency:	Recorded every 2 hours and daily cumulative data, reported monthly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, AM0014 version 04 requires monthly recording (named MCHO in the methodology). Yes, the monitoring plan in the registered PDD specifies only "measuring frequency" as continuous.
Type of monitoring equipment:	Electric power meters
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	Accuracy: ±0.2% It is in line with the accuracy specified in the registered PDD.
Calibration frequency /interval:	Every 2 years
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The registered PDD does not specify the calibration frequency. It is in line with the supplier (Siemens) recommendation and thus it is deemed to represent good monitoring practice.
Company performing the calibration:	In-house calibration
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes The calibration refers NEPRA (National Electric Power Regulation Authority) Grid Code, although the system is not connected with the external power grid.
Is (are) calibration(s) valid for the whole reporting period?	No. 1 gas turbine generator output (C4) Date of calibration: 26 August 2008 (supplier calibration) Commissioning: 22 January 2009 Validity: 22 January 2011 No. 2 gas turbine generator output (C10) Date of calibration: 26 August 2008 (supplier calibration) Commissioning: 22 January 2009 Validity: 21 January 2011 No. 3 gas turbine generator output (C16) Date of calibration: 26 August 2008 (supplier

	calibration) Commissioning: 22 January 2009 Validity: 21 January 2011 Emergency diesel generator output (C11) Date of calibration: 26 August 2008 (supplier calibration) Commissioning: 22 January 2009 Validity: 21 January 2011 No. 1 station transformer output (C6) Date of calibration: 26 August 2008 (supplier calibration) Commissioning: 22 January 2009 Validity: 21 January 2011 No. 2 station transformer output (C14) Date of calibration: 26 August 2008 (supplier calibration) Commissioning: 22 January 2009 Validity: 21 January 2011
If applicable, has the reported data been cross-checked with other available data?	Cross-checked with formal monthly data
How were the values in the monitoring report verified?	Comparing the values in the spreadsheet with the daily operation log book by sampling
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The utility plant operators transfer the data in the log book to the spreadsheet and they are to be checked and approved by the Unit Manager, Utilities.
In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	Full data are available

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	Total Natural gas consumption of cogeneration plant (V_{NG}) i.e. includes NG both for HRSG and GTG
Measuring frequency:	continuous
Reporting frequency:	Recorded every 2 hours and daily cumulative data, reported monthly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, AM0014 version 04 requires monthly recording. Yes, the monitoring plan in the registered PDD

	specifies only “measuring frequency” as continuous.
Type of monitoring equipment:	Orifice and differential pressure sensor type with pressure and temperature compensation function
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	Accuracy: ±2.5% It is in line with the accuracy specified in the registered PDD.
Calibration frequency /interval:	Monthly
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The registered PDD does not specify the calibration frequency. It is in line with the supplier (FOXBORO, USA) recommendation and thus it is deemed to represent good monitoring practice.
Company performing the calibration:	In-house calibration
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
Is(are) calibration(s) valid for the whole reporting period?	Gas turbine generator fuel consumption: Flow meter (FT-01) Date of calibration: 5 May, 4 June, 4 July, 3 August, 2 September, 2 October, 1 November, 1 December, 31 December 2010 Validity: 31 December 2011 Pressure transmitter (PT-01) Date of calibration: 5 May, 4 June, 4 July, 3 August, 2 September, 2 October, 1 November, 1 December, 31 December 2010 Validity: 31 December 2011 Temperature sensor (TT-01) Date of calibration: 5 May, 4 June, 4 July, 3 August, 2 September, 2 October, 1 November, 1 December, 31 December 2010 Validity: 31 December 2011 Heat recovery steam generator fuel consumption: Flow meter (FT-12) Date of calibration: 3 May, 2 June, 2 July, 1 August, 31 August, 30 September, 30 October, 29 November, 29 December 2010 Validity: 29 January 2011 Pressure transmitter (PT-10) Date of calibration: 3 May, 2 June, 2 July, 1 August, 31 August, 30 September, 30 October, 29 November, 29 December 2010 Validity: 29 January 2011

	Temperature sensor (TT-10) Date of calibration: 3 May, 2 June, 2 July, 1 August, 31 August, 30 September, 30 October, 29 November, 29 December 2010 Validity: 29 January 2011 Gas Flowmeter at old powerhouse (FT-1501) Date of calibration: 26 February 2010, 10 July 2010, 1 December 2010 Validaty: 5 month
If applicable, has the reported data been cross-checked with other available data?	Cross-checked with formal monthly data
How were the values in the monitoring report verified?	Comparing the values in the spreadsheet with the daily operation log book by sampling
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The utility plant operators transfer the data in the log book to the spreadsheet and they are to be checked and approved by the Unit Manager, Utilities.
In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	Full data are available

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	Natural gas calorific values for calculating NCV_{NG}: GCV_{NG} (BTU)
Measuring frequency:	Monthly
Reporting frequency:	Monthly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, it is in accordance with the monitoring plan in the registered PDD.
Type of monitoring equipment:	Not applicable (monthly invoice from gas supplier)
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	Not applicable
Calibration frequency /interval:	Not applicable
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of	Not applicable

calibration, does the selected frequency represent good monitoring practise?	
Company performing the calibration:	Not applicable
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not applicable
Is(are) calibration(s) valid for the whole reporting period?	Not applicable
If applicable, has the reported data been cross-checked with other available data?	Cross-checked with the PP's laboratory data based on ISO 6976
How were the values in the monitoring report verified?	Compared with the monthly invoice from the gas supplier /11/
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Not applicable
In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	Full data are available

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	Net and gross calorific values: NCV_{NG} and GCV_{NG}
Measuring frequency:	Gross calorific value is provided on Monthly Invoices from the supplier NCV and GCV is measured daily by the laboratory for cross checking and calculation of the NCV/GCV ratio.
Reporting frequency:	Monthly average
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, it is in accordance with the monitoring plan in the revised PDD.
Type of monitoring equipment:	The gross calorific value is GCV_{NG} provided by the supplier. NCV_{NG} is calculated from GCV_{NG} multiplied by the NCV/GCV ratio determined by the plant laboratory. The gross and net calorific values are measured by the plant laboratory according to ISO 6976 standard.
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring	Not applicable (NCV: calculated, GCV: gas supplier data)

equipment, does the monitoring equipment represent good monitoring practise?	
Calibration frequency /interval:	Gas chromatograph used for gas composition analysis by PFL was calibrated monthly /17/
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	Yes, the revised monitoring plan specifies monthly calibration.
Company performing the calibration:	Internal calibration by PFL
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes, calibration was done monthly during the monitoring period /17/.
Is(are) calibration(s) valid for the whole reporting period?	Not applicable (NCV: calculated, GCV: gas supplier data)
If applicable, has the reported data been cross-checked with other available data?	Not applicable
How were the values in the monitoring report verified?	Compared with the laboratory daily analysis records/12/, included in annex 6 of the monitoring report. Values from the laboratory are consistent with suppliers data.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Not applicable
In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	Full data are available

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	Electricity generated by baseline dedicated power plant (MWh)
Measuring frequency:	Continuous
Reporting frequency:	Recorded every 2 hours and daily cumulative data, reported monthly Cumulative data during a monitoring period are also reported
Is measuring and reporting frequency in accordance with the monitoring plan and	Yes, AM0014 version 04 requires annual (during a monitoring period) recording.

monitoring methodology? (Yes / No)	The monitoring plan in the registered PDD does not specify measuring and reporting frequency.
Type of monitoring equipment:	Electric power meters
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	Accuracy: ±0.2% It is not specified in the registered PDD. The accuracy is inline with the specification provided by the supplier.
Calibration frequency /interval:	Every 2 years
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The calibration frequency is not specified in the monitoring plan. It is deemed sufficient as it is in line with the supplier recommendation.
Company performing the calibration:	In-house calibration
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
Is (are) calibration(s) valid for the whole reporting period?	Steam turbine generator-1 output Date of calibration: 26 August 2008 (supplier calibration) Commissioning: 22 January 2009 Validity: 22 January 2011 Steam turbine generator-2 output Date of calibration: 26 August 2008 (supplier calibration) Commissioning: 22 January 2009 Validity: 22 January 2011 Steam turbine generator-3 output Date of calibration: 26 August 2008 (supplier calibration) Commissioning: 22 January 2009 Validity: 22 January 2011
If applicable, has the reported data been cross-checked with other available data?	Cross-checked with formal monthly data
How were the values in the monitoring report verified?	Comparing the values in the spreadsheet with the daily operation log book by sampling
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The utility plant operators transfer the data in the log book to the spreadsheet and they are to be checked and approved by the Unit Manager, Utilities.
In case only partial data are available because activity levels or non-activity parameters have not been monitored in	Full data are available

accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	

3.7 Assessment of data and calculation of emission reductions

The calculation of baseline emissions, project emissions and emission reductions for the monitoring period was checked by the verification team and found to be correct and carried out in accordance with the formulae and methods described in the monitoring methodology, AM0014 version 04, and the approved revised PDD. There is no uncertainty related to transfer of the main data, i.e. cogeneration system heat and electricity output, natural gas consumption and fate of electricity by baseline dedicated power plants, since these values are manually transferred from the operation log book to the spreadsheet. The log book is checked and approved by the Utilities Unit Manager by means of comparing with the weekly cumulative values. The values were verified by the verification team by sampling and by means of comparing the recorded values with the monthly cumulative values.
Spreadsheets were made available for DNV. The calculations have been checked and found to be correct /3/.
In the monitoring, no assumption was used.

The project participants used the following default values;

a) CO_2 emission factor for natural gas (EF_{NG}): 56.1 tCO_2e/TJ

It is the default emission factor of "2006 IPCC guideline, Chapter 2 Stationary Combustion, Table 2-2 (energy industries) and Table 2-3 (manufacturing industries and construction) and in line with the monitoring plan in the registered PDD.

b) Thermal efficiency or heat rate for steam generation in heat-only mode (baseline): 91.0% or 1.10 GJ_{NCV}/GJ_{th}

It is in line with the value specified in the approved revised PDD and a slightly higher than the value proposed by AM0014 version 04 of 90%. It is conservative and thus acceptable.

c) Net electric efficiency or net heat rate for electricity generation in condensing mode with existing steam turbines (baseline): 23.4% or 15.38 GJ_{NCV}/MWh_{elec}

The default value is sourced from Fisher's thermodynamic cycle simulation software KPRO®, applying name-plate thermodynamic parameters of the steam turbines. The value is consistent with one specified in the approved revised PDD.

All of the data were available during the verification site-visit.

For the cogeneration heat and electricity output, natural gas consumption data in the spreadsheets provided by the participant was cross-checked with the daily operation log sheets in the plant control room by sampling. The formulae for calculating baseline emissions and project emissions are in line with the monitoring plan in the approved revised PDD.

As stated in AM0014 version 04, the leakage relevant to this type of project are the emission of methane from natural gas production and gas leak from pipeline associated with gas consumption of cogeneration system. The natural gas consumption in the project scenario is smaller than one in the baseline scenario thus it is conservative not to account for leakage. This is also in line with the approved revised PDD.

AM0014 version 04 requires that the electricity produced by the baseline dedicated power plants have been reduced by at least the same amount as the electricity generated by the project activity cogeneration plant. During the monitoring period of 214 days, 77 862 MWh of electricity was generated by the project cogeneration plants and 0 MWh of electricity was generated by the baseline dedicated power plants and the ratio was 0%. The total power generation by the project cogeneration plants and the baseline dedicated plants was 77 862 MWh and was 88.6% of the annual historical average power generation from 2004 to 2006 provided in the PDD /2/, i.e. 149 900 MWh * 214 days / 365 days = 87 886 MWh. Thus the electricity produced by the baseline dedicated power plants is deemed to be reduced by more than the electricity generated by the project activity cogeneration plant.

The emission reductions achieved during the monitoring period are correctly calculated as 34 119 tonnes of CO2e, which accounts 48% of the emission reductions estimated in the PDD (119 481 tCO2e* 214 days/ 365 days= 70 052 tCO2e). The difference is mainly due to fuel supply shortage, and lower power and heat demand from the fertilizer plant than expected, as the extension anticipated in the PDD is not implemented yet.

3.8 Quality of evidence to determine emission reductions

The main parameters are indicated and recorded through the distributed control system (DCS). All necessary documentation is collected, referenced and aggregated and is easily accessible in spread sheets. Measurements are performed by properly calibrated equipment, and the key data can also be cross-checked via other sources, such as formal accounting report /14/, daily reports and meters available in the operators control room. No assumptions are used that have any material influence on reported emission reductions.

All measurement and analytical instruments are calibrated as per the prescriptions in the registered PDD and as per the documented procedures used by the plant operators.

All instruments have a valid calibration covering the whole monitoring period. DNV confirms the all instruments are working within the specified error ranges as per certificates. The calibration certificates were provided as evidence of the work performed. The accuracy and calibration interval of the monitoring equipment is in accordance with the relevant guidance provided by the CDM Executive Board and is controlled and calibrated in accordance with the monitoring plan. The monitoring system and instruments as well as the applied QA/QC scheme (i.e. calibration, maintenance, etc.), following supplier recommendations, represent good monitoring practice.

3.9 Management system and quality assurance

The project is operated by Pakarab Fertilizer Limited. The monitoring and reporting of data under the CDM activity have been conducted by mainly by Pakarab Fertilizer Limited with support of Fichtner GmbH & Co. KG. The quality assurance and quality control procedures in terms of equipment operation and maintenance as well as data reporting are covered by the documented procedures.

The ammonium nitrate plant of the Pakarab Fertilizer Limited has recently been ISO 9001:2000 certified /9/. Although the project activity has not yet been certified, they already

deployed the equivalent quality management system based on ISO9001:2000. The certification will be renewed applying ISO9001:2008.

Local operators, instrumentation engineers and calibration personnel of the system have been trained by equipment suppliers and qualified internally. Data handling solutions involve redundancy, data manipulation protection, integrity check as well as proper archiving.

4 CERTIFICATION STATEMENT

DNV Climate Change Services AS (DNV) has performed the verification of the emission reductions that have been reported for the "Pakarab Fertiliser Co-generation Power Project" (UNFCCC Registration Reference No.2687) for the period 1 June 2010 to 31 December 2010. The project was registered on 21 December 2009 and the crediting period is from 21 December 2009 to 20 December 2016 (Renewable).

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.

It is DNV's responsibility to express an independent verification statement on the reported GHG emission reductions from the project. DNV does not express any opinion on the selected baseline scenario or on the validated and approved revised PDD.

DNV conducted the verification on the basis of the monitoring methodology AM0014 (version 04), the monitoring plan contained in the approved revised Project Design Document, version 3 of 13 July 2012 and the monitoring report, version 5 dated 28 January 2013. 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.

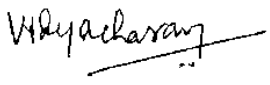
DNV's verification approach draws on an understanding of the risks associated with reporting of GHG emission data and the controls in place to mitigate these. DNV planned and performed the verification by obtaining evidence and other information and explanations that DNV considers necessary to give reasonable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

In our opinion the GHG emissions reductions of the "Pakarab Fertiliser Co-generation Power Project" (UNFCCC Registration Reference No.2687) for the period 1 June 2010 to 31 December 2010 are fairly stated in the monitoring report, version 5 dated 28 January 2013.

The GHG emission reductions were calculated correctly on the basis of the approved baseline and monitoring methodology AM0014 (version 04) and the monitoring plan contained in the approved revised PDD, version 3 of 13 July 2012.

DNV Climate Change Services AS is able to certify that the emission reductions from the "Pakarab Fertiliser Co-generation Power Project" during the period 1 June 2010 to 31 December 2010 amount to 34 119 tonnes of CO_2 equivalent.

Bangalore and Oslo, 3 September 2013



Astakala Vidyacharan
CDM Verifier
DNV Bangalore, India

Ole A. Flagstad
Approver,
DNV Climate Change Services AS

5 REFERENCES

5.1 Documentation provided by the project participants

/1/	CDM Monitoring Report, Pakarab Fertiliser Co-generation Power Project (reference number: 2687), version 2 dated 12 January 2011 CDM Monitoring Report, Pakarab Fertiliser Co-generation Power Project (reference number: 2687), version 4 dated 28 January 2013 (first issuance request) and version 05 dated 28 January 2013 (final version)
/2/	CDM Project Design Document: "Pakarab Fertiliser Co-generation Power Project, version 11" dated 8 December 2009 TÜV-SÜD, validation report "Pakarab Fertiliser Co-generation Power Project, revision 5" dated 15 December 2009
/3/	CDM Project Spreadsheet for the verification period 1 June 2010 to 31 December 2010: - Monitoring protocol for the first monitoring period
/4/	Daily operation log book, 1 June 2009 – 31 December 2010

5.1 Methodologies, tools and other guidance by the CDM Executvie Board

/5/	CDM Executive Board: CDM Validation and Verification Standard, version 04.0
/6/	CDM Executive Board : CDM Project standard, version 04.0
/7/	CDM Executive Board : CDM Project cycle procedure, version 04.0
/8/	CDM Executive Board: meeting report, EB51, para55
/9/	CDM Executive Board: Approved Monitoring methodology AM0014, version 04

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

/10/	UMAG Technologie GmbH, Test Operation Report - GTG/HRSG No. 1, 17 June 2009 - GTG/HRSG No. 2, 17 June 2009 GTG/HRSG No. 3, 03 September 2009
/11/	IQNet and AIB-VINÇOTTE USA Inc., ISO9001:2000 Certificate, 27 June 2007
/12/	SUI Northern Gas Pipelines Limited, Monthly invoice (with GCV) - For June, 1 July 2010 - For July, 2 August 2010 - For August, 1 September 2010

	- For September, 1 October 2010 - For October, 1 November 2010 - For November, 1 December 2010 - For December, 1 January 2011
/13/	Pakarab Fertilizer Limited Laboratory, Monthly natural gas analysis report - for June, 1 July 2010 - for July, 1 August 2010 - for August, 1 September 2010 - for September, 1 October 2010 - for October, 2 November 2010 - for November, 1 December 2010 - for December, 1 January 2011
/14/	Pakarab Fertilizer Limited, Calibration Record: <u>Steam Flow Sensor (FT-08):</u> - 5 May 2010 - 4 June 2010 - 4 July 2010 - 3 August 2010 - 2 September 2010 - 2 October 2010 - 1 November 2010 - 1 December 2010 - 31 December 2010 <u>Steam Pressure Sensor (PT-05):</u> - 5 May 2010 - 4 June 2010 - 4 July 2010 - 3 August 2010 - 2 September 2010 - 2 October 2010 - 1 November 2010 - 1 December 2010 - 31 December 2010 <u>Steam Temperature Sensor (TT-05):</u> - 5 May 2010 - 4 June 2010 - 4 July 2010 - 3 August 2010 - 2 September 2010 - 2 October 2010 - 1 November 2010

- 1 December 2010
- 31 December 2010

Condensate Flow Meter (FT-09):

- 7 May 2010
- 7 June 2010
- 7 July 2010
- 6 August 2010
- 5 September 2010
- 5 October 2010
- 4 November 2010
- 4 December 2010

Condensate Pressure Sensor (PT-06):

- 5 May 2010
- 4 June 2010
- 4 July 2010
- 3 August 2010
- 2 September 2010
- 2 October 2010
- 1 November 2010
- 1 December 2010
- 31 December 2010

Condensate Temperature Sensor (TT-06):

- 3 May 2010
- 2 June 2010
- 2 July 2010
- 1 August 2010
- 31 August 2010
- 30 September 2010
- 30 October 2010
- 29 November 2010
- 29 December 2010

Demineralized Make-up Water Flow Meter (FT-05):

- 7 May 2010
- 7 June 2010
- 7 July 2010
- 6 August 2010
- 5 September 2010
- 5 October 2010
- 4 November 2010
- 4 December 2010

Demineralized Make-up Water Temperature Sensor (TT-02):

	- 3 May 2010 - 3 June 2010 - 3 July 2010 - 2 August 2010 - 1 September 2010 - 1 October 2010 - 31 October 2010 - 30 November 2010 - 30 December 2010 <u>Natural Gas Flow Meter to Gas Turbine Cogeneration Plants (FT-01):</u> - 5 May 2010 - 4 June 2010 - 4 July 2010 - 3 August 2010 - 2 September 2010 - 2 October 2010 - 1 November 2010 - 1 December 2010 - 31 December 2010 <u>Natural Gas to Turbine Cogeneration Plants Pressure Sensor (PT-01):</u> - 5 May 2010 - 4 June 2010 - 4 July 2010 - 3 August 2010 - 2 September 2010 - 2 October 2010 - 1 November 2010 - 1 December 2010 - 31 December 2010 <u>Natural Gas to Turbine Cogeneration Plants Temperature Sensor (TT-01):</u> - 5 May 2010 - 4 June 2010 - 4 July 2010 - 3 August 2010 - 2 September 2010 - 2 October 2010 - 1 November 2010 - 1 December 2010 - 31 December 2010 <u>Natural Gas Flow Meter to Heat Recovery Steam Generators (FT-12):</u> - 3 May 2010

- 2 June 2010
- 2 July 2010
- 1 August 2010
- 31 August 2010
- 30 September 2010
- 30 October 2010
- 29 November 2010
- 29 December 2010

Natural Gas to Heat Recovery Steam Generators Pressure Sensor (PT-10):

- 3 May 2010
- 2 June 2010
- 2 July 2010
- 1 August 2010
- 31 August 2010
- 30 September 2010
- 30 October 2010
- 29 November 2010
- 29 December 2010

Natural Gas to Heat Recovery Steam Generators Temperature Sensor (TT-10):

- 3 May 2010
- 2 June 2010
- 2 July 2010
- 1 August 2010
- 31 August 2010
- 30 September 2010
- 30 October 2010
- 29 November 2010
- 29 December 2010

Natural Gas Flow Meter to the Old Power House (FT-1501):

- 26 February 2010
- 10 July 2010
- 1 December 2010

Power Meter, Gas Turbine Generator-1 Output (C4):

- 26 August 2008 (Vendor calibration certificate: Siemens)

Power Meter, Gas Turbine Generator-2 Output (C10):

- 26 August 2008 (Vendor calibration certificate: Siemens)

Power Meter, Gas Turbine Generator-3 Output (C16):

- 26 August 2008 (Vendor calibration certificate: Siemens)

Power Meter, Steam Turbine Generator-1 Output:

- 26 August 2008 (Vendor calibration certificate: Siemens)

Power Meter, Steam Turbine Generator-2 Output:

	- 26 August 2008 (Vendor calibration certificate: Siemens) Power Meter, Steam Turbine Generator-3 Output: - 26 August 2008 (Vendor calibration certificate: Siemens) Power Meter, Emergency Diesel Generator Output (C11): - 26 August 2008 (Vendor calibration certificate: Siemens) Power Meter, Station Trandformer-1 Output (C6): - 26 August 2008 (Vendor calibration certificate: Siemens) Power Meter, Station Trandformer-2 Output (C14): 26 August 2008 (Vendor calibration certificate: Siemens)
/15/	Pakarab Fertilizer Limited, Procedure for calibration factor determination and application, 16 September 2009
/16/	Pakarab Fertilizer Limited, Monthly Utility Report, June 2010 to December 2010
/17/	Pakarab Fertilizer Limited, Gas Chromatograph calibration records, June 2010 to December 2010.

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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 dates of the calibration stated in the monitoring report are seen to be inconsistent with the calibration records, i.e. TT-01, TT-02, FT-01 and FT-12.	The dates were corrected in the updated monitoring report.	OK The dates in the updated monitoring report were confirmed to be consistent with the calibration records. CAR 1 is closed.
CAR 2	The following data in the monitoring report were inconsistent with the primary data (hand written operation log); − GTG power output on 2 June, 6 November − Total gas flow to GTG/HRSG at 07:00 of 15 June, 01:00 of 25 June, 21:00 of 1 September, 03:00 of 2 September, 07:00 of 8 September, 17:00 of 13 September, 11:00 of 16 September, 23:00 of 19 September − Steam pressure on 13 October, 8 November − Steam temperature on 6 November, 9 November − Demineralized water temperature on 2 November, 3 November, 7 November − Condensate temperature on 8 November	The data were corrected in the updated monitoring report.	OK The correction was confirmed to be made properly. CAR 2 is closed.

Clarification requests

CL ID	Clarification request	Response by Project Participants	DNV's assessment of response by Project Participants
CL 1	In the monitoring plan in the registered PDD and the monitoring report, the flow measurement of the steam and natural gas are defined to be compensated according to ISO5167. Besides the calibration factors are to be determined by means of periodic calibration. The factors determine should be clarified in the monitoring report.	The procedure to determine and apply calibration factors was presented to the verification team. Additional explanation was made in the corrected monitoring report.	OK Confirmed the procedure /13/ is in line with the registered PDD, and the corrected monitoring report is in line with the procedure. CL 1 is closed.
CL 2	Remarks/reasons in Table 2 "Tripping and normal stoppage" should be clarified for the following events: − GTG #1: Normal stop on 30 July − HRSG #3: Trip on 13 August − HRSG #1: Normal stop on 9 September	The reasons of the events are explained in the updated monitoring report.	OK The clarification in Table 2 are confirmed to be in line with the operation log. CL 2 is closed.

Forward action requests from validation

There is one forward action requests (FAR) raised at the validation.

FAR ID	Forward action request	Summary of how FAR has been addressed in this reporting period	Assessment of how FAR has been addressed
FAR 1	While it was checked during this verification that the low caloric value gas (process gas) from the fertiliser process is not being used for supplementary firing of the HRSGs, the same needs to be checked/verified in the subsequent verifications also. The above should be demonstrated by the PP.	The visible check of the fuel gas pipeline connection is possible. The flow counter readings of the low calorific by-product gas remain the same.	The piping connection and the meter readings of the fuel line were confirmed to be connected with the low calorific gas lines. The overall thermal efficiency during the 2nd verification period was lower than expected and thus it is not likely that additional fuel was accounted for during the monitoring period. This FAR will need to be verified for each subsequent verification as well.

Forward action requests from previous verification

There is no pending forward action request (FAR) 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
FAR 1	N/A	N/A	N/A

Forward action requests from this verification

No FAR has been issued for the current verification period.

FAR ID	Forward action request	Response by Project Participants	DNV's assessment of response by Project Participants
FAR 1	N/A	N/A	N/A

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APPENDIX B

POST REGISTRATION CHANGE

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	Not applicable	☐ Yes ☐ No ☐ Not applicable	Not applicable
Temporary deviations from the registered monitoring plan and/or monitoring methodology	Not applicable	☐ Yes ☐ No ☐ Not applicable	Not applicable
Permanent changes from the registered monitoring plan or applied methodology	The changes from the registered monitoring plan includes 1) Change requested by the CDM EB in the incomplete message of 13 March 2012, regarding monitoring of the electricity output of the cogeneration system (CEO). In the revised monitoring plan, CEO is calculated as the difference between the gross electricity generated by each generator, less the auxiliary consumption. Change required by the PP/DOE for monitoring of the NCV of Natural Gas. The NCV is calculated as the product of the GCV provided on the supplier invoice, and the ratio NCV/GCV determined by the PP in laboratory.	☒ Yes ☐ No ☐ Not applicable	*29 August 2012*
Changes to the project design of a registered project activity	Not applicable	☐ Yes ☐ No ☐ Not applicable	*Not applicable*

* 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 /8/

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APPENDIX C

CURRICULA VITAE OF THE VERIFICATION TEAM MEMBERS

Lumír Nemecek

Mr. Lumír Nemecek *holds a MSc. Degree in Energy industries. Having an overall experience of around 32 years. Prior to joining DNV having 33 years experience in nuclear, hydro, fossil-fuelled power and other renewable. He worked for large and medium size energy companies in different roles and capacities including project management, project engineering and consulting. He has acquired his experience in energy industry markets from both Subcontractor and Client Company's perspective combined with understanding of business climate and adopted practice covering*
1. Staff member of power plant during the construction - direct participation on construction and equipment installations, supervision of suppliers and designers, safety aspects of construction and operation.
2. Energy utility (10yrs) - Project preparation and project management activities, preparation and supervision of the plants technical development, site visits, supervision of suppliers installations., bidding procedures and construction preparation of new power plants, plant operations support, project management, supervision individual plants technical departments.
3. Consultancy activities in energy sector (11yrs) - feasibility studies, site visits, supervision of suppliers, supervision of installations, bidding procedures, supervision of reengineering and plant renovations, time scheduling, administrative and legal procedures during projects preparations
4. Export/import of complete power plants, equipment and technology (5yrs) Bidding procedures, preparation and realization supervision of power facilities, project management, planning, monitoring, and reporting.

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 1.1, 1.2 ."

Sekine, Akira

Mr. Akira Sekine *holds Bachelor Degree in Mechanical Engineering. Having an overall experience of around 32 years. Prior to joining DNV having 4 years experience in Petroleum Refining and Petrochemical industries covering process engineering of catalytic desulfurization and reforming, and utility management, 9 years experience in Lubricant Industry covering design, manufacturing and quality management of lubricating oils and metal working fluids, 4 years experience of Real Estate Industry covering Large Scale Land Development Planning, 3 years in Social Education Sector covering exhibition design of aquarium museum of, and 3 years experience covering Quality Management System Audits. He has experience of around 9 years in Management System Audits based on ISO9001/14001, and around 6 years in validation and verification of CDM/JI and the other independent greenhouse gas verification in DNV, both in Japan & abroad.*
His qualification, industrial experience and experience in Management System Audit, CDM/JI and the other greenhouse gas auditing demonstrate his sufficient sectoral competence in Refining, Chemical Process industries in CDM/JI audit and management system certification in Oil Products, Metal Working, Land Development in management system audit.

Astakala Vidyacharan

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."

Govindarajulu Murali

Holds a Bachelor's Degree in Chemical Engineering and has done a Short term diploma course in Management. Having an overall experience of around eleven years. Prior to joining DNV having around seven years experience in Chemical process industry covering production, energy efficiency improvement and equipment design erection and commissioning. 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 140001 and OHSAS 18001 standards in chemical process industry for more than three years.

He has experience of around 4 years in validation and verification of numerous CDM projects in DNV, both in India & abroad. His qualification, industrial experience and experience in CDM demonstrate his sufficient sectoral competence in energy generation from renewable energy sources.

Kakaraparthi Venkata Raman

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.