VERIFICATION / CERTIFICATION REPORT

PAKARAB FERTILIZER CO-GENERATION POWER PROJECT IN PAKISTAN

(UNFCCC Registration Ref. No.2687)

Monitoring Period:
21 December 2009 to 31 May 2010

REPORT NO. 2010-9241

REVISION NO. 02

DET NORSKE VERITAS

VERIFICATION / CERTIFICATION REPORT

Date of first issue: 2010-11-20	Project No.: PRJC-225088-2010-CCS-JPN
Approved by: Ole A. Flagstad	Organisational unit: : DNV Kema Energy & Sustainability 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 Fertilizer Co-generation Power Project " (UNFCCC Registration Ref. No. 2687) for the period 21 December 2009 to 31 May 2010.

In our opinion, the GHG emission reductions reported for the project in the monitoring report (Version 6) of 28 September 2012 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.

DNV Climate Change Services AS is able to certify that the emission reductions from the "Pakarab Fertilizer Co-generation Power Project " during the period 21 December 2009 to 31 May 2010 amount to 22 428 tonnes of CO_2 equivalent.

Report No.: 2010-9241	Subject Group: Environment	
Report title: Pakarab Fertilizer Co-generation Power Project in Pakistan		
Work carried out by: Akira Sekine, Lumír Nemecek, Zhiang Tang, Namboodiri Krishnan; Vidyacharan Astakala		
Work verified by: Ole A. Flagstad, Hou Bao Jun, Li Lian Fei Figo		
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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
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

Pakarab Fertiliser Limited has commissioned DNV Climate Change Services AS (DNV) to carry out the verification and certification of emission reductions reported for the "Pakarab Fertilizer Co-generation Power Project " in Pakistan (the project) in the period 21 December 2009 to 31 May 2010. 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 "Pakarab Fertilizer Co-generation Power Project " for the period 21 December 2009 to 31 May 2010.

1.2 Scope

The scope of the verification 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.

1.3 Description of the project activity

Project Parties:	*Pakistan (Host)* *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 Fertiliser 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:	*21 December 2009 to 31 May 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 to be 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 need a small amount of supplementary fuel (natural gas) to obtain the maximum thermal efficiency. On the other hand the respective HRSGs are possible to 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 sharply 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 emissions are offset by heat supplied by the natural gas co-generation system. The baseline fuel and the project fuel are identical and thus those emissions can be eliminated from both the baseline emission and the project emission in a conservative manner.
The project received the request for review in this regards in October 2009. And the CDM-EB accepted the response including the above explanation, and agreed to register, subject to satisfactory corrections at the 51st CDM-EB meeting /6/.

- 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). It is calculated as the heat content of steam output minus the heat content of the returned condensate minus the heat content of the make up water.

FR_{th} (equivalent to $1/e_b$ in the registered methodology) is the fuel rate for steam generation in heat only mode determined ex-ante (GJ_{NCV}/GJ_{th}).

- 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 to be monitored (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(GJ/MWh)
- EF_{BF} is emission factor of the fuel used to generate heat determined ex-ante ($kgCO_2/TJ$)

- 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 to be calculated (TJ)
- V_{NG} *is the natural gas consumption in the monitoring period to be monitored (Nm^3)
- NCV_{NG} is the net calorific value of the natural gas determined ex-ante (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 lower 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***	TA4.others	Desk review	Site visit	Reporting	Supervision of work	Technical review	MG4 competence	TA 1.1 competence
Team leader (Verifier)	Vidyacharan	Astakala	India		✓		✓	✓		✓	
Verifier	Sekine	Akira	Japan	✓	✓	✓	✓				
Expert	Namboodiri	Krishnan	India		✓		✓				✓
Expert	Nemecek	Lumír	Czech Republic			✓					✓
Verifier with methodology competence	Tang	Walter	China		✓					✓	
Technical reviewer	Flagstad	Ole	Norway						✓		
Person with sectoral competence assisting technical reviewer	Hou	Bao Jun	China								✓
Person with sectoral competence assisting technical reviewer	Li	Lian Fei Figo	China	✓							

Duration of verification

Publishing of MR:	*29 June 2010*
Desk review:	*From 01 July 2010 to 20 August 2010*
On-site assessment:	*27 August 2010 and 2 February 2011*
Reporting, calculation checks and QA/QC:	*From 30 August 2010 to 12 October 2012*

2.1 Desk review

The basis for the verification has been the monitoring report from the project for the period 21 December 2009 to 31 May 2010, Version 2 dated 21 June 2010, and the revised monitoring report, Version 6 dated 28 September 2012 /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 /7/. The project operator has in addition supplied the verification team with procedures from its management system as well as other documentation and spreadsheets with all data necessary for verification of the emission reductions /3/, /4/, and /9/-/13/.

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 27 August 2010. As the site visit was conducted by the verification team leader with a competence of only chemical process technical area, the site-visit was conducted again on 2 and 3 February 2011 by the verification team with a competence of thermal power generation, i.e. TA 1.1 as well as TA4.others to confirm the assessment results. During the site visits, 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. Tariq Qasim Khan*	Pakarab Fertilizers Limited	Unit Manager, Instrument
Mr. Tahir Sherazi*	Pakarab Fertilizers Limited	Unit Manager, Utilities
Mr. Syed Muhammad Ali*	Pakarab Fertilizers Limited	Senior Production Engineer, Utility
Mr. Ijaz Ahmed Ghauri**	Pakarab Fertilizers Limited	Day Engineer, Utility
Mr. Hamza Manj*	Pakarab Fertilizers Limited	Process Engineer, Utilities
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. Muhammad Raza*	Pakarab Fertilizers Limited	Field Maintenance Engineer, Utilities
Mr. Rashid Saud*	Pakarab Fertilizers Limited	Instrument Head Technician, Utilities
Mr. Shuja Ahmed*	Pakarab Fertilizers Limited	Instrument Technician, Utilities
Mr. Imran Khan*	Pakarab Fertilizers Limited	Instrument Technician, Utilities
Mr. Amman Rashid*	Pakarab Fertilizers Limited	Sub Engineer, Electrical Utilities
Mr. Sohail Ahmed*	Pakarab Fertilizers Limited	Field Maintenance Technician

*: the 1st site-visit participants, **: the 2nd site-visit participants

2.2.1 Audit program

27 August 2010

10:00 Assessment of monitoring equipment and calibration procedures/records
- Steam heat measurement (flow, temperature, pressure)
- Condensate measurement (flow temperature, pressure)
- Boiler feed water heat measurement (flow, temperature)
- Power generation mearsurement
- Natural gas consumption measurement (flow, temperature, pressure)

11:00 Plant walk through
- Location of the monitoring equipment
- Location and configuration of the co-generation system including fuel gas line
- Calibration laboratory

13:30 Calculation in the spreadsheet

14:10 Other remaining issues

14:40 Preparation for wrap-up

15:20 Wrap-up meeting and tentative conclusion

16:00 End of the verification

2 February 2011

15:00 Plant walk through
- Location of the monitoring equipment
- Location and configuration of the co-generation system including fuel gas line
- Calibration laboratory

16:00 Monitoring equipment, maintenance and calibration

17:00 Operation during the monitoring period

18:00 End of the day

3 February 2011

08:30 Monitoring equipment, maintenance and calibration

11:00 Operation during the monitoring period

12:00 Preparation for wrap-up

12:15 Wrap-up meeting and tentative conclusion

16:00 End of the verification

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 and has not been sufficiently documented by the project participant, 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.

Six CARs and three CLs were raised during this 1st verification (refer to Appendix A). The project participants adequately addressed the CARs and CLs raised and provided a corrected monitoring report, Version 5 dated 02 December 2011, which was submitted to UNFCCC together with the version 01 of this report for issuance request.

This issuance request received an incomplete message on 13 March 2012, and a post registration change was requested on approved 29 august 2012 in order to address the issue raised by UNFCCC. Finally, the monitoring report was updated (version 06 of 28 September 2012) in line with the monitoring plan included in the revised approved PDD, and using the latest monitoring template form version 2.0.

The difference in the emission reduction between the first and second submission is due to an error in the calculation of the power generation of GTG1 on 17 May 2010. This error was corrected by the project participant for the second submission and verified by DNV.

3 VERIFICATION FINDINGS

This section summarises the findings from the verification of the emission reductions reported for the "Pakarab Fertilizer Co-generation Power Project " (the project) in the period 21 December 2009 to 31 May 2010.

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

According to the final validation report issued by the validator, TÜV SÜD (report number 1173531 dated 15 December2009), the project participants submitted a request for deviation to the applied methodology, AM0014 version 04, as the project participants wanted to use low calorific fuel gas from its ammonia plant as supplemental fuel of HRSGs (heat recovery steam generators). However the request was rejected by the methodology panel. According to the validation report submitted for the registration, after EB decision the PP decided that low caloric value gas (process gas) from the fertiliser process will not be used for supplementary firing of the HRSGs, and only natural gas will be used in gas turbines as well as in HRSGs. The process gas will be used again at the ammonia plant furnace as supplementary fuel. 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.

The verification team confirmed at the site visit that there was no piping connection between the low caloric fuel gas line and the fuel feed line to the HRSGs at the times of verification site-visits. Although it can not be denied that there is a possibility of installing temporary pipeline for the purpose, the verification team conducted the crosscheck by means of evaluating thermal efficiency of the co-generation units. The overall thermal efficiency during the 1st monitoring period was 77.76% 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 efficiency would have been higher. Thus it is likely that the low calorific gas had not been used during the 1st monitoring period.

As it is the 1st periodic verification, no CARs or FARs from previous verification are 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 13 July 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 co-generation systems and all instrumentation necessary for the monitoring of the emission reductions.

The project was implemented and has been in full operation since July 2009 by Pakarab Fertilizer Limited. Guarantee test runs of the GTG No. 1, No. 2 and No. 3 were started in April 2009, June 2009 and July 2009 respectively and completed with guaranteed performance. It was confirmed through the test operation reports from the supplier, UMAG Technologie GmbH /8/.

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

There is no information (data and variables) provided in the monitoring report that is different from that stated in the registered PDD and which is likely to increase the estimates of emission reductions in the current or the future monitoring periods.

During this monitoring period, the emission reductions of the project are significantly less than expected in the PDD. This is mainly due to limitation in gas delivery from supplier. The natural gas consumption during the monitoring period (162 days) was 39 10^6 Nm^3, while it was estimated in the PDD as 130.09/365*162= 58 Nm^3 for the same period (ie 32% less). This result in both lower baseline emission from heat output (CAHO) used in the fertilizer plant, as well as lower baseline emission from electricity output (CEO) than expected in the PDD. In addition, there was annual turn around in January so that the project was running at reduced capacity.

3.5 Compliance of monitoring plan with monitoring methodology

DNV is able to confirm that the monitoring plan contained in the approved revised PDD dated 13 July 2012 is in accordance with the approved methodology applied by the project activity, i.e. AM0014 (version 04). And thus it was concluded that any revision to the monitoring plan or deviation prior to submitting request for issuance need not be sought and approved by the CDM Executive Board.

3.6 Compliance of monitoring with the monitoring plan

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

All parameters, i.e. project emission 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 in the project scenario is less than baseline.

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 described in the monitoring report. The information flow for the 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 /12/.

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 output 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 output = 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 steam heat value used to calculate the 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 of the heat output. The monitoring plan in the registered PDD specifies only “measuring frequency” as continuous.
Type of monitoring equipment:	The flowrate is measured by orifice and differential pressure sensor type with pressure and temperature compensation function. The heat content (enthalpy) of the steam is provided by 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	Accuracy specified in the registered PDD: ±2.5%. Vendor specification: Flow sensor: ±0.13%

represent good monitoring practise?	Temperature sensor: ±0.1% Pressure sensor: ±0.1% The combined uncertainty of the measurement is ±0.19%, and is 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: 05 December 2009, 04 January 2010, 03 February 2010, 05 March 2010, 05 April 2010, 05 May 2010 Validity: 04 June 2010 Steam pressure sensor (PT-05) Calibration date: 05 December 2009, 04 January 2010, 03 February 2010, 05 March 2010, 05 April 2010, 05 May 2010 Validity: 04 June 2010 Steam temperature sensor (TT-05) Calibration date: 05 December 2009, 04 January 2010, 03 February 2010, 05 March 2010, 05 April 2010, 05 May 2010 Validity: 04 June 2010
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 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 return condensate heat value used to calculate the 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 of the heat output.
Type of monitoring equipment:	Condensate flowrate is measured by flow meter with temperature sensor 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 specified in the registered PDD for CAHO was ±2.5%. Vendor specification: Flowmeter: ±0.13% Temperature: ±0.10 The uncertainty of the measurement is better than the accuracy specified 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?	Condensate flow meter (FT-09) Calibration date: 05 December 2009, 05 January 2010, 04 February 2010, 08 March 2010, 07 April 2010, 07 May 2010 Validity: 06 June 2010 Condensate temperature sensor (TT-06) Calibration date: 02 December 2009, 01 January 2010, 01 February 2010, 03 March 2010, 02 April 2010, 03 May 2010 Validity: 02 June 2010
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 the 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 of the heat output
Type of monitoring equipment:	Make up water flowrate is measured by flow meter with temperature sensor. The heat content is provided by 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 specified in the registered PDD: ±2.5%.Vendor specification: Flow meter:±0.13% Temperature: ±0.10 The uncertainty of the measurement (incl. steam, condensate and make up water) is better than specified 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?	Demineralised make-up water flow meter (FT-05) Calibration date: 06 December 2009, 05 January 2010, 04 February 2010, 08 March 2010, 07 April 2010, 07 May 2010 Validity: 06 June 2010 Demineralised make-up water temperature sensor (TT-02) Calibration date: 02 December 2009, 01 January 2010, 01 February 2010, 03 March 2010, 02 April 2010, 03 May 2010 Validity: 02 June 2010
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 transformator 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. 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: 22 January 2011 No. 3 gas turbine generator output (C16) Date of calibration: 26 August 2008 (supplier calibration) Commissioning: 22 January 2009 Validity: 22 January 2011 Emergency diesel generator output (C11) Date of calibration: 26 August 2008 (supplier calibration) Commissioning: 22 January 2009 Validity: 22 January 2011 No. 1 station transformer output (C6) Date of calibration: 26 August 2008 (supplier calibration) Commissioning: 22 January 2009 Validity: 22 January 2011 No. 2 station transformer output (C14) 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 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 consumption of cogeneration plant (V_{NG})
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	Yes

of monitoring equipment? (Yes / No):	
Is(are) calibration(s) valid for the whole reporting period?	Gas turbine generator fuel consumption: Flow meter (FT-01) Date of calibration: 4 December 2009, 4 January 2010, 3 February 2010, 5 March 2010, 5 April 2010, 5 May 2010 Validity: 04 June 2010 Pressure transmitter (PT-01) Date of calibration: 4 December 2009, 4 January 2010, 3 February 2010, 5 March 2010, 5 April 2010, 5 May 2010 Validity: 04 June 2010 Temperature sensor (TT-01) Date of calibration: 4 December 2009, 4 January 2010, 3 February 2010, 5 March 2010, 5 April 2010, 5 May 2010 Validity: 4 June 2010 Heat recovery steam turbine generator fuel consumption: Flow meter (FT-12) Date of calibration: 1 December 2009, 1 January 2010, 1 February 2010, 3 March 2010, 2 April 2010, 3 May 2010 Validity: 2 June 2010 Pressure transmitter (PT-10) Date of calibration: 1 December 2009, 1 January 2010, 1 February 2010, 3 March 2010, 2 April 2010, 3 May 2010 Validity: 2 June 2010 Temperature sensor (TT-10) Date of calibration: 1 December 2009, 4 January 2010, 1 February 2010, 3 March 2010, 2 April 2010, 3 May 2010 Validity: 2 June 2010
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	Full 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?	

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	Natural gas net and gross calorific values NCV_{NG} and GCV_{NG}
Measuring frequency:	$GCV_{NG:}$ Monthly NCV_{PFL} and $GCV_{PFL:}$ daily
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 approved revised PDD.
Type of monitoring equipment:	GCV_{NG} is sourced from gas supplier invoices (=GCV_{GS}) NCV_{NG} is calculated as follow: $NCV_{NG} = GCV_{GS*} (NCV_{PFL}/GCV_{PFL})$ NCV_{PFL} and GCV_{PFL} are calculated according to ISO6976, based on the natural gas composition determined in the laboratory by gas chromatography.
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 (NCV_{NG}: calculated, GCV_{NG} : gas supplier data)
Calibration frequency /interval:	Gas chromatograph used for gas composition analysis by PFL was calibrated monthly /15/. ,
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, the calibration is performed using standard test gas and calibration factor is determined for each gas components.
Is(are) calibration(s) valid for the whole reporting period?	Yes, calibration was done monthly during the monitoring period /15/.
If applicable, has the reported data been cross-checked with other available data?	Not applicable
How were the values in the monitoring	Compared with the laboratory daily analysis

report verified?	records
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 monitoring methodology? (Yes / No)	Yes, AM0014 version 04 requires annual (during a monitoring period) recording. 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 in line 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 <u>Steam turbine generator-2 output</u> Date of calibration: 26 August 2008 (supplier calibration) Commissioning: 22 January 2009 Validity: 22 January 2011 <u>Steam turbine generator-3 output</u> 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 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

3.7 Assessment of data and calculation of emission reductions

The calculation of baseline emissions, project emissions and emission reductions for the respective 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 but 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 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/.
Spreadsheets including corresponding re-calculations were made available for the verification team.

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_2/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 approved revised 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 registered PDD.

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

For the cogeneration heat and electricity output, natural gas consumption data provided in the spreadsheets from the participant were cross-checked with the daily operation log sheets in the plant control room by sampling. During the monitoring period of 162 days, 50 daily log-sheets were checked.

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.

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 162 days, 50 413 MWh of electricity was generated by the project cogeneration plants and 217 MWh of electricity was generated by the baseline dedicated power plants and the ratio was 0.4%. The total power generation by the project cogeneration plants and the baseline dedicated plants was 50 630 MWh and was 76 % of the annual historical average power generation from 2004 to 2006, i.e. 149 900 MWh * 162 days / 365 days = 66 530 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.

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 spreadsheets. 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 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 ammonia nitrate plant of the Pakarab Fertilizer Limited has recently been ISO9001:2000 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" in Pakistan (UNFCCC Registration Reference No.2687) for the period 21 December 2009 to 31 May 2010.

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 06 dated 28 September 2012. 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 21 December 2009 to 31 May 2010 are fairly stated in the monitoring report, Version 06 dated 28 September 2012.

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 21 December 2009 to 31 May 2010 amount to 22 428 tonnes of CO_2 equivalent.

Bangalore and Oslo, 15 October 2012

Astakala Vidyacharan
CDM Verifier
DNV India

Ole A. Flagstad
Approver,
DNV Climate Change Services

5 REFERENCES

5.1 Documentation provided by the project participants

/1/	● CDM Monitoring Report, Pakarab Fertilizer Co-generation Power Project (reference number: 2687), version 2 dated 21 June 2010 ● CDM Monitoring Report, Pakarab Fertilizer Co-generation Power Project (reference number: 2687), version 6 dated 28 September 2012
/2/	● CDM Project Design Document: "Pakarab Fertilizer Co-generation Power Project, version 11" dated 8 December 2009, and revised version 3 dated 13 July 2012. ● TÜV-SÜD, validation report "Pakarab Fertilizer Co-generation Power Project, revision 5" dated 15 December 2009
/3/	● CDM Project Spreadsheet for the verification period 21 December 2009 to 31 May 2010: - December 2009 - January 2010 - February 2010 - March 2010 - April 2010 - May 2010 - Monitoring protocol for the first monitoring period
/4/	Daily operation log book, 21 December 2009 – 31 May 2010

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

/5/	CDM Executive Board: Validation and Verification Standard, version 02.0
/6/	CDM Executive Board: meeting report, EB51, para55
/7/	CDM Executive Board: Approved Monitoring methodology AM0014, version 04

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

/8/	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
/9/	IQNet and AIB-VINÇOTTE USA Inc., ISO9001:2000 Certificate, 27 June 2007
/10/	SUI Northern Gas Pipelines Limited, Monthly invoice (with GCV) - 15 January 2010 - 15 February 2010 - 15 March 2010 - 15 April 2010 - 17 May 2010 - 15 June 2010
/11/	Pakarab Fertilizer Limited Laboratory, Monthly natural gas analysis report - for December 2009, 1 January 2010 - for January 2010, 2 February 2010 - for February 2010, 1 March 2010 - for March 2010, 1 April 2010 - for April 2010, 3 May 2010 - for May 2010, 1 June 2010
/12/	Pakarab Fertilizer Limited, Calibration Record: <u>Steam Flow Sensor (FT-08):</u> - 5 December 2009 - 4 January 2010 - 3 February 2010 - 5 March 2010 - 5 April 2010 - 5 May 2010 <u>Steam Pressure Sensor (PT-05):</u> - 5 December 2009 - 4 January 2010 - 3 February 2010 - 5 March 2010 - 5 April 2010 - 5 May 2010 <u>Steam Temperature Sensor (TT-05):</u> - 5 December 2009 - 4 January 2010 - 3 February 2010 - 5 March 2010 - 5 April 2010

	- 5 May 2010 Condensate Flow Meter (FT-09): - 5 December 2009 - 5 January 2010 - 4 February 2010 - 8 March 2010 - 7 April 2010 - 7 May 2010 Condensate Temperature Sensor (TT-06): - 2 December 2009 - 1 January 2010 - 1 February 2010 - 3 March 2010 - 2 April 2010 - 3 May 2010 Demineralized Make-up Water Flow Meter (FT-05): - 6 December 2009 - 5 January 2010 - 4 February 2010 - 8 March 2010 - 7 April 2010 - 7 May 2010 Demineralized Make-up Water Temperature Sensor (TT-02): - 2 December 2009 - 1 January 2010 - 1 February 2010 - 3 March 2010 - 2 April 2010 - 3 May 2010 Natural Gas Flow Meter to Gas Turbine Cogeneration Plants (FT-01): - 4 December 2009 - 4 January 2010 - 3 February 2010 - 5 March 2010 - 5 April 2010 - 5 May 2010 Natural Gas to Turbine Cogeneration Plants Pressure Sensor (PT-01): - 4 December 2009 - 4 January 2010 - 3 February 2010 - 5 March 2010 - 5 April 2010 - 5 May 2010 - 4 June 2010

	Natural Gas to Turbine Cogeneration Plants Temperature Sensor (TT-01): - 4 December 2009 - 4 January 2010 - 3 February 2010 - 5 March 2010 - 5 April 2010 - 5 May 2010 - 4 June 2010 Natural Gas Flow Meter to Heat Recovery Steam Generators (FT-12): - 1 December 2009 - 1 January 2010 - 1 February 2010 - 3 March 2010 - 2 April 2010 - 3 May 2010 Natural Gas to Heat Recovery Steam Generators Pressure Sensor (PT-10): - 4 December 2009 - 1 January 2010 - 1 February 2010 - 3 March 2010 - 2 April 2010 - 3 May 2010 - 2 June 2010 Natural Gas to Heat Recovery Steam Generators Temperature Sensor (TT-10): - 1 December 2009 - 4 January 2010 - 1 February 2010 - 3 March 2010 - 2 April 2010 - 3 May 2010 - 2 June 2010 Natural Gas Flow Meter to the Old Power House (FT-1501): - 10 July 2009 - 26 February 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)
/13/	Pakarab Fertilizer Limited, Procedure for calibration factor determination and application, 16 September 2009
/14/	Pakarab Fertilizer Limited, Monthly Utility Report, December 2009 to May 2010
/15/	Pakarab Fertilizer Limited, Gas Chromatograph calibration reports, December 2009 to May 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 registration date of the project activity is missing in the published monitoring report.	The registration date was inserted.	The registration date of 21 December 2009 was confirmed to be inserted into the updated monitoring report and found to be correct. CAR closed
CAR 2	In the section D.2, the condensate pressure sensor (PT-06) is described. However the pressure compensation is to applied to obtain the enthalpy of the return condensate. The table needs be corrected.	The information regarding PT-06 was removed.	The description was conformed to be removed appropriately. CAR closed
CAR 3	Electricity generated by the baseline dedicated power plants has been monitored continuously and recorded every two hours actually. However the measuring/recording frequency is specified to be "every second year" in the monitoring report.	The description was corrected from "every second year" to "measured continuously and recorded every two hous".	The correction was confirmed to be made properly. CAR closed
CAR 4	The decimal digits used in the spreadsheet and the monitoring report are inconsistent.	The decimal digits used in the monitoring report was corrected to be in line with the spreadsheet.	The correction was confirmed to be made properly. CAR closed
CAR 5	In the section E.2, the natural gas consumption is specified to be recorded as "daily average" in the monitoring report. However it has been recorded as "daily accumulative" actually. It shall be corrected.	The description was corrected to "daily accumulative".	The correction was confirmed to be made properly. CAR closed

CAR ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CAR 6	In the section E.3, leakage calculation is explained referring "natural gas consumption". However the description is "national gas consumption". It shall be corrected.	The description was corrected to "natural gas consumption".	The correction was confirmed to be made properly. CAR 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.	Confirmed the procedure /13/ is in line with the registered PDD, and the corrected monitoring report is in line with the procedure. CL closed
CL 2	The calorific value of the natural gas consumed is to be obtained by the calculation. However it is not specified or referred in Section D.2. It should be clarified in the monitoring report.	The calculation is explained in Annex 6 of the monitoring report. The description in the section D.2 was added as "refer to Annex 6".	The clarification in the section D.2 is appropriate. CL closed
CL 3	The fate of the electricity generated by the baseline dedicated power plant should be evaluated using the historic generation of the plant and the electricity generation during the monitoring period.	The explanation is added in the monitoring report discussing the historic power generation.	The explanation is appropriate. The fate of the electricity generated by the baseline dedicated power plant during the monitoring period was clarified to be sufficiently small compared with the historic power generation. CL 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	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. It 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 1st verification period was lower than expected and thus it is likely that no additional fuel which was not accounted for was utilized during the period. This FAR need to be verified for each subsequent verification as well.

Forward action requests from previous verification

There are no forward action requests (FAR) raised at the 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		

Forward action requests from this verification

As it is the first periodic verification, there are no forward action requests remaining as open issues.

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

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	Not Applicable	☐ Yes ☐ No	Not Applicable
Temporary deviations from the registered monitoring plan and/or monitoring methodology	Not Applicable	☐ Yes ☐ No	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. 2) 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	*29 August 2012*
Changes to the project design of a registered project activity	Not Applicable	☐ Yes ☐ No	*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/

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 33 years. Prior to joining DNV, having 33 years experience in nuclear, hydro, fossil-fuelled power and other renewables . 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 sectorial 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 desulfurrization and reforming, and utility management, 9 years experience in Lubricant Industry covering design, manufacturing and quality management of lubricating oils and metal warking 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 auditting 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.

Krishnan Namboodiri

Holds graduate degree in chemical engineering and has done a short term diploma course in Management. Prior to joining DNV in 2008, has had 24 years of direct work experience in the fertilizer and chemicals industry. Work experience covers 5 years in process design & engineering for chemical industry; 7 years in technical services, including environment management activities, 7 years in project management and 5 years in training & corporate planning in fertilizer & petrochemical manufacturing units. Has been actively involved in Management System Audits as per ISO 14001 for more than 8 years.

The above work experience includes-(a) experience in steam system optimization & trouble shooting , development of improvement schemes in large fertilizer & caprolactam complex (b) Design and engineering, efficiency studies and development of efficiency improvement schemes for fossil fuel fired steam & power generation plants (c) Implementation of energy saving measures in Ammonia plants , sulphuric acid plant etc (d)Monitoring, trouble shooting and development & implementation of improvement schemes for of pollution control facilities (chemical, aerobic & anaerobic treatment systems) in Fertilizer and petrochemical complex. Development & implementation of landfill facilities for solid and hazardous wastes from fertilizer & caprolactam manufacturing complex.

He has received extensive training in the CDM validation and verification process. He is an appointed GHG auditor for the CDM validation and verification program of DNV and has performed validation & verification of several CDM projects.

His qualification, industrial experience and experience in CDM demonstrate his sufficient sectoral competence in (i) Thermal energy generation from fossil fuels as well as thermal electricity from solar, (ii) Waste handling and disposal (iii) Energy demand and (iv) Chemical process industries

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."

Zhiang Tang

Mr. Zhiang Tang: holds a Bachelor Degree in Thermodynamic Engineering and a Master Degree in Business Administration. Having an overall experience of around twelve years. Prior to joining DNV, having around 5 years in the field of power industry covering of consulting and engineering for thermal power, wind power, hydropower and solar energy projects. His experience also covers the field of space industry for thermal design, the energy analysis and thermal control for about 4 years.

He has gained the relevant financial and investment knowledge through his courses in MBA. He has applied his financial and investment knowledge in his consulting work for the power industry, such as investment risk analysis, financial accounting, investment parameters assessment, etc.

He has experience of more than 3 years in validation and verification of numerous CDM, VCS and GS projects in DNV both in China and abroad. His qualification, industrial experience and experience in CDM demonstrate his sufficient sectoral competence in "Energy Generation from Renewable Energy Sources".

Ole Andreas Flagstad

Ole Andreas Flagstad holds a Master Degree in thermodynamics/energy efficiency and has an overall working experience of around 20 years. He has worked both in public and private sector, including 5 years with a research institute (IFE) where specific responsibilities included running an energy efficiency network in the food industry and direct intervention with the industry. Other work experience includes working in European research programmes, administering national research programmes and International Energy Agency annexes.
Ole Andreas Flagstad has more than 5 years experience in validation and verification of projects within CDM, JI and other carbon credit schemes. His qualifications and experience in carbon credit schemes (primarily CDM and JI), qualifies him for different roles in a broad group of technical areas.

Hou Bao Jun

Mr. Hou Bao Jun holds a Master Degree in Applied Chemistry. Having an overall experience of around 5 years. Prior to joining DNV, having around 4 years experience in thermal power plant and about 10 months experience in chemical cleaning field. He was responsible for the normal operation of water treatment equipment and was tasked to redesign the production process to raise its efficiency. He participated in the device process design and construction. He has accumulated rich experience in the construction of the power equipment. He is also familiar with other areas of a power plant, namely the boiler system, the turbine system and the electricity system. His experience covers the fields of chemistry and energy. His qualification, industrial experience demonstrate his sufficient sectoral competence in "Thermal Energy Generation from Fossil Fuels and Biomass including Thermal Electricity from Solar" and "Waste Handling and Disposal".

Li Lian Fei Figo

Mr. Li Lian Fei, Figo holds a Bachelor Degree in the Chemical Engineering. Having an overall experience of more than three years in the field of chemical industries. Prior to joining DNV having these three years experience in chemical process industry covering sulfur burning sulfuric acid plant, heavy oil boiler, de-salted water system, and water purification system, involved in basic design, operation practice, EPC, commissioning, and troubleshooting of these plants.

He has experience of more than one year in validation and verification of several CDM projects in renewable and N2O area in DNV.

His qualification, industrial experience demonstrate his sufficient sectoral competence in "Chemical Processes Industries".