



MONITORING REPORT II

MEN-TANGERANG 13.6 MW NATURAL GAS COGENERATION PROJECT

This Report is prepared for purpose of Verification & Certification of resulting emission reduction from the project activity.

PROJECT DETAILS:

PROJECT REFERENCE ID	:	1313	
REGISTRATION DATE	:	26 FEBRUARY 2008	
PROJECT DEVELOPER	:	MANUNGGAL ENERGI NUSANTARA	
PROJECT PARTICIPANTS	:	<ul style="list-style-type: none">PT MANUNGGAL ENERGI NUSANTARAMITSUBISHI UFJ SECURITIES CO., LTD.DEUTSCHE BANK AG	<div>INDONESIA</div> <div>JAPAN</div> <div>UNITED KINGDOM</div>
REPORTING PERIOD	:	01 SEPTEMBER 2008 to 31 AUGUST 2009	
MONITORING REPORT NO.	:	II (SECOND)	
METHODOLOGY	:	AM0014 VER.03 NATURAL GAS BASED PACKAGE COGENERATION	
ACCOMPANYING DOCUMENTS	:	<div>DOCUMENT TITLE</div> <ul style="list-style-type: none">EMISSION REDUCTION DELIVERY REPORT II (Period: 1 September 2008 – 28 February 2009)EMISSION REDUCTION DELIVERY REPORT III (Period: 1 March 2009 - 31 August 2009)ERDR II CONSOLIDATED Version 2.0.0ERDR III CONSOLIDATED Version 2.0.0EF JAMALI 07 Version 1.4.0MRII Consolidated Spreadsheet Version 2.0.1	<div>TYPE</div> <div>HARDCOPY REPORT</div> <div>HARDCOPY REPORT</div> <div>SPREADSHEET</div> <div>SPREADSHEET</div> <div>PUBLISHED SPREADSHEET</div> <div>PUBLISHED SPREADSHEET</div>



Zeus-Innavitas is a Carbon Asset Management Company and is commissioned by PT Manunggal Energi Nusantara to manage the Project's carbon asset portfolio.

This Monitoring Report is prepared based on operational data & information provided by the Project Developer/Operator. Zeus-Innavitas is not a Project Participant.

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DOCUMENT HISTORY

Version	Completion Date	Description	Note
Version 1.0.0	11 November 2009	Internal Review Completed	First Version submitted to DOE for publication
Version 2.0.0	24 February 2010	Final Version	2 nd Version to be submitted for Request for Issuance, based on the following internal versions: <ul style="list-style-type: none"> Monitoring Report Version 1.9.0 ERDR II Consolidated Spreadsheet Version 1.5.0 ERDR III Consolidated Spreadsheet Version 1.5.0 MR II Consolidated Spreadsheet Version 1.7.0 EF JAMALI 07 Version 1.4.0
Version 2.0.3	23 June 2010	Final Version	Updated Project emission due to delayed calibration instrument NG-100 in the month of May and June 09 <ul style="list-style-type: none"> MR II Consolidated Spreadsheet Version 2.0.1
Version 2.0.4	05 November 2010	Final Version	Update the Appendix A - Method Applied for Calculation with more explanation on the reason to use latest approved Tool to calculate grid EF.

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1 PROJECT ACTIVITIES

1.1 BACKGROUND

PT Manunggal Energi Nusantara (hereafter referred as “MEN”, “Project Developer”, or “Project Operator”) is an energy service company in the field of clean and renewable energy. The company entered into engagement to supply electricity and steam to its subscribers using natural gas cogeneration technology. The Project Plant and the subscribers are located within Argo Pantes Tangerang integrated textile industrial complex.

The new supply of electricity and steam from the new installation effectively reduces (a) the amount of electricity the complex imports from PLN and (b) the amount of coal/residue oil that the complex needs to generate steam. The Project procures natural gas from PT Perusahaan Gas Negara (“PGN”), which is the national gas distribution company.

The investment was proposed with application of UNFCCC-sanctioned Clean Development Mechanism which mandated project activities and its emissions to be regularly reported. This report is the 2nd of such report to be submitted to CDM Executive Board.

1.2 IMPLEMENTATION TO DATE

Construction, Commissioning & Operation Status

The Project has been constructed and operated as planned. It's compliance against the Project Design Documentation was verified by a Designated Operational Entity (DOE) in the Project's first verification report. No physical changes had been carried out within this period of reporting.

Electricity Production and Distribution

The Project was proposed to deliver (a) electricity to three subscribers: PT Argo Pantes, PT. Argo Fajar and PT Argo Beni and (b) steam to PT Argo Pantes. Due to financial down-turn, PT Argo Fajar and PT Argo Beni officially withdrew its commitment to procure electricity from the Project, and leaving only PT Argo Pantes as the only remaining subscriber.

As consequence to such cancellation, the Project's utilization level and its subsequent CERs production are below expectation and likely to remain so in the coming months if no new subscribers are secured. In order to sustain business, the Project Developer considers exporting excess electricity to the PLN-operated national grid, and likely to commence delivery in first half of 2010 (outside this reporting period). In view of grid-sales restriction in the underlying methodology, the project developer took proactive steps to preserve its CDM status by seeking guidance from the CDM Executive Board.

For clarity, no sales agreement has been concluded with PLN and no electricity had been exported to the grid within this reporting period.

CDM Process to Date

- **Registration** The Project was submitted for registration in 28 August 2007. Following corrections in its validation report, the Project was granted registration in 26 February 2008.
- **First Verification** The first verification took place on 17th November 2008 by SGS United Kingdom, and a Request for Issuance was submitted in 08 December 2008, covering for period of 26 February 2008 to 31 August 2008. The board granted issuance in the amount of 17,154 tCO₂ in 24 March 2009.
- **Updated Modalities of Communication.** The original Modalities of Communication was replaced to update contact details of signatories using the new Modalities of Communication Form, and to add Deutsche Bank AG as a Project Participant. The new form is effective since 3rd July 2009.
- **Other CDM Processes.** In order to pursue its intention to sell electricity to the grid authority, Zeus-Innavitas on behalf of MEN has filed a Request of Clarification via TUV-SUD in December 2008 requesting guidance to apply Post-Registration changes. Upon recommendation by Secretariat, a letter was submitted to the CDM Executive Board on 31st of March 2009. On 22nd of June 2009, the Secretariat recommended the Project Developer to wait for the procedure to apply changes for projects already registered, to be discussed in EB47 and approved in EB48.

Immediately following its approval, Zeus-Innavitas, on behalf of MEN, requested TUV-NORD to prepare a validation opinion to evaluate the impact of the proposed changes in compliant with the established rules. The Post-Registration change will only take into effect in the next reporting periods.

1.3 REPORTING PERIOD

This Monitoring Report covers project activity for period starting 1st of September 2008 and ending 31st of August 2009. In accordance with its monitoring plan, the annual period is split into two half-year periods reported in the following documents:

- Emission Reduction Delivery Report II (ERDR II) : for period of 1 September 2008 to 28 February 2009; and
- Emission Reduction Delivery Report III (ERDR III): for period of 1 March 2009 to 31 August 2009.

1.4 DESCRIPTION OF PROJECT ACTIVITY

The project implementation doesn't change from its original intention as described in the PDD. It covers the installations of five natural gas power generator coupled with waste heat boilers. It is designed with electrical generation capacity of 13.6 MW (gross) and steam generation capacity of 9.5 tonnes per hour, which can be varied depending on the required qualities. Simplified schematic diagram of the project activity is shown in the following figure.

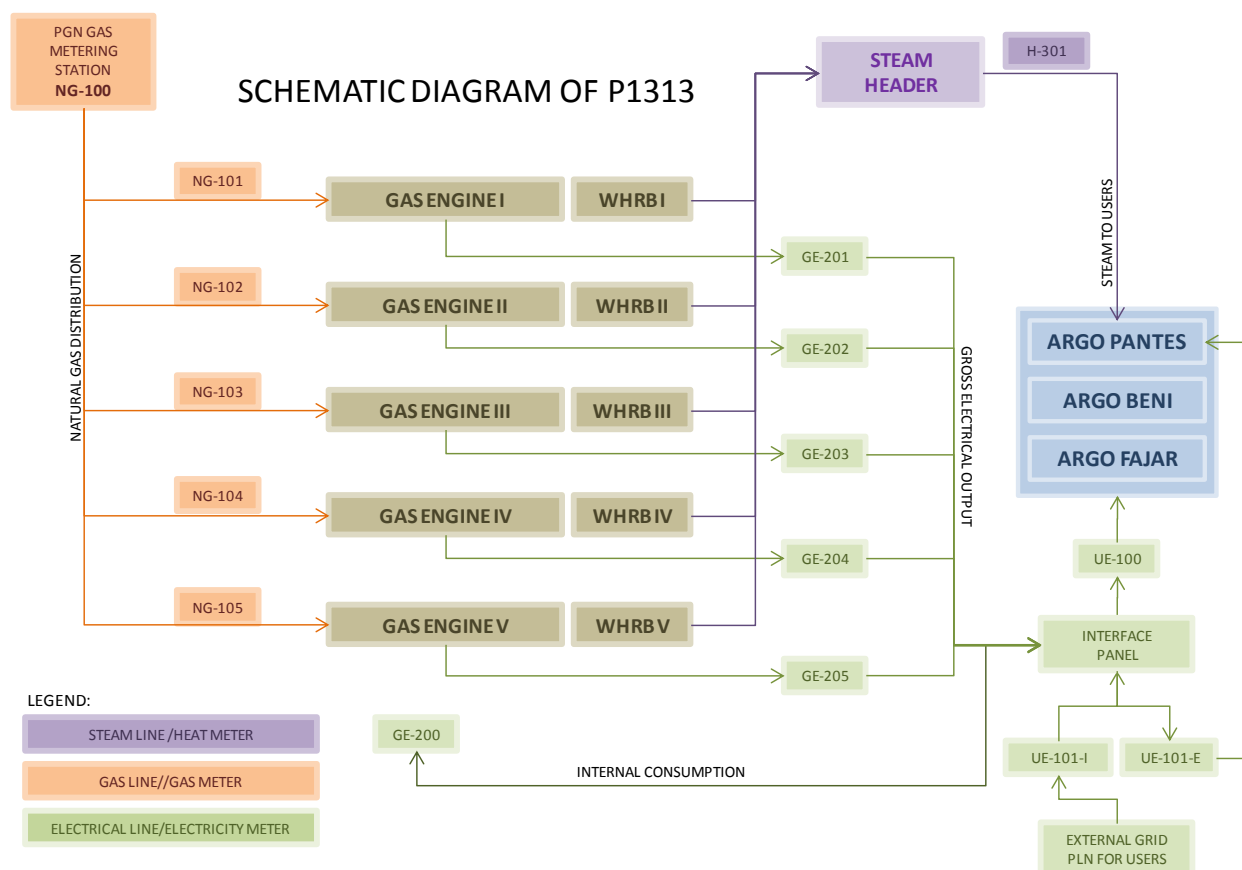


Figure 1. Project's Simplified Schematic Diagram, including position of its monitoring implements

Primary Instruments For purpose of this monitoring report, the primary instrument is defined as instrument which directly measures parameters that are specified in the Project Design Documents Section B.7.1. This includes:

- Gas flow meter **NG-100** owned and operated by PGN.
- Steam/heat meter **H-301** measuring aggregate flow-rate and conditions of steam delivered to the user.
- Electricity meters **GE-201** to **GE-205** measuring gross electrical output from individual gas engine.

- Electricity meter **GE-200** measuring total electricity consumption of the project.

Compliance of these primary instruments relative to the PDD requirements is described in Table 1 in the ensuing Section 1.5.

Secondary Instruments The secondary instruments are instruments employed for purpose of safeguarding credibility of critical data. This includes:

- INTERFACE PANEL Electricity Meters consisting of electricity meters: **UE-100** and **UE-101(I/E)**. Net electricity supplied to the user as measured by the primary instruments is compared against balance of readings from these meters.
- Gas flow-rate to the individual gas engines **NG-101 to NG-105**. Gas consumption as measured by the primary meter is compared against the aggregate readings from these instruments.

No secondary instrument is available for measurement of steam/heat to the user. However, during the second-half of the monitoring period, the client suggested installation of a secondary meter to ensure the accuracy of the reading. The installation of a secondary meter (**H-302**) is now incorporated in the project's planning, but is not yet effective within this period.

Emission reduction is calculated based on reading from the primary meters, except in situation where the magnitude of error is detected to be above the tolerance sets in the PDD.

1.5 KEY MONITORED PARAMETERS

Table 1 summarizes project-specific parameters that are monitored against requirement in the PDD. Readings from all instruments listed in this table are logged on daily basis as mandated by the PDD.

Table 1 – Key monitored parameters and its relevant instrument.

PDD Ref.	Output of measurements	Source of Data as required in Section B.7.1 of PDD	Accuracy Mandated in PDD	Comparative Medium for Cross Checking
		<i>Instruments Installed</i>	<i>Instrument's Accuracy</i>	<i>Comparative Medium during Implementation.</i>
MCHO (monthly) or CAHO (annually)	Monthly heat recovered in the project waste heat boiler	Steam flow and heat metering device	4% or less	Sales Invoice to Argo Pantes
		H-301 <i>Heat Flow computer measuring steam flow-rate, temperature and pressure.</i>	<i>+/-0.5% at 95% confidence level.</i>	<i>Billing is based on measurement (mass flow-rate) of the same instrument.</i>
CEO	Amount of electricity generated by the Project net of its parasitic consumptions	Electricity meter measuring net delivery to individual users	4% or less	Sales Invoice to subscribers
		GE-201 to GE 205 <i>Built in gas-engine DIA.NXT System, metering (amongst others) electricity production from individual gas engines</i>	GE-201 to GE-205 , accuracy class of 0.5 or deviation of +/-0.1 at cosphi 1.	<i>Only 1 subscriber so far.</i>
		GE-200 <i>Independent electricity meter measuring parasitic consumptions.</i> <i>Calculated as aggregate readings of GE-201 to GE205 deducted by reading from GE-200.</i>	GE-200 <i>+/-0.15% reading + 0.025% full scale at 95% confidence level.</i>	<i>However reading is compared with balance of electricity recorded by instruments UE-100 and UE-101I/E</i>
VNG	Amount of natural gas consumed in Normalized Volume	Gas meter entering MEN facility	4% or less	PGN Gas Bill
		NG-100 Gas meter measuring incoming gas controlled by PGN.	NG-100 is calibrated to error level of less than 0.5%. This flow-meter is equipped with volume corrector sets to 1 bar, 27 degC as specified in the gas contract.	<i>NG-101 o NG-105</i> <i>Gas meters measuring gas input to individual gas engines.</i> <i>Calculated as aggregate reading of NG-101 to NG 105 in Normal Volume.</i>

PDD Ref.	Output of measurements	Source of Data as required in Section B.7.1 of PDD	Accuracy Mandated in PDD	Comparative Medium for Cross Checking
		<i>Instruments Installed</i>	<i>Instrument's Accuracy</i>	<i>Comparative Medium during Implementation.</i>
			For purpose of reconciliation with the secondary meter, the volume is corrected to normal (1bar, 0 degC)	
NCV _{NG}	Net calorific value of natural gas	Periodic gas analysis from gas suppliers <i>Periodic gas analysis quoted only Gross Calorific Value. Thus, equivalent Net Calorific Value is re-calculated using ASTM-compliance method.</i>	N/A	IPCC 2006 Table 1.2
D _{NG}	Density of natural gas	Periodic gas analysis from gas suppliers <i>Periodic gas analysis quoted only Gross Calorific Value. Thus, equivalent Net Calorific Value is re-calculated using ASTM-compliance method.</i>	N/A	N/A

Table 2 –Monitored Parameters specific to Grid Emission Factor

PDD Ref.	Description	Source of Data Used in this Reporting Period
$F_{i,j,y}$	Consumption of fuel type i in year y for power plant in JAMALI grid excluding the low-cost must run sources (group j, for Operating Margin)	The following sources are used in the following preferential order: 1. Official publications from individual power plant (see Table 19) 2. Official correspondence where publication is not available (see Table 19) 3. In situation where (1) and (2) are not available, the power plant is handled in accordance with latest <i>Tool to Calculate Emission Factor for an Electricity System</i> by assigning appropriate generation efficiency (see Table 20)
$F_{i,m,y}$	Consumption of fuel type i in year y for power plant in JAMALI grid which represents five most recently build power plants, or power plants capacity addition that comprise 20% of system generation whichever the larger (group m, for Build Margin)	The same data source and preferential order as per $F_{i,j,y}$. Data used for Build Margin are compiled in Table 26.
$\sum_j GEN_{j,y}$	Generation data for power plant in JAMALI grid excluding the low-cost must run (group j, for Operating Margin)	Official publication from JAMALI grid operator PT PLN P3B
$\sum_j GEN_{j,y}$	Generation data for power plant in JAMALI grid which represents five most recently build power plants, or power plants capacity addition that comprise 20% of system generation whichever the larger (group m, for Operating Margin)	Official publication from JAMALI grid operator PT PLN P3B
GEN _{IMPORT,j,y} EF _{CO2,i,IMPORT}	Generation data & associated emission factor of power plants <u>exporting to</u> JAMALI grid excluding low-cost must-run sources (group j)	Official publication from JAMALI grid operator PT PLN P3B suggested that such import does not occur this period.
NCV _i	Net calorific value of fuel type i used by power plant connected to the grid	Country specific information from reliable publications (See Table 22)
EF _{CO2,i}	CO2 Emission factor of fuel type i used by power plant connected to the grid	Table 1.4, 2006 IPCC Report representing lower limit emission factor (See Table 22)

2 QUALITY CONTROL & MONITORING PROGRAM

2.1 STANDARD PROCEDURE FOR CDM MONITORING PROGRAM

In order to ensure consistency between monitoring implementation and the PDD, the Project Developer applies a CDM Standard Operating Procedure (SOP). The procedure was first tested for period of January 2008, and was fully implemented for month of February 2008 onward. The procedure provides interpretations of monitoring plan described in the PDD into actual step-by-step instructions/responsibilities for all members of CDM Team. It also designates the structure of monitoring implementations, reporting lines, consolidation process and internal evaluation process, and accompanied with pre-designed data collection forms.

Following first verification in November 2008, the standard procedure was reviewed and updated by the CDM team, resulted in some revisions in (a) the pre-designed Monitoring Forms and (b) improvement in the internal audit follow-up method based on input from various parties.

2.2 ORGANIZATION STRUCTURE

In order to distribute the monitoring & reporting load throughout the entire year, the monitoring implementation is structured around three functional roles: (a) Plant Operator, (b) a CDM Manager, and (c) one Member of Management, heading the CDM Activity. The reporting structure is split into four layers of daily report, monthly report, mid-term report and final monitoring report, all simplified and delegated. On six-monthly basis, the monitoring activity is audited by an external party (Zeus-Innavitas) for correctness and completeness, and the result is reported to the management team as an Emission Reduction Delivery Report (ERDR). Participants of the CDM Monitoring Program as well as their respective obligations are summarized in Figure 2 overleaf.

For quality control, each report produced is checked by functional group to which the report is submitted. For example, the CDM Manager evaluates the daily reports and the interim Emission Reduction Delivery Report prepared by the CDM Manager is audited by a representative member of management prior to its approval.

2.3 COMPLIANCE TO REPORTING OBLIGATIONS

This Monitoring Period comprise of two (2) half-yearly reports (ERDR II and ERDR III) containing the following information:

- Electricity & Steam Production Reports,
- Gas Consumption & Gas Analysis Report;
- Electricity Steam & Sales Invoices
- Gas Procurement Invoice.
- 6-monthly Consolidated Report,
- Calibration Activity Reports,
- Environmental Reports,
- (if applicable) Safety Permits,
- Results of Internal Audit.

The Project Operator has issued its first internal Emission Reduction Delivery Report (ERDR I) in October 2008 as basis of First Verification. This monitoring report is prepared based on ERDR II and ERDR III.

2.4 PREVENTION OF DATA LOSS

In order to prevent data loss, all reports are kept in both MEN's site office in Tangerang and it's headquarters in Jakarta. The minimum frequency of data transfer as defined in the Standard Monitoring Procedure is performed once per month and done in both hard copy and soft copy.

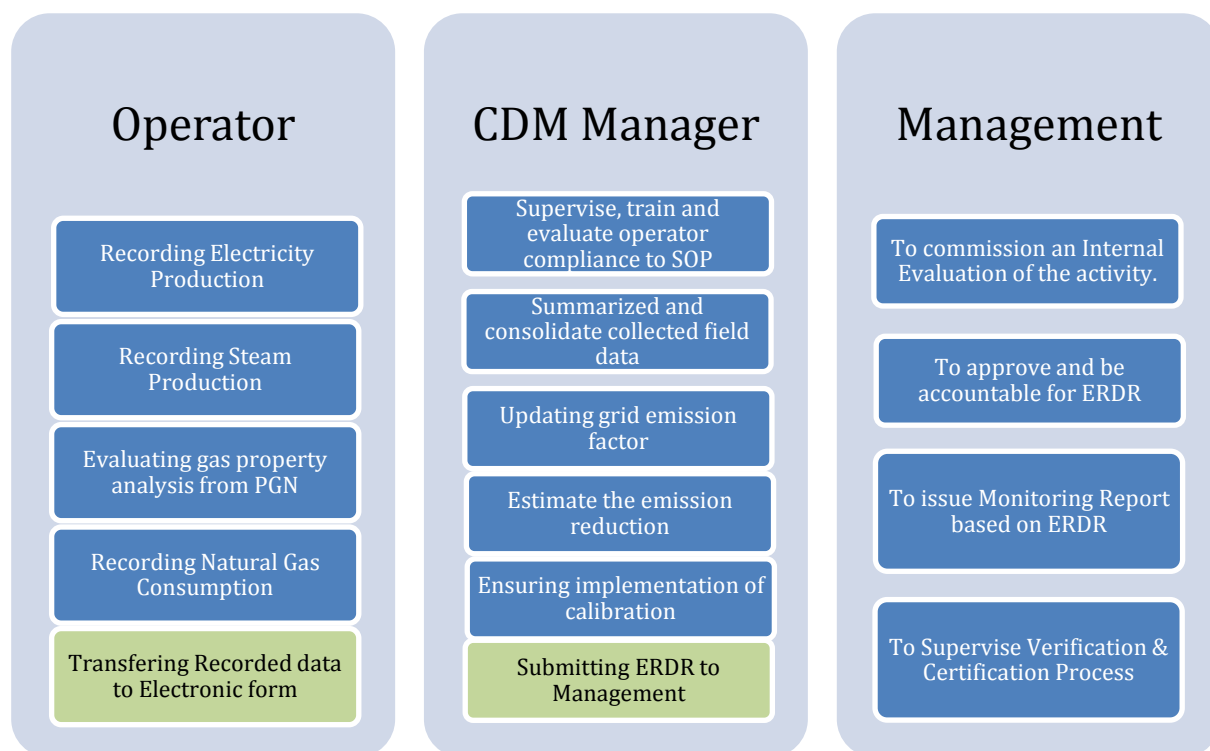


Figure 2 – Organization of the Monitoring Team

2.5 INSTRUMENTATION MAINTENANCE & CALIBRATION

Specification of the primary instruments is briefly detailed in Table 1, (Section 1.5). The PDD requires that all instruments must (a) have a valid calibration certificate and be regularly maintained and (b) meet the uncertainty range of +/- 4%.

The following is the calibration status of the monitoring equipment during this period:

	Instrument ID	Group	Calibration Activity this Period
Primary	NG-100	Gas flow meter	<p>The primary gas flow meter belonging to the gas supplier (PGN, National Gas Company) was calibrated within this period although 2 months lapse following the previous calibration period.</p> <p>Since this instrument is not owned by the developer, a reminder was sent to PGN twice, first reminder sent in 13 April 2009 and second reminder in 24 June 2009. PGN responded in 25 June 2009 that the delay of calibration was pending due to unavailability of a replacement instrument.</p> <p>The instrument was calibrated by <i>Direktorat Metrologi</i>, on 07 July 2009, which is the national agency for testing and calibration of measuring instrumentations. The agency is an official body under the Directorate General for Internal Trades, under the Ministry of Trade.</p> <p>Gas meter is subject to laboratory calibration on regular basis to accuracy level of 4% or less as agreed by both PGN and MEN. Data verified with payment receipt from PGN.</p> <p>However, for two months delayed calibration, PP applied 4% addition in Project Emission for conservativeness reason even though instrument accuracy is 0.5% and calibration result was 0.8%.</p>
	GE-200	Electricity meter	This electricity meter is calibrated this period by PT PLN Laboratory which is accredited by National Accreditation Committee (KAN) on 3 rd of March 2009 (with a certificate dated 4th of March 2009).
	GE-201 to GE-205	Electricity meter	These electricity meters are part of the computerized integrated monitoring device of the gas engines DIA.NE systems, which are digital Multi Measurement Transducer and do not require calibration.

	H-301	Steam flow meter	<p>Due to the technical difficulty, the steam flow meter was only calibrated on 10th August 2009. Delay arises due to lack of support from suppliers on appointing the party that can perform calibration.</p> <p>Nevertheless, the instrument was calibrated by the manufacturer at the time of installations, and is within the manufacturer's recommendation for calibration period, which is at least 3 years since date of installation (September 2007).</p>
Secondary	NG-101 to NG-105	Gas flow meter	<p>All of 5 secondary gas flow meters were calibrated on 09 September 2008 (certificates are dated 10 September 2008). Toward the end of the monitoring period, these sets are calibrated again, with certificates dated 10th of August 2009.</p> <p>The calibrations are performed by <i>Direktorat Metrologi</i> (for calibration conducted in 2008) and <i>Balai Pengelola Laboratorium Metrologi</i> (for calibration conducted in 2009). Both are the national agency for testing and calibration of measuring instrumentations, under the Directorate General for Internal Trades, under the Ministry of Trade.</p>
	UE-100	Electricity meter	<p>This electricity meter is calibrated on 3rd of March 2009 by PT PLN Laboratory which is accredited by National Accreditation Committee (KAN). The certificate was dated 04th of March 2009.</p>

3 RESULTS OF MONITORING ACTIVITIES

3.1 CONSOLIDATED ELECTRICITY OUTPUTS

This monitoring outputs corresponds to the following:

- MCEO or monthly consolidated electricity supplied to industrial users, referred in the methodology;
- CEO or amount of electricity generated by the project net of its parasitic consumption, referred in the PDD.

As explained earlier, electricity supplied to the subscribers is measured by 2 sets of instrumentations:

- **Primary** instruments: electricity meters **GE-201** to **GE-205**, and **GE-200**
- **Secondary** instruments: electricity meters **UE-100** and electricity Import/Export Meter **UE-101E**;

As electricity billing is based on the balances of primary meters, and comparison with sales invoice is less meaningful. Thus, for purpose of upholding the quality of data, the electrical reading is compared with balances from secondary instrument set.

Table 3 - Consolidated Electricity Deliveries as reported in ERDR II

Month	Reading of Primary Instrument (MWh) PDD Ref: CEO		Reading of Secondary Instruments (MWh)	Delta	
				MWh	%
September 08	001/IX/M-1/MEN-TNG/08	5,331.58	5,351.60	20.02	0.38
October 08	001/X/M-1/MEN-TNG/08	3,322.24	3,326.40	4.20	0.13
November 08	001/XI/M-1/MEN-TNG/08	4,331.68	4,356.98	25.30	0.58
December 08	001/XII/M-1/MEN-TNG/08	3,380.23	3,400.10	19.87	0.59
January 09	001/I/M-1/MEN-TNG/09	3,754.12	3,774.80	20.68	0.55
February 09	001/II/M-1/MEN-TNG/09	3,883.00	3,904.30	21.30	0.55
Total		24,002.84	24,114.18	111.37	0.46

Table 4 - Consolidated Electricity Deliveries as reported in ERDR III

Month	Reading of Primary Instrument PDD Ref: CEO		Reading of Secondary Instruments (MWh)	Delta	
				MWh	%
March 09	001/III/M-1/MEN-TNG/09	4,254.01	4,275.10	21.09	0.50
April 09	001/IV/M-1/MEN-TNG/09	3,959.48	3,981.71	22.23	0.56
May 09	001/V/M-1/MEN-TNG/09	4,119.36	4,144.10	24.74	0.60
June 09	001/VI/M-1/MEN-TNG/09	4,380.35	4,403.70	23.35	0.53
July 09	001/VII/M-1/MEN-TNG/09	4,303.84	4,326.90	23.06	0.54
August 09	001/VIII/M-1/MEN-TNG/09	4,100.85	4,125.40	24.55	0.60
Total		25,117.89	25,256.91	139.02	0.55

Negligible differences are observed between net electricity recorded by primary instruments and those recorded by secondary instruments. Both sets of equipments show a start-to-end-of-period deviation of 0.46% and 0.55 % in ERDR II and ERDR III respectively or equivalent to 0.51% for the whole period.

Electrical outputs reported for both periods (ERDR II and ERDR III) are totaled to 49,120MWh, or equivalent to 52% of that projected in the PDD. This amount represents a significant decline compared to generation of previous half-yearly period which was recorded at 43.096MWh¹.

¹ Reported in First Monitoring Report

3.2 CONSOLIDATED STEAM OUTPUT, CAHO

This monitoring output corresponds to the followings:

- MCHO or monthly consolidated heat supplied to industrial plant, referred in the methodology, and
- CAHO or annual amount of heat generated by the Project, referred in the PDD

The consolidated steam output within the reporting period is summarized in the following table. Data is reported in both mass unit (kg) and energy unit (MJ).

Table 5 – Consolidated Steam Output CAHO as Reported in ERDR II

Month	Source Report	Mass Recorded (kg)	Equivalent Energy MJ [PDD Ref: CAHO]
September 08	001/IX/M-1/MEN-TNG/08	5,612,841	13,014,000
October 08	001/X/M-1/MEN-TNG/08	4,161,935	12,261,000
November 08	001/XI/M-1/MEN-TNG/08	6,431,830	14,273,000
December 08	001/XII/M-1/MEN-TNG/08	5,646,270	13,445,000
January 09	001/I/M-1/MEN-TNG/09	4,548,520	12,489,000
February 09	001/II/M-1/MEN-TNG/09	4,078,897	11,166,000
Total		30,480,293	76,648,000

Table 6 – Consolidated Steam Output CAHO as Reported in ERDR III

Month	Source Report	Mass Recorded (kg)	Equivalent Energy MJ [PDD Ref: CAHO]
March 09	001/III/M-1/MEN-TNG/09	5,218,242	13,047,000
April 09	001/IV/M-1/MEN-TNG/09	4,973,765	12,681,000
May 09	001/V/M-1/MEN-TNG/09	4,825,372	12,842,000
June 09	001/VI/M-1/MEN-TNG/09	5,978,414	13,525,000
July 09	001/VII/M-1/MEN-TNG/09	5,882,305	13,879,000
August 09	001/VIII/M-1/MEN-TNG/09	3,186,908	11,179,000
Total		30,065,006	77,153,000

The consolidated thermal delivery suggests sizable decline of steam production compared to previous half-yearly period recorded 39,780,020 kg or equivalent to 86,070,188 MJ. In total, this monitoring period reported a full-year production of 153.8TJ or compared to 210TJ expected in the PDD.

3.3 CONSOLIDATED NATURAL GAS CONSUMPTION (VOLUME)

This monitoring output corresponds to the followings:

- MEC_{NG} for monthly consolidated volume of natural gas consumed, referred in the methodology, and
- VNG the amount of natural gas consumed for the project activity, referred in the PDD

Summary of readings of the primary gas meter (**NG-100**) as reflected in the monthly gas bills as well as aggregate readings from secondary gas meters (**NG-101** to **NG-105**) are summarized in the ensuing table. The primary gas meters reported volume at difference reference condition than the secondary meter, and thus is adjusted for purpose of this report.

Table 7 – Consolidated Gas Consumption in Volumetric Unit as reported in ERDR II

Month	Source Report	PGN Gas Meter/Billing (Primary Meter) (PDD Ref: VNG)		Aggregate of Secondary Meters	Observed Delta*
		m ³ (1 bar, 27 degC)	Nm ³	Nm ³	%
September 08	001/IX/M-1/MEN-TNG/08	1,529,280	1,391,714	1,329,890	4.44
October 08	001/X/M-1/MEN-TNG/08	917,118	834,619	876,610	-5.03
November 08	001/XI/M-1/MEN-TNG/08	1,295,444	1,178,912	1,176,675	0.19

December 08	001/XII/M-1/MEN-TNG/08	1,044,847	950,858	951,650	-0.08
January 09	001/I/M-1/MEN-TNG/09	1,063,583	967,908	1,002,699	-3.59
February 09	001/II/M-1/MEN-TNG/09	1,111,986	1,011,957	1,020,844	-0.88
Total		6,962,258	6,335,968	6,358,368	-0.35

*relative to primary meter

Table 8 – Consolidated Gas Consumption in Volumetric Unit as reported in ERDR III

Month	Source Report	PGN Gas Meter/Billing (Primary Meter) (PDD Ref: VNG)		Aggregate of Secondary Meters	Observed Delta*
		m ³ (1 bar, 27 degC)	Nm ³		
March 09	001/III/M-1/MEN-TNG/09	1,224,148	1,114,030	1,122,854	-0.79
April 09	001/IV/M-1/MEN-TNG/09	1,127,650	1,026,212	1,036,614	-1.01
May 09	001/V/M-1/MEN-TNG/09	1,191,438	1,127,633**	1,089,556	-0.49
June 09	001/VI/M-1/MEN-TNG/09	1,261,415	1,193,862**	1,171,171	-2.02
July 09	001/VII/M-1/MEN-TNG/09	1,263,345	1,149,701	1,161,634	-1.04
August 09	001/VIII/M-1/MEN-TNG/09	1,236,322	1,125,109	1,124,364	0.07
Total		7,304,318	6,736,546	6,706,193	-0.89

*relative to primary meter

**add 4% higher due to delayed calibration

The month of September 2008 and October 2008 reported more than 4% deviation in the gas consumption. This deviation is due to confusion on the part of project developer related to the reference volume adopted by PGN. It was earlier thought that PGN's 'Normal Volume' made reference to the internationally accepted 0degC, and thus comparable to readings from the secondary meter.

When continuous differences were discovered during an internal audit for the first reporting period, it was erroneously thought that the error was on the part of the secondary instruments and repairs were ordered. Further investigations later conclude that the differences were not due to error in the reading, but merely due to differences in reference conditions applied, and the secondary meters were again reinstated to its original settings.

The gap in time for noting the gas volume of primary and secondary meters also contributes to the differences in the readings of both instruments, such as those observed in January 2009 and June 2009. Nevertheless, the aggregate discrepancies for each of the start-to-end period are well below tolerance, or equivalent to 0.63% throughout the whole reporting period.

This monitoring period recorded combustion of 12,983,226Nm³ of natural gas or equivalent to 53% of the total projection in the PDD.

3.4 CONSOLIDATED NATURAL GAS CONSUMPTION (ENERGY)

This parameter corresponds to parameter AEC_{NG} in the methodology, which is annual natural gas consumption of the cogeneration facility in energy unit. The conversion of natural gas consumptions from primary meter's Normal Volume (Table 7 and Table 8, Section 3.3) into its energy equivalent is based upon calculated gas properties (NCV and Density) as described in the ensuing Section 3.5.

Table 9 - Consolidated Gas Consumption in Energy Unit, AEC_{NG} as reported in ERDR II

Month	Source Report	Eqv. Energy (MJ) PDD Ref: AEC _{NG}
September 08	Derivative Parameter calculated from: <ul style="list-style-type: none"> Monthly Gas Consumptions, [VNG, see Section 3.3] Monthly Evaluated Density [D_{NG}, see Section 3.5] and Monthly Evaluated NCV [NCV_{NG} see Section 3.5] AEC _{NG} = VNG × D _{NG} × NCV _{NG}	50,964,934
October 08		30,337,050
November 08		42,588,443
December 08		35,376,064
January 09		35,610,663
February 09		36,984,377

Total		231,861,531
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Table 10 - Consolidated Gas Consumption in Energy Unit, AEC_{NG} as reported in ERDR III

Month	Source Report	Eqv. Energy (MJ) PDD Ref: AEC _{NG}
March 09	Derivative Parameter calculated from: ▪ Monthly Gas Consumptions, [VNG, see Section 3.3] ▪ Monthly Evaluated Density [D _{NG} , see Section 3.5] and ▪ Monthly Evaluated NCV [NCV _{NG} see Section 3.5] $AEC_{NG} = VNG \times D_{NG} \times NCV_{NG}$	40,390,707
April 09		37,105,760
May 09		41,648,631
June 09		44,162,980
July 09		42,152,519
August 09		41,056,151
Total		246,516,747

3.5 GAS PROPERTIES: NCV_{NG} AND D_{NG}

The PDD requires Net Calorific Value (TJ/kt) and density (kg/Nm³) of the natural gas used is to be analyzed on monthly basis. PGN had been able to supply monthly compositional analysis of its gas for all months reported in this period. The report comprise of (a) the compositional molar fraction and (b) compressibility factor of the gas. Based on these factors, the gas net calorific value and density are derived using method complies with industry standard (ASTM). The results are summarized in the following tables.

Table 11 – Natural Gas Properties: Net Calorific Value and Density as reported in ERDR II

Month	Source Report	LHV/NCV (TJ/kt) PDD Ref: NCV _{NG}	Density (kg/Nm ³) PDD Ref: D _{NG}
September 08	001/IX/M-1/MEN-TNG/08	48.22	0.75946
October 08	001/X/M-1/MEN-TNG/08	48.43	0.75051
November 08	001/XI/M-1/MEN-TNG/08	47.66	0.75792
December 08	001/XII/M-1/MEN-TNG/08	48.42	0.76832
January 09	001/I/M-1/MEN-TNG/09	48.56	0.75762
February 09	001/II/M-1/MEN-TNG/09	48.36	0.75577
Weighted Average		48.25	0.75849

Table 12 – Natural Gas Properties: Net Calorific Value and Density as reported in ERDR III

Month	Source Report	LHV/NCV (TJ/kt) PDD Ref: NCV _{NG}	Density (kg/Nm ³) PDD Ref: D _{NG}
March 09	001/III/M-1/MEN-TNG/09	48.41	0.74887
April 09	001/IV/M-1/MEN-TNG/09	48.79	0.74110
May 09	001/V/M-1/MEN-TNG/09	48.13	0.76744
June 09	001/VI/M-1/MEN-TNG/09	48.14	0.76849
July 09	001/VII/M-1/MEN-TNG/09	48.28	0.75939
August 09	001/VIII/M-1/MEN-TNG/09	48.40	0.75397
Weighted Average		48.35	0.75685

The net calorific values reported above are within the range reported in Table 1.2 of 2006 IPCC for natural gas (46.5TJ/kt-50.4TJ/kt). There is no available national literature data to reliably benchmark the gas density. For comparison, the first monitoring reported an average NCV of 47.66 TJ/kt and average density of 0.76534 kg/Nm³.

3.6 GRID EMISSION FACTOR, $EF_{CM,Y}$

The project proponent chose *ex-post* approach for emission factor and thus required to annually update the emission factor of the electricity system. For the **first** monitoring period, emission reduction occurred in year 2008 and grid emission factor calculated from data vintage 2006 (y-2) were applied.

For **this** reporting period, emission reduction occurred in the last 4 months of 2008 and the first 8 months of 2009, thus the emission factor needs to be updated with the latest data available which is vintage data 2007. The update results are 0.954tCO₂/Mwh for Operating Margin and 0.947tCO₂/Mwh for Build margin with a combined margin emission factor of 0.951tCO₂/MWh for 2007 compared to 0.901tCO₂/MWh applied for the previous year. The increase is largely due to the increased activities of the newer large power plants commissioned in 2006: Tanjung Jati B (coal), Cilacap SSP (coal), and Cilegon (gas). The approach of calculation is detailed in Appendix A, and accompanying spreadsheet titled: EF JAMALI 07 Version 1.4.0.

4 DELIVERED EMISSION REDUCTION

4.1 NON-MONITORED PARAMETERS

Non-monitored parameter adopted for calculation of emission reduction is summarized in the following table. These parameters are consistent with Section B.6.2 of the PDD.

Table 13 - Fixed Parameters for Calculation of Emission Reduction

Parameter	Green House Gas		
	CO ₂	CH ₄	N ₂ O
Global Warming Potential of GHG	GWP _{CO2} : 1 tCO ₂ /tCO ₂	GWP _{CH4} : 21 tCO ₂ /tCH ₄	GWP _{N2O} : 310 tCO ₂ /tN ₂ O
Emission Factor of GHG from combustion of residue oil (displaced)	EF _{CO2-R} 77.4 tCO ₂ /TJ	EF _{CH4-R} 0.003 tCH ₄ /TJ	EF _{N2O-R} 0.0006 tN ₂ O/TJ
Emission Factor of GHG from combustion of natural gas (Project)	EF _{CO2-NG} 56.1 tCO ₂ /TJ	EF _{CH4-NG} 0.001 tCH ₄ /TJ	EF _{N2O-NG} 0.0001tN ₂ O/TJ
Methane emission factor from activities related to the production of natural gas (Leakage)	ΣMEF _k : 0.0287518 Gg-CH ₄ /10 ⁶ m ³ or 0.0287518×10 ³ tCH ₄ /Nm ³		
Efficiency of Baseline (Residue oil) Boiler	E _B : 90%		

4.2 CALCULATED EMISSION SOURCES

Based on the results of monitoring activity as outlined in Section 3, and the non-monitored parameter summarized in Table 13, each emission sources are calculated in accordance with method set-out in the PDD.

4.2.1 BASELINE EMISSIONS

Table 14 - Summary of Baseline Emissions

PDD Ref.	Grid Electricity Displacement (Equation 3 of PDD)	Ref.	Unit	ERDR II	ERDR III
CEO	Total net consolidated electricity generated and supplied to the subscribers (see Table 3 and Table 4)	[A]	MWh	24,002.84	25,117.89
EF _{CM,2007}	2007 Combined Margin emission factor for Jawa-Madura Bali grid (see Section 3.6)	[B]	tCO ₂ /MWh	0.951	0.951
BE _{ELEC}	Baseline emission associated with grid-power displacement	[C]=[A]×[B]	tCO ₂	22,826.70	23,887.11
PDD Ref.	Residue Oil Displacement (Equation 2 of PDD)				
CAHO	Total net consolidated steam supplied to Argo Pantes (see Table 5 and Table 6)	[D]	MJ	76,648,000	77,153,000
E _B	Efficiency of displaced residual oil boiler (see Table 13)	[E]	Unitless	0.900	0.900
ABEC	Energy baseline for thermal generation	[F]=[D] ×10 ⁻⁶ /[E]	TJ	85.16	85.73
EF _{CO2-R}	CO2 emission factor from combustion of residue oil (see Table 13)	[G]	tCO ₂ /TJ	77.4	77.4
EF _{CH4-R}	CH4 emission factor from combustion of residue oil (eqv. CO2) (see Table 13)	[H]	tCO ₂ /TJ	0.063	0.063
EF _{N2O-R}	N2O emission factor from combustion of residue oil (eqv. CO2) (see Table 13)	[I]	tCO ₂ /TJ	0.186	0.186
BE _R	Baseline emission associated with displacement of residue oil	[J]=[F] ×[G+H+I]	tCO ₂	6,612.93	6,656.50

4.2.2 PROJECT & LEAKAGE EMISSIONS

Table 15 - Summary of Project & Leakage Emission

PDD Ref.	Natural Gas Combustion (Equation 7 of PDD)	Ref.	Unit	ERDR II	ERDR III
AEC _{NG}	Consolidated Natural Gas Consumption (Table 9, and Table 10)	[A]	TJ	231.9	246.5
EF _{CO2-NG}	CO ₂ Emission factor from combustion of natural gas (see Table 13)	[B]	tCO ₂ /TJ	56.10	56.10
EF _{CH4-NG}	CH ₄ Emission factor from combustion of natural gas (eqv. CO ₂) (see Table 13)	[C]	tCO ₂ /TJ	0.021	0.021
EF _{N2O-NG}	N ₂ O Emission factor from combustion of natural gas (eqv. CO ₂) (see Table 13)	[D]	tCO ₂ /TJ	0.031	0.031
PE _{NG}	Project emission from combustion of natural gas	[E]=[A] × [B+C+D]	tCO ₂	13,019.49	13,842.41
PDD Ref.	Natural Gas Production & Distribution (Equation 9 of PDD)	Ref.	Unit	ERDR II	ERDR III
AEC _{NG}	Consolidated Natural Gas Consumption (Table 9, p. 12)	[F]	TJ	231.9	246.5
ΣMEF _k	Total methane emission factor from gas production & distribution (see Table 13)	[G]	tCH ₄ /Nm ₃	2.87518E-05	2.87518E-05
GWP _{CH4}	Global Warming Potential of Methane (see Table 13)	[H]	tCO ₂ /tCH ₄	21	21
D _{NG}	(Weighted) Average Density of natural gas consumed (see Table 11 and Table 12)	[I]	tgas/Nm ₃	0.00075849	0.00075685
NCV _{NG}	(Weighted) Average Net Calorific Value of natural gas consumed (see Table 11 and Table 12)	[J]	TJ/tgas	0.04825	0.04835
LE	Leakage emission associated with gas production & distribution	$[K] = \frac{[F]}{[I \times J]} \cdot [G \times H]$	tCO ₂	3,825.27	4,066.92

4.3 EMISSION REDUCED DURING THIS MONITORING PERIOD

Table 16 -Delivered Emission Reduction for This Reporting Period

PDD Ref.	Project Activity Emission Reduction (Equation 10 of PDD)	Ref	Emission in tCO ₂	
			ERDR II	ERDR III
BE _{ELEC}	Baseline emission from grid electricity displacement (Table 14)	[A] Rounded Down	22,826	23,887
BE _R	Baseline emission from residue oil displacement (Table 14)	[B] Rounded Down	6,612	6,656
PE _{NG}	Project emission from combustion of natural gas (Table 15)	[C] Rounded Up	13,020	13,843
LE	Leakage emission from gas production & transportation (Table 15,)	[D] Rounded Up	3,826	4,066.92
ER	Emission Reduction	[E]=[A+B-C-D]	12,592	12,633
ER _v	Aggregated Emission Reduction This Reporting Period		25,225	

5 ENVIRONMENTAL PERFORMANCE

Within this reporting period, two environmental assessments had been performed on the Project in the month of June 2008, and March 2009 by a third party laboratory. Results of these tests are summarized in the following table.

Table 17 - Results of Ambient Quality Monitoring

Major Gases	Ambient Quality			Applicable Standards*
	13 June 2008	12 March 2009 North	12 March 2009 South	
SO ₂ (Sulfur Dioxide)	20 µg/Nm ³	24.01 µg/Nm ³	25.22 µg/Nm ³	900 µg/Nm ³
CO (Carbon Monoxide)	208µg/Nm ³	2,749µg/Nm ³	2,864 µg/Nm ³	30,000µg/Nm ³
NO _x (Nitrous Oxide)	6 µg/Nm ³	21.85 µg/Nm ³	22.07 µg/Nm ³	400µg/Nm ³
O ₃ (Oxidant)	1 µg/Nm ³	26.87µg/Nm ³	28.91 µg/Nm ³	235µg/Nm ³
Particulate	24 µg/Nm ³	86 µg/Nm ³	96 µg/Nm ³	230µg/Nm ³
Pb (Lead)	Not tested	<0.03 µg/Nm ³	<0.06 µg/Nm ³	2 µg/Nm ³
Ammonia	Not tested	0.04640 ppm	0.04445 ppm	2 ppm**
Hydrogen Sulfide	Not tested	0.00130 ppm	<0.00072 ppm	0.02 ppm**

*Government Regulation PP No. 41 year 1999 concerning Air Pollution Control

**Ministry of Environment Decree KepMenLH No. 50 year 1996 Concerning Odour Level Quality

Table 18 - Results of Noise Monitoring

Location	Noise		
	Project (13 June 2008)	Project (12 March 2009)	Applicable Standard*
Project Site (K2)	82 dBA	83.0 dBA	70 dBA
Parking Area of Complex	68 dBA	73.1 dBA	70 dBA

*Ministry of Environment Decree KepMenLH No. 48 year 1996 concerning Noise Level Quality

The results of the tests show that the exhausts of gas engine are well within the national standard, but noise resulting from its operation still exceeds the required standard at the Project's site, and marginally meets the standard if measured from the parking area of the complex. When reviewing these results, the readers are required to consider that the law requires noise monitoring based on absolute value and not the contribution of the project activity itself. Measurement is performed within the proximity of production factories which is operating 24 hours and bordered by busy thoroughfare.

6 CONCLUSION

The management of PT Manunggal Energi Nusantara believes that it has operated and monitored the Project in accordance with the requirement of the registered Project Design Documentation (P1313). The company is also committed to meet all expected statutory requirements, including operation & safety permits, as well as its environmental obligations.

Within this reporting period, the steam and power generations activity reduces 25,463tCO₂ relative to the baseline case. Such delivery is still below expectation in the PDD, which was estimated to be 42,622 tCO₂ per year. The shortage is primarily due to under-utilization of the facility compared to its design capacity, as two subscribers eventually cancelled its contracts due to commercial matter. This situation is further exacerbated by the low productivity of the major (and only) subscriber due to unfavorable export market. Despite this discouraging business environment, the company management is committed to keep the project afloat and continue to fulfill its responsibility as required as an operator of a CDM Project.

The Project Proponent believes to have taken all reasonable efforts to maintain credibility of data through proper administration and supervision, and wishes to immediately expedite the verification process to certify the delivered emission reduction.

APPENDIX A - EMISSION FACTOR CALCULATION

The emission reduction reported in this monitoring period occurred between September 2008 and August 2009, or mostly 2009. Since the Project opted for an *ex-post* emission factor, the emission factor was updated with the latest data available which is 2007 data vintage for this reporting period. Please see accompanying spreadsheet EF JAMALI 2007 Version 1.4.0.xlsx for full calculations.

Boundary of Emission Factor

The boundary for emission factor calculations remains the same as per PDD. The plan to integrate the Java-Madura-Bali (JAMALI) grid to South Sumatra grid has not been realized, thus no electricity is imported or exported from the original grid delineation. This is evident from the report published by PT PLN P3B (grid operator) which shows no import/export activities in the JAMALI grid.

Method Applied for Calculations

The updated emission factor applies methods as stipulated in the PDD and made reference to latest *Tool to Calculate Emission Factor for an Electricity System version 01.1* or 'Tool' for treatment of aspect not outlined in the PDD. Such aspect includes estimation of emissions from power plants of which the data is not complete.

Based on available data, the Tool further explained how to calculate the emission factor for the grid based on data on fuel consumption and net electricity generated (option A), or based on data net electricity generation, average efficiency and fuel type used (option B) as explained further below.

Data Collection Process

Zeus-Innavitas on behalf of the project proponent, directly contacted various institutions and power-plant operators to obtain information of fuel consumptions and generations for 2007².

- **Net generations.** Statistical data published by the JAMALI's grid authority: PT PLN P3B for 2007 provides for complete net generation data from all power plants delivering electricity to the grid.
- **Fuel consumptions.** Fuel consumptions of connected power plants are requested via formal correspondence with individual operator. Major institutions responded by providing their annual statistical report (Indonesia Power, Pembangkit Jawa Bali) containing generation and fuel consumption data. Others simply responded to information requested in the correspondence. Information/publications exchanged are documented and was provided to auditor for verification.
 - Power plants of which both net generations and fuel consumptions are available grouped as **Group B1 Power Plant**, and its aggregate CO₂ emission is calculated directly from the reported fuel consumptions (option A).
 - A number of power plants decided not to disclose its fuel consumption information: PT Paiton Energy Company, PT Jawa Power, PT Cikarang Listrindo. Since net generation data is available from other publications, these power plants are grouped as **Group B2 Power Plants**, and its CO₂ emissions are estimated in accordance with method outlined in Option B of the Tool by assigning an appropriate efficiency (option B).

Information gathered during this process is compiled and consolidated in the subsequent table³.

² All communication was cc-ed to Directorate General for Electricity (DJPPE) and National Committee for Clean Development Mechanism (KOMNAS MPB, DNA)

³ Fuel consumption and generation data from PT Krakatau Daya Listrik are excluded from this Table due to uncertainty of data provided. This power plant delivers only 1.7GWh in 2007 of 107,715 total generations and thus is considered as a minor omission.

Table 19. 2007 Net Generation and Fuel Consumptions of Power Plants in JAMALI Grid in Subset Group B1

OWNER	FUEL TYPE	FUEL CONSUMPTION		NET GENERATION		TOTAL	
INDONESIA POWER	COAL	ton	12,448,426	GWh	21,842	GWh	43,134
	GAS	MMBTU	44,115,358	GWh	6,739		
	HSD	kL	2,184,035	GWh	6,329		
	MFO	kL	610,438	GWh	1,953		
	HYDRO			GWh	3,430		
	GEOTH			GWh	2,841		
PEMBANGKIT JAWA BALI	COAL	ton	3,040,419	GWh	5,645	GWh	27,171
	GAS	MMBTU	76,864,852	GWh	8,550		
	MFO	kL	1,311,828	GWh	5,723		
	HSD	kL	1,611,617	GWh	5,264		
	HYDRO			GWh	1,989		
MUARA TAWAR	HSD	kL	536,034	GWh	1,546	GWh	1,546
TANJUNG JATI B	COAL	ton	3,403,577	GWh	7,906	GWh	7,906
CILEGON	GAS	MMBTU	13,004,241	GWh	1,338	GWh	1,338
PERUM JASA TIRTA	HYDRO			GWh	511	GWh	511
GEO DIPA ENERGY	GEOTH			GWh	164	GWh	164
DSP SALAK	GEOTH			GWh	1,574	GWh	1,574
MNL WAYANG WINDU	GEOTH			GWh	938	GWh	938
CHEVRON GI DRAJAD	GEOTH			GWh	1,154	GWh	1,154
SSP CILACAP	COAL	ton	1,727,354	GWh	2,977	GWh	2,977
TOTAL				GWh	75,813	GWh	75,813

Table 20. 2007 Net Generation and Fuel Consumptions of Power Plants in JAMALI Grid in Subset Group B2

OWNER	FUEL TYPE	ASSIGNED EFFICIENCY & JUSTIFICATIONS		NET GENERATION	
PAITON ENERGY	COAL	31%	Calculated based on documented 2006 fuel consumption as provided by the operator ⁴ and generation data from grid authority: PT PLN P3B	GWh	9,653
JAWA POWER	COAL	32%	Calculated based on documented 2006 fuel consumption as provided by the operator ⁵ and generation data from grid authority: PT PLN P3B	GWh	9,162
CIKARANG LISTRINDO	GAS	60%	Default values efficiency as provided in the Annex I: Default efficiency factors for power plants of the Tool for gas power plant, by choosing the highest efficiency value for conservativeness. The generation data source is from grid authority PT. PLN P3B ⁶ .	GWh	467
INDORAMA	COAL	50%	Default values efficiency as provided in the Annex I: Default efficiency factors for power plants of the Tool for new coal power plant, by choosing the highest efficiency value for conservativeness. The generation data source is from grid authority PT. PLN P3B ⁶ .	GWh	20

⁴ Paiton Energy Fuel Consumption 2006

⁵ Jawa Power Fuel Consumption 2006

⁶ Laporan statistic 2007 Penyaluran dan Pusat Pengatur Beban (Statistic Report 2007 Distribution and Load Control Center) ref. 3

TOTAL			GWh	19,301
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Fuel Properties Applied

The following table summarizes the net calorific value (NCV) and CO₂ emission factor (EF_{CO2}) used to calculate emissions of power plants connected to the JAMALI grid. It is pertinent to note that the most recent publication of national communication does not cover emission factor or calorific values of fuel available in the country. As consequence, data is mostly obtained from reliable publications as justify below. Emission factor for all fuel type is obtained from Table 1.4 2006 IPCC Report representing Lower Limit.

Table 21. Density data used for grid emission calculation

Conversion Data	Source	Value	Unit
Density of HSD	Publication by PERTAMINA (state oil company) ⁷ . This is reliable as PERTAMINA is the only operator of oil refinery in Indonesia.	0.880 ⁸	t/kL
Density of MFO		0.955	t/kL

Table 22. NCV and emission factor of fuels used by power plants in JAMALI grid

Fuel Type	Adopted Net Calorific Value		Emission Factor ⁹
	GJ/kt	Source/Justification	kgCO ₂ /TJ
HSD & IDO ¹⁰	42,933	Publication by PERTAMINA (state oil company) ¹¹ . This is reliable as PERTAMINA is the only operator of oil refinery in Indonesia.	72,600
MFO	40,992		75,500
Coal	23,811	Official statistics issued by Directorate Program Supervision for Mineral Coal and Geothermal ¹² show that major power plant procures coal with the rank between 5,500 - 6,500 kcal/kg (HHV) (medium rank). This corresponds with majority of coal produced in Indonesia. Since no exact data is available, mid-point of this range is used. This is further corrected to LHV basis by applying ISO method using moisture contents, Hydrogen, and Oxygen content, analyzed from samples of coals obtained from various mining site across Indonesia by an independent study.	92,800
Natural Gas	-	All statistics ¹³ reported natural gas in energy unit, thus conversion factor is not necessary.	54,300

2007 Simple OM (Operating Margin)

From fuel consumption and generation data contained in Table 19 and Table 20, and fuel properties as summarized in Table 21 and Table 22, the CO₂ emissions associated with each type of fuel are displayed in the subsequent table.

Table 23. CO₂ emission and Net Electricity Generation of the Project Electricity System from Group B1 Power Plants

Fuel Type	Consumption	Associated Net Generation	Associated CO ₂ Emission
COAL	ton 20,619,776	MWh 38,370,895	tCO ₂ 45,562,777
GAS	MMBTU 133,984,451	MWh 16,627,027	tCO ₂ 7,670,771

⁷ 'Bahan Bakar Minyak, LPG and BBG', PERTAMINA

⁸ IDO is assumed to have similar properties as per HSD. The use of IDO is very small from total fuel consumption and thus represents a minor omission. The selected value here represent the mid-point of lower and upper limit.

⁹ Table 1.4, V.2 IPCC 2006 Report, Lower Limit Emission Factor

¹⁰ HSD: High Speed Diesel; IDO: Industrial Diesel Oil;

¹¹ 'Bahan Bakar Minyak, LPG and BBG' PERTAMINA

¹² 'Indonesia Mineral, Coal, Geothermal, Groundwater 2008', issued by Directorate General of Mineral Coal and Geothermal of the Ministry of Energy and Mineral Resources.

¹³ Various publications by power plant operators.

MFO	kL	1,922,266	MWh	7,676,000	tCO ₂	5,681,443
HSD	kL	4,331,686	MWh	13,138,860	tCO ₂	11,881,261
HYDRO			MWh	5,930,326	tCO ₂	-
GEOETH			MWh	6,671,240	tCO ₂	-
	TOTAL		MWh	88,414,348	tCO ₂	70,796,252
	TOTAL NON-LCMR		MWh	75,812,782		
OPERATING MARGIN CO ₂ EMISSION FACTOR FOR GROUP B1 POWER PLANTS					tCO ₂ /MWh	0.933

Table 24. CO₂ emission and Net Electricity Generation of the Project Electricity System from Group B2 Power Plants

OWNER	FUEL TYPE	NET GENERATION	$3.6 \cdot [EG_m \cdot EF_{CO_2}/\eta_m]$
PAITON ENERGY	COAL	MWh 9,652,660	tCO ₂ 10,381,458
JAWA POWER	COAL	MWh 9,161,566	tCO ₂ 9,496,381
CIKARANG LISTRINDO	GAS	MWh 466,980	tCO ₂ 152,142
INDORAMA	COAL	MWh 19,502	tCO ₂ 13,030
TOTAL NON-LCMR		MWh 19,300,708	tCO ₂ 20,043,012
OPERATING MARGIN CO ₂ EMISSION FACTOR FOR GROUP B2 POWER PLANTS			tCO ₂ /MWh 1.038

CO₂ emission from Group B1 Power Plants is calculated to be 0.933 tCO₂/MWh. This group contributes to 79.7% of total Non-LCMR generations, with the remaining 20.3% is attributed to Group B2, with emission intensity of 1.038tCO₂/MWh (see Table 24). Subsequently, the combined Group B1/B2 results in emission intensity of 0.954tCO₂/MWh as outlined in Table 25.

Table 25. Operating Margin CO₂ Emission Factor from Group B1 and Group B2 Power Plants

Power Plant Group	Non-LCMR Generation	% Generation	CO ₂ Emission Factor
Group B1	MWh 75,812,782	79.7%	tCO ₂ /MWh 0.933
Group B2	MWh 19,300,708	20.3%	tCO ₂ /MWh 1.038
Total non LCMR Generations	MWh 95,113,490		
Total Operating Margin CO ₂ Emission Factor			tCO ₂ /MWh 0.954

2007 Build Margin

The following table detailed net generation, fuel consumptions and associated CO₂ emissions from all Build Margin power plants, which comprise to 22.76% of total grid generation. Similar for the calculation of the Operating Margin, the calculation for Combined Margin is also segregated into Group B1 and Group B2 Power Plants. It is calculated that power plant in this group generates 23,213,967tCO₂ associated with production of 24,517,510MWh of electricity or equivalent to 0.947tCO₂/MWh

Table 26. Electricity Generation and Fuel Consumption of Power Plants identified in Sample Group m for 2007 Build Margin

Power Plants		Fuel Type	Net Generation	Fuel Consumptions /Assigned Efficiency	Associated Emission	
B2: Indorama	2007	COAL	MWh 19,502	50%	tCO2	13,030
B1: Cilegon	2006	GAS	MWh 1,338,027	MMBTU 13,004,241	tCO2	744,508
B1: Tanjung Jati B	2006	COAL	MWh 7,906,449	ton 3,403,577	tCO2	7,520,762

B1: SSP Cilacap	2006	COAL	MWh 2,977,446	ton	1,727,354	tCO2	3,816,872
B1: Muara Tawar	2004	HSD	MWh 1,545,860	kL	536,034	tCO2	1,470,272
B2: Cikarang Listrindo	2003	GAS	MWh 466,980		60%	tCO2	152,142
B1: Geodipa Energy	2002	GEOTH	MWh 163,750		-		-
B1: Wayang Windhu	2000	GEOTH	MWh 937,930		-		-
B2: Jawa Power	2000	COAL	MWh 9,161,566		32%	tCO2	9,496,381
			MWh 24,517,510			tCO2	23,213,967
Total Operating Margin CO2 Emission Factor						tCO2/MWh	0.947

2007 Combined Margin

Based on the above calculated 2007 Operating Margin of 0.954 tCO₂/MWh and 2007 Build Margin of 0.947tCO₂/MWh, the resulting Combined Margin Emission Factor for JAMALI Grid Power Plants is calculated to be 0.951tCO₂/MWh on Simple OM Basis.