

Wayang Windu Phase 2 Geothermal Power Project

Voluntary Carbon Standard Emission Reduction Monitoring Report

Monitoring Period: 04 Mar 2009 – 1 December 2010 (inclusive of both days)
CDM Registration No: 3193

Date: 26 Aug 2011
Version 03

A project designed to meet the baseline and monitoring requirements of UN CDM Approved
Methodology

“Consolidated methodology for grid-connected electricity generation from renewable sources”
Version 9 (ACM0002)

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MONITORING REPORT

SECTION A. General description of the project activity

A.1. Brief description of the project activity: >>

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The project activity, Wayang Windu Phase 2 Geothermal Power Project, involves the installation of the additional 117 MW steam turbine and peripheral equipment to enable the turbine to be driven by the steam produced by the Wayang Windu geothermal fields. The turbine is connected to a generator which would produce the electricity to the JAMALI grid, and hence adding the electricity capacity of the existing Wayang Windu Phase 1.

Wayang Windu Phase 1 has been producing power since June 2000, delivering 110 MW of electricity into the national grid through a single buyer, PLN.

The baseline scenario for this project is the generation of electricity by the operation of grid-connected power plants and by the addition of new generation sources. In the absence of the project activity electricity will continue to be generated by the existing generation units in the JAMALI grid.

The purpose of the Project activity is the generation of power using a reliable and renewable resource in place of power generation by a more greenhouse gas intensive fuel/source. The project will reduce greenhouse gas emissions through the displacement of fossil fuel electricity generation with a clean, renewable energy source.

The construction of the project activity started in Jan 2007 (EPC contract was signed on 30 Jan 2007) and the project started its operation and reduced GHG emissions from 4 March 2009 (project start date). The project activity has been registered with the United Nations Framework Convention on Climate Change (UNFCCC) as a CDM project activity (Reference No. 3193) on 2 December 2010. The details can be viewed on <http://cdm.unfccc.int/Projects/DB/TUEV-SUED1260194062.48/view>

This monitoring report provides an overview of the (voluntary) emission reductions generated by the project activity for the purpose of verification against the Voluntary Carbon Standard (VCS2007.1), covering the monitoring period of 4 Mar 2009 – 1 Dec 2010 (inclusive of both days).

Voluntary emission reductions achieved during the monitoring period: 1,406,789 tCO₂eq.

A.2. Project Participants

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Star Energy Geothermal (Wayang Windu) Ltd, a private geothermal company which operates in Indonesia and having its office at Jl. Let. Jend. S. Parman Kav 62-63, 8th - 11th floor, Jakarta 12710, Indonesia (hereinafter referred to as “SEG(WW)L”).

Sindicatum Carbon Capital Ltd, a company incorporated under the laws of England and having its office at 33 Duke Street, London, W1U 1JY, United Kingdom (hereinafter referred to as “SCC”).

A.3. Location of the project activity:

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Republic of Indonesia , 40km south of Bandung Kecamatan Pangalengan, West Java
7° 12' 26.79" S, 107° 37' 44.12" E



Figure 1 Location of Bandung



Figure 2 Location of Wayang Windu

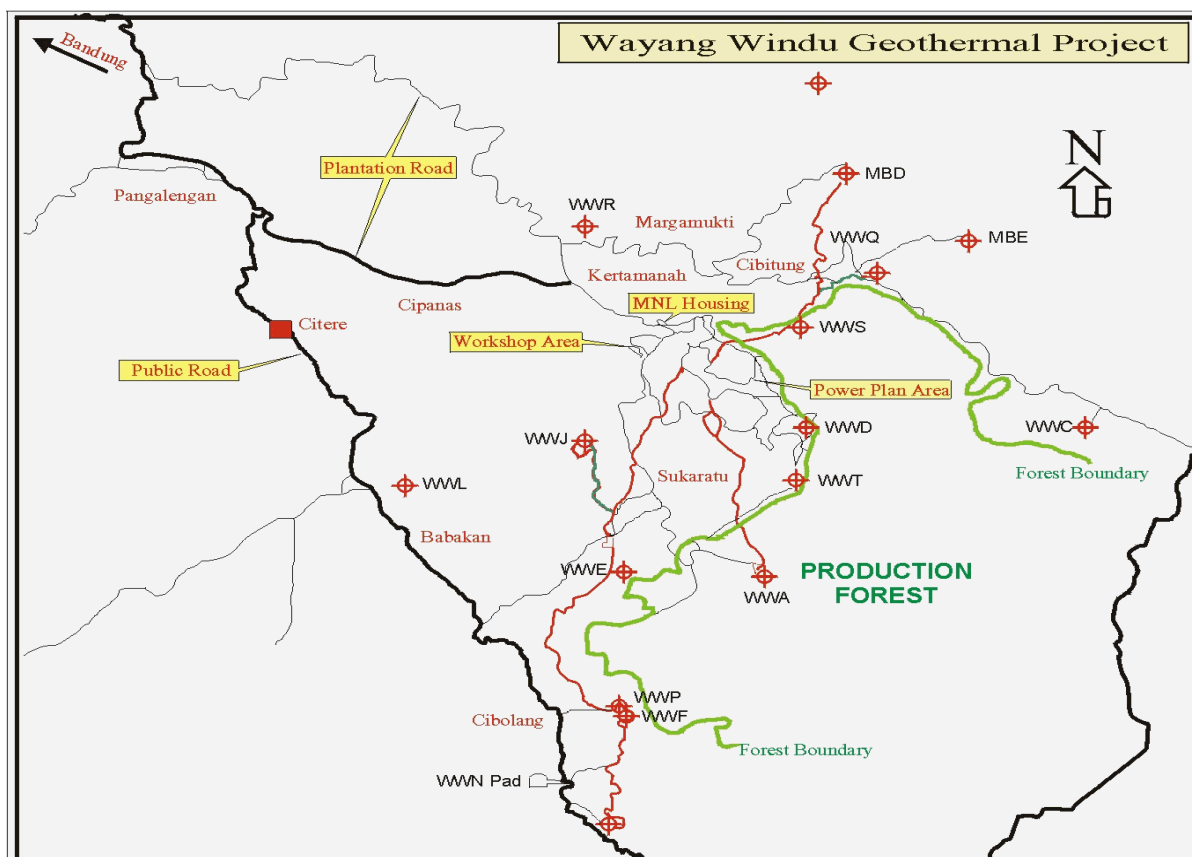


Figure 3 Location of the Wayang Windu Wells and Plant

A.4. Technical description of the project

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The proposed project activity, Wayang Windu Phase 2 Geothermal Power Project, is the construction and operation of a 117 MW geothermal power station, which is an additional power unit to an existing grid-connected renewable power plant. Wayang Windu Phase 1 has been producing power since June 2000, delivering 110 MW of electricity into the national grid through a single buyer, PLN.

Geothermal energy in Wayang Windu is stored in a steam reservoir within the earth's crust. Dry saturated steam at high pressure is produced at the surface from wells drilled into this reservoir. The steam is delivered to the power generation facilities through a steam gathering system, to move the turbine blades and drive a generator hence generating electricity. Exhaust steam from the turbine is condensed in a direct contact condenser and part of the condensed exhaust steam is re-injected into the geothermal reservoir, with the remaining being evaporated in the cooling towers. The electricity produced is transferred by the load dispatcher at the adjacent power switchyard to the transmission lines located outside the power plant.

The power plant will consist of a conventional geothermal condensing steam turbine generator with a capacity of 117 MW. Energy of condensation will be transferred to the circulating cooling water system in the steam exhaust condenser and will subsequently be rejected to atmosphere in a conventional mechanical draught cooling tower.

List of Main Equipment and Systems:

- One unit of 117 MW steam turbine
- 17,900 m³/hour condenser
- Cooling tower
- One unit of 137.5 MVA Main Generator
- One unit of 150kV/13.8kV Generator Transformer
- Scrubbers

- Separator
- Plant DCS (Distributed Control System)
- SAGS (Steamfield Above Ground System)

This technology is technically sound and environmentally safe as is demonstrated by hundreds of similar installations around the world, including Indonesia. Sumitomo Corporation, a Japanese corporation, which was selected to provide technical equipment, and to perform all engineering, procurement and construction services of the Project. Knowledge transfer is ensured through a comprehensive training for SEG(WW)L, the Owner's operation and maintenance personnel. The training covered the configuration and maintenance of all Equipment and systems of the Project designed and supplied by the Contractor.

A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

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Title : Wayang Windu Phase 2 Geothermal Power Project

Methodology : Consolidated methodology for grid-connected electricity generation from renewable sources – Version 9 (ACM0002). This methodology also uses the build margin (BM) and operating margin (OM) approach as specified in “Tool to calculate the emission factor for an electricity system” (Version 01.1) and also references the “Tool for the demonstration of additionality” (Version 5.2), “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” (Version 02)

A.6. Registration date of the project activity:

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Registration Date: 02 December 2010.

A.7. Monitoring period:

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04 Mar 2009 – 1 December 2010

A.8. Name of responsible person(s)/entity(ies):

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Mr. Gareth Phillips	Sven	JP	Starckx
Chief Climate Change Officer	Senior Technical Advisor	–	Monitoring & Issuance
Sindicatum Carbon Capital (SCC)	Sindicatum Carbon	Capital	(SCC)
33 Duke Street	33	Duke	Street
London, UK	London,		UK
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SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

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Wayang Windu Phase 2 Geothermal Power Project Plant started operation on 1 Mar 2009 and the project activity was registered as a CDM activity on 2 Dec 2010.

This Monitoring Report covers the monitoring period of 4 Mar 2009 – 1 Dec 2010 (inclusive of both days). The total emission reductions achieved in this monitoring period is 1,406,789 tCO₂e.

During this monitoring period, there are events that affect the outages of the plant, such as earthquake and turbine overhaul. Refer to Annex 1 for further details.

SECTION C. Description of the monitoring system

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The location of measurement devices installed is presented in figure below:

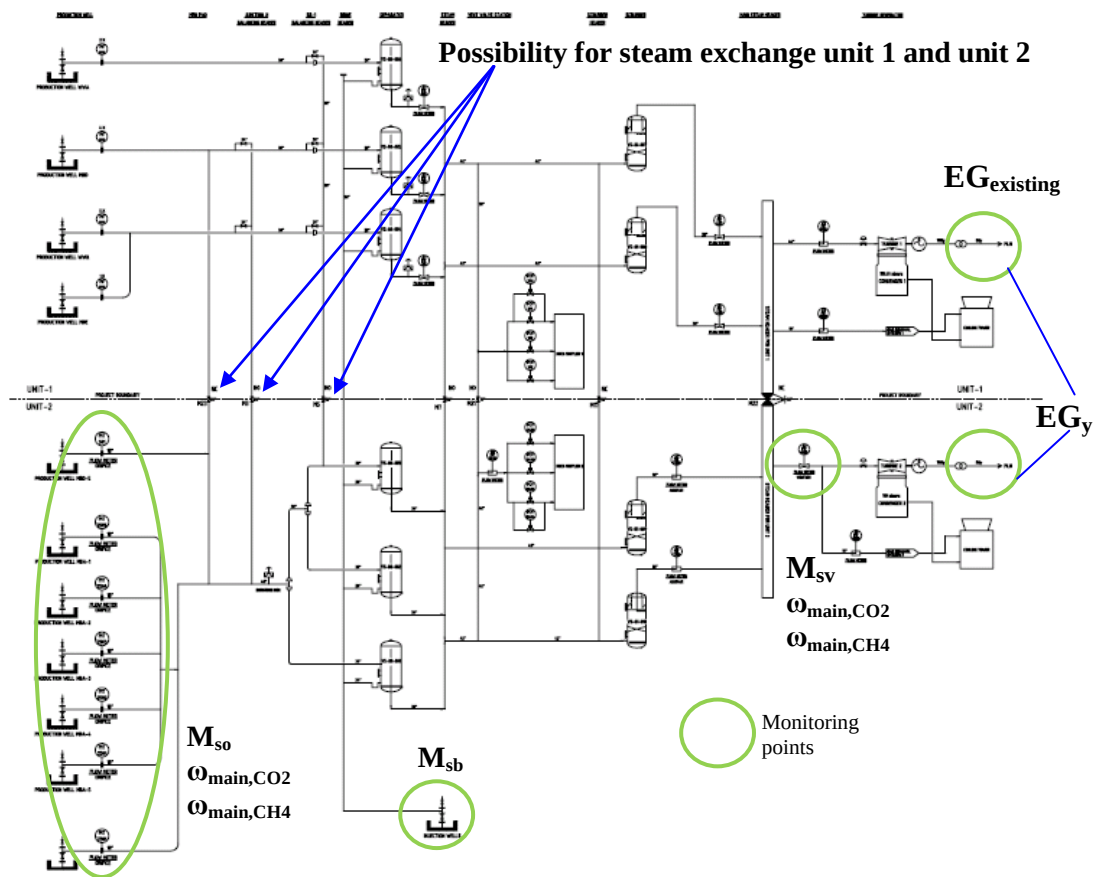


Figure 4 Simplified Process Flow Diagram for Monitoring

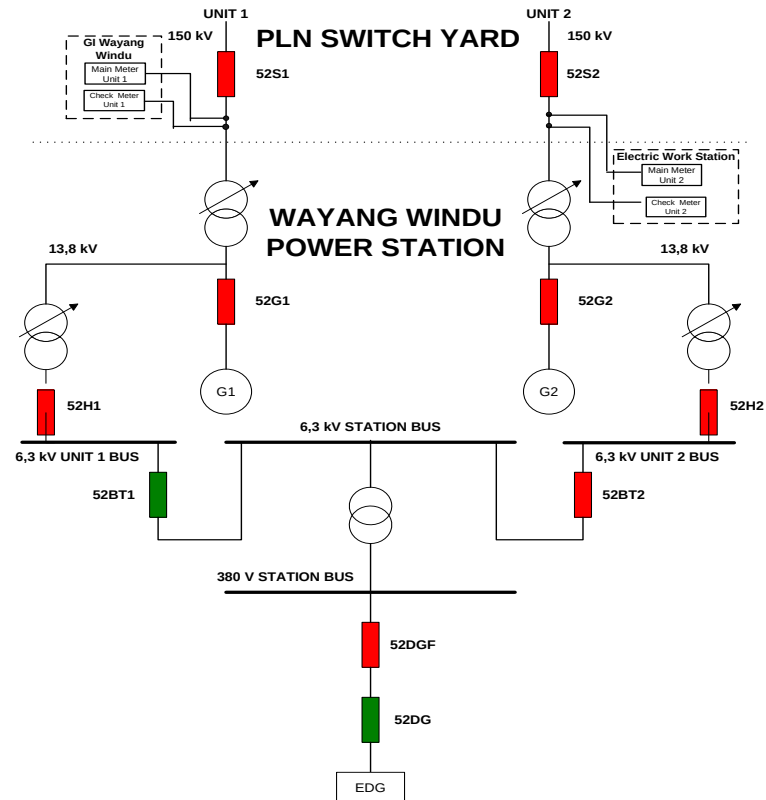


Figure 5 Electrical Layout Drawing

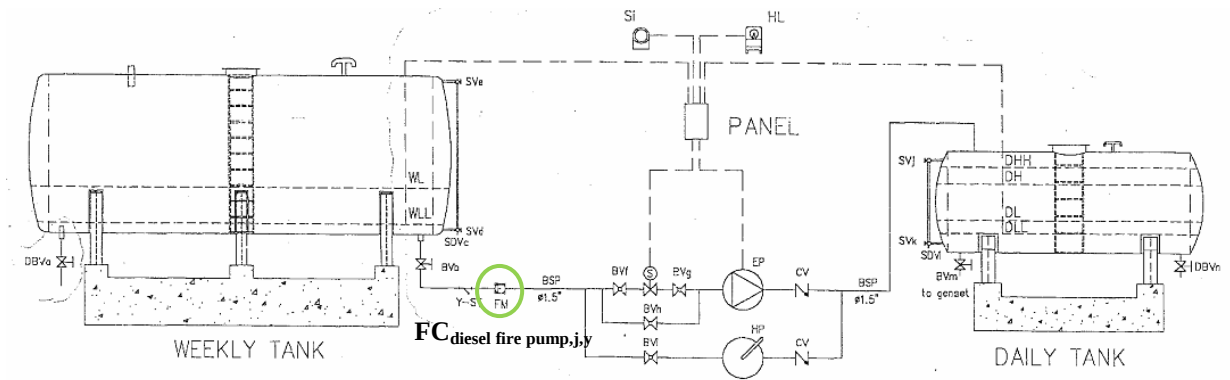


Figure 6 Fire Pump Fuel System

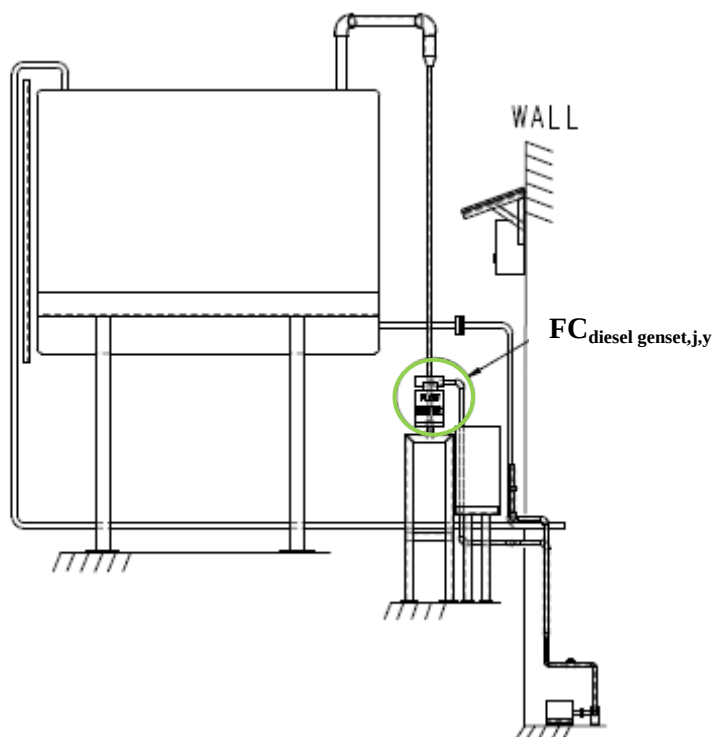


Figure 7 Diesel Generator Set Fuel System

In order to guarantee the quality of the data and data collection system, a detailed monitoring manual has been developed and implemented. This quality manual or monitoring plan (available for verification by a designated operational entity (DOE)) is based upon the requirements set in the registered PDD and addresses as a minimum the items listed below.

Data will be compared from month to month using trend analysis to show where parameters have deviated significantly from preceding or following values. Any values identified as being unusual in this manner will be rechecked. Where preceding or following values are not available, reference values may be taken from published data as appropriate such as 2006 IPCC guideline.

Table 1 Data collection process

Parameter	Reference	Procedure Frequency	/ Registration	Check and correct primary measurements
Baseline Emissions	The baseline emissions are calculated using the formulae described in the PDD, section B6.1 - using the CDM spreadsheet.	Primary data (weekly reports) are entered by the SCC officer in the CDM spreadsheet at the start of each month	CDM spreadsheet stored at SCC Project File S-Server	The SCC project officer performs a consistency check based upon previous months. In case of irregularities data is double checked with SEG(WW)L and if needed corrected
Leakage	= 0			

Project Emissions	The project emissions are calculated using the formulae described in the PDD, section B6.1 - using the CDM spreadsheet	Primary data are entered by the SCC officer in the CDM spreadsheet at the start of each month	CDM spreadsheet stored at SCC Project File S-Server	The SCC project officer performs a consistency check based upon previous months. In case of irregularities data is double checked with SEG(WW)L and if needed corrected
Emissions Reductions	The emission reductions are calculated using the formulae described in the PDD, section B6.1 - using the CDM spreadsheet	Primary data (weekly reports) are entered by the SCC officer in the CDM spreadsheet at start of each month	CDM spreadsheet stored at SCC Project File S-Server	The SCC project officer performs a consistency check based upon previous months. In case of irregularities data is double checked with SEG(WW)L and if needed corrected

Preparation of monitoring report

The data will be used to prepare a periodic monitoring report to be submitted for verification and issuance of voluntary emission reductions. A standard format for the monitoring report will be prepared and prior to the submission of the first monitoring report. An internal technical review process will be conducted and documented before such a report will be submitted for verification.

Accuracy and calibration of instruments

All meters will be purchased and maintained to ensure a high level of accuracy. The exact specifications of each meter will be determined during the detailed design of the project. Thereafter the meter accuracies will be included in this procedure and steps taken to maintain those levels of accuracy.

All key meters will be subjected to a quality control regime that will include regular maintenance and calibration. A record will be maintained showing the location and unique identification number of each meter, the calibration status of that meter (when last calibrated, when next due for calibration) and who performs the calibration service. Calibration certificates will be retained for all meters until two years after the end of the crediting period.

Archiving of data

The monitoring team will periodically archive data to a secure and retrievable storage format on a periodic e.g. weekly basis. Calibration records may be archived by scanning and storage in an accessible electronic format. These data will be stored until 2 years after the end of the crediting period.

Document Control

The Project Manager will implement a document control system that ensures that the current versions of necessary documents are available at the point of use. All documents must be maintained in English with local translations because English is the formal language of the CDM.

Audit function and management review

The Project Manager will arrange for an audit of the management system periodically and at least once per year. The auditor will not be involved in the daily operation of the project and if necessary, may be sourced from a third party. The auditor will assess the implementation of the monitoring procedure and the preparation of the monitoring report. Audit findings, and steps taken to address findings will be recorded and reviewed by the Management which will also review the effectiveness of these procedures will be reviewed and necessary changes implemented.

Organisation & Responsibilities

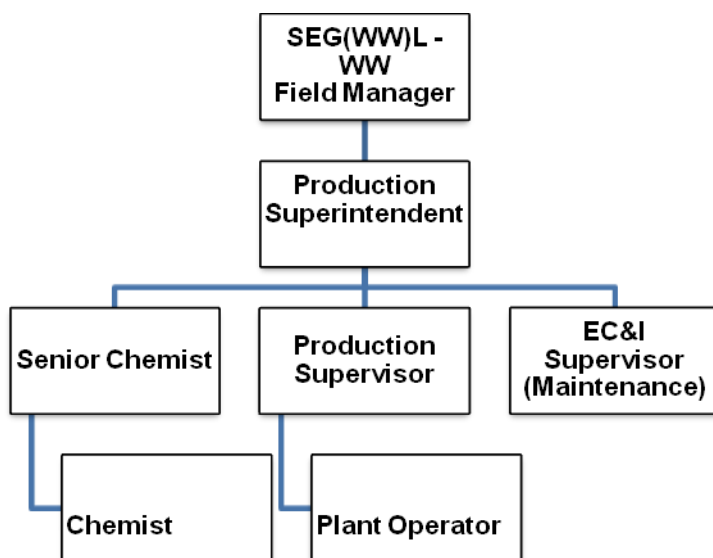
SEG(WW)L

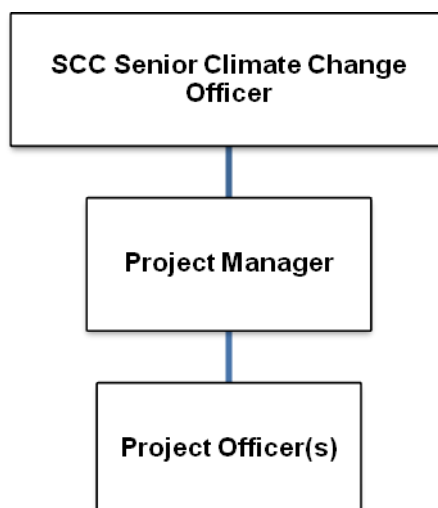
- Wayang Windu Field Manager is responsible for supervision of overall plant operations and management responsibilities
- Production Superintendent is responsible for the preparation of monthly CDM report and supervision of plant productions
- EC&I Supervisor is responsible for maintaining the measurement devices and ensuring calibration of the measurement devices
- Senior Chemist is responsible for checking steam quality information for CDM and submission to SCC
- Chemist is responsible for steam sampling and analysis, checking and recording of steam quality
- Production Supervisor is responsible for external data collection, checking CDM information (excluding steam quality data) and weekly spreadsheet and submission to SCC
- Plant Operators are responsible for meter readings, data recording and other roles as specified by the supervisors

SCC

- Senior Climate Change Officer is responsible for the supervision of overall climate change monitoring of the project, initiate verification with DOE, and conducts internal audit on correct implementation MP
- Project Manager is responsible for management and checking of CDM information and reporting
- Project Officer is responsible for project coordination, implementation and liaison, data gathering and retention, completion of the CDM spreadsheet, calculation of emission reductions, preparation of monitoring report

The organizational structure will be as follows:





SECTION D. Data and parameters

The parameters monitored and the monitoring procedure applied for determination of the emission reductions is described in section B.6.2 and more specific in section B.6.3 and B.6.4 of the Project Design Document version 3 dated 2 December 2010, and available up on the UNFCCC website <http://cdm.unfccc.int/filestorage/67XO09RNKPFWQ415AS3THEVIYDLMC8/PDD.pdf?t=S058MTMwMDQzNTk4Ny4yMQ==9jkgd4EJpb7d59UY7Xxql6jwSpg=>

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	GWP_{CH_4}
Data unit:	tCO ₂ /tCH ₄
Description:	Global warming potential of methane valid for the relevant commitment period
Source of data used:	IPCC
Value(s) :	Default value for the first commitment period = 21 tCO ₂ /tCH ₄
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculations
Additional comment:	--

Data / Parameter:	$EG_{historical}$
Data unit:	MWh
Description:	Average of historical electricity delivered by the existing facility to the grid
Source of data used:	Project activity site.
Value applied:	912,476
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations
Any comment:	The average of historical electricity delivered by the existing facility (Wayang Windu Phase 1) to the grid, spanning all data from the most recent available month (February 2009) to the time at which the facility was operated (June 2000) expressed in MWh per year.

	Data is based on invoices from net electricity sales to the grid operator.
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Data / Parameter:	$DATE_{BaselineRetrofit}$
Data unit:	Date
Description:	Point in time when the existing equipment would need to be replaced in the absence of the project activity
Source of data used:	Project activity site
Value applied:	01 June 2030
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations The technical lifetime of the existing facility, i.e. Wayang Windu Phase 1, in the absence of the project activity is taken to be 30 years. This is a conservative number, considering many of the power plants in Indonesia are operated even after its technical lifetime. Wayang Windu 1 started operation in June 2000, hence the $DATE_{BaselineRetrofit}$ is 01 June 2030.
Any comment:	--

Data / Parameter:	$EF_{grid,CM,y}$
Data unit:	tCO ₂ /MWh
Description:	Grid emission factor for JAMALI
Source of data used:	Grid calculation published by Department of Energy and Mineral Resources of Indonesia - Directorate General of Electricity and Energy Utilization and endorsed by Indonesia DNA on 19 January 2009.
Value applied:	0.891
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations
Any comment:	Calculated with “tool to calculate the emission factor for an electricity system version 01.1”. Calculated once ex-ante at the start of the crediting period, using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation

D.2. Data and parameters monitored

Data / Parameter:	ω_{main,CO_2}
Data unit:	tCO ₂ /t steam
Description:	Average mass fraction of CO ₂ in the produced steam
Measured /Calculated /Default:	Measured
Source of data:	The mass fraction of CO ₂ in the produced steam at the production wells and at the steam field-power plant interface by the external laboratory.
Value(s) of monitored parameter:	See VER spreadsheets
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation
Monitoring equipment (type,	The CO ₂ monitoring equipment consists of gas flasks, filled with sodium

accuracy class, serial number, calibration frequency, date of last calibration, validity)	hydroxide solution and additional chemicals to prevent oxidation. The gas sampling is carried out using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling single phase steam only). The analysis are carried out by an external laboratory accredited under ISO 17025 by the National Accreditation Committee (KAN - Komite Akreditasi Nasional).
Measuring/ Reading/ Recording frequency:	Sampling, analysis, and reecording are performed every 3 months.
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Detailed procedures are described in the CDM Monitoring Manual

Data / Parameter:	$\mathbf{Q_{main, CH_4}}$
Data unit:	t CH ₄ /t steam
Description:	Average mass fraction of CH ₄ in the produced steam
Measured /Calculated /Default:	Measured
Source of data:	The mass fraction of CH ₄ in the produced steam at the production wells and at the steam field-power plant interface by the external laboratory.
Value(s) of monitored parameter:	See VER spreadsheets
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The C _x H _y monitoring equipment consists of gas flasks, filled with sodium hydroxide solution and additional chemicals to prevent oxidation. The as sampling is carried out using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling single phase steam only). The analysis are carried out by an external laboratory accredited under ISO 17025 by the National Accreditation Committee (KAN - Komite Akreditasi Nasional).
Measuring/ Reading/ Recording frequency:	Sampling, analysis, and recording are performed every 3 months.
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Detailed procedures are described in the CDM Monitoring Manual

Data / Parameter:	$\mathbf{M_{S, v}}$
Data unit:	Tonnes
Description:	Quantity of steam produced during the year y
Measured /Calculated /Default:	Measured
Source of data:	Continuous measurement by a Venturi flow meter ($M_{sv,y}$) located at the upstream of the Wayang Windu Unit 2 turbine and which is adjusted for losses of brine at the steam separator ($M_{sb,y}$) as well as Orifice Plates ($M_{so,i,y}$) located at the Wayang Windu Unit 2 well heads.
Value(s) of monitored parameter:	See VER spreadsheets
Indicate what the data are used for (Baseline/ Project/	Project emission calculation

Leakage emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Venturi Flow Meter Serial Number: A2-FE-0106, A2-FIT-0106-DP (91GA08958738), A2-FIT-0106-SP (91GA08958738) Calibration Frequency : biannually Orifice Flow Meter for MBB-1 well steam flow Serial Number: FE-2301, FIT-2301 (8G201612), PIT-2302 (01830135) Calibration Frequency : biannually Orifice Flow Meter for MBA-1 well steam flow Serial Number: FE-2501, FIT-2501 (S/n 01830374), PIT-2502 (s/n 01830130) Calibration Frequency : biannually Orifice Flow Meter for MBA-2 well steam flow Serial Number: FE-2502, FIT-2502 (S/n 8G201617), PIT-2504 (s/n 01830131) Calibration Frequency : biannually Orifice Flow Meter for MBA-3 well steam flow Serial Number: FE-2503, FIT-2503 (s/n 01830360), PIT-2506 (s/n 01830132) Calibration Frequency : biannually Orifice Flow Meter for MBA-4 well steam flow Serial Number: FE-2504, FIT-2504 s/n 01830361, PIT-2508 s/n 01830133 Calibration Frequency : biannually Orifice Flow Meter for MBA-5 well steam flow Serial Number: FE-2505, FIT-2505 s/n 01830359, PIT-2510 01830134 Calibration Frequency : biannually Orifice Flow Meter for MBD-5 well steam flow Serial Number: FE-MBD5 s/n 702044, FIT501 S/n 01845811, PIT506 s/n 01593780 Calibration Frequency : biannually Orifice Flow Meter for WWW-1 brine injection flow Serial Number: FE-984, FIT-984 (S/n 0G238876), PIT-918 (S/n 8F196683) Calibration Frequency : biannually Flow meters are calibrated using internal calibrator. The internal calibrator is calibrated every 2 years by accredited laboratory. Refer to Annex 2 Monitoring Equipments for further details
Measuring/ Reading/ Recording frequency:	Data is monitored continuously (polling of at least every second) and condensed to half hour values. Daily figures will be built according to the methodology by accumulation of data.
Calculation method (if applicable):	In order to be conservative, the primary data will be taken from the higher values from either the upstream metering points or the downstream metering. In case steam is transferred from unit 1 steam fields for power

	generation at unit 2 the upstream figure will higher. In case steam from the new steamfields at unit 2 will be transferred to the power generator of unit 1 the downfield figure will be higher. Using the higher one of the two values ensures that project emissions which are attributable to the capacity addition by unit 2 are clearly identified and accounted. Thus, the quantity of steam ($M_{s,y}$) is given by: $M_{s,y} = \max((M_{sv,y} + M_{sb,y}), \sum_i M_{so,y})$
QA/QC procedures applied:	Detailed procedures are described in the CDM Monitoring Manual

Data / Parameter:	EG_y
Data unit:	MWh
Description:	Electricity supplied by the project activity to the grid (total of net electricity generated by Wayang Windu Unit 1 and Unit 2)
Measured /Calculated /Default:	Measured
Source of data:	The reading of the electricity from the transaction meters from Wayang Windu Unit 1 and Unit 2. Primary data is sourced from the check kWh meters.
Value(s) of monitored parameter:	See VER spreadsheets
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Wayang Windu 1 main kWh meter which is owned by PLN: Accuracy Class: 0.2 Serial Number: MT-0809A063-01 Calibration Frequency : every 5 years Wayang Windu 1 check kWh meter which is owned by SEG(WW)L (primary data): Accuracy Class: 0.2% Serial Number: PT-0807A249-01 Calibration Frequency : every 2 years WayangWindu 2 main kWh meter which is owned by PLN: Accuracy Class: 0.2 Serial Number: MT 0806 A 388 - 01 Calibration Frequency : every 5 years WayangWindu 2 check kWh meter which is owned by SEG(WW)L (primary data): Accuracy Class: 0.2% Serial Number: PT-0802A192-01 Calibration Frequency : every 2 years Refer to Annex 2 Monitoring Equipments for further details
Measuring/ Reading/ Recording frequency:	The meter reading is recorded every half hourly and recorded automatically at load profile at the transaction kWh meters.
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Based on the Standard Operating Procedure of Metering System of PT PLN (Persero) P3B – Jawa Bali, the data from the main meter and the

	check meter are compared on the monthly basis and any differences greater than 4% will be investigated further. During this monitoring period, the difference between the data from main meter and check meter has never achieved a difference exceeding 4% and therefore is considered acceptable. Primary data (data applied to the VERs calculation) is sourced from the check meter. Data from check meter is taken for the primary data instead of the data from main meter because the data from the check meter is displayed and recorded continuously at the SEG(WW)L's DCS system and can be downloaded at any point of time by SEG(WW)L authorized staff. The data from the main meter can only be downloaded on the monthly basis by PLN Staff. Detailed procedures are described in the CDM Monitoring Manual.
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Data / Parameter:	EG_{existing,v}
Data unit:	MWh
Description:	Electricity supplied by the existing power generation unit to the grid (net electricity generated by Wayang Windu Unit 1)
Measured /Calculated /Default:	Measured
Source of data:	The reading of the electricity from the transaction meters from Wayang Windu Unit 1. Primary data is sourced from the check kWh meter.
Value(s) of monitored parameter:	See VER spreadsheets
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Wayang Windu 1 main kWh meter which is owned by PLN: Accuracy Class: 0.2 Serial Number: MT-0809A063-01 Calibration Frequency : every 5 years Wayang Windu 1 check kWh meter which is owned by SEG(WW)L (primary data): Accuracy Class: 0.2% Serial Number: PT-0807A249-01 Calibration Frequency : every 2 years Refer to Annex 2 Monitoring Equipments for further details
Measuring/ Reading/ Recording frequency:	The meter reading is recorded every half hourly and recorded automatically at load profile at the transaction kWh meter.
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Based on the Standard Operating Procedure of Metering System of PT PLN (Persero) P3B – Jawa Bali, the data from the main meter and the check meter are compared on the monthly basis and any differences greater than 4% will be investigated further. During this monitoring period, the difference between the data from main meter and check meter has never achieved a difference exceeding 4% and therefore is considered acceptable. Primary data (data applied to the VERs calculation) is sourced from the check meter. Data from check meter is taken for the primary data instead

	of the data from main meter because the data from the check meter is displayed and recorded continuously at the SEG(WW)L's DCS system and can be downloaded at any point of time by SEG(WW)L authorized staff. The data from the main meter can only be downloaded on the monthly basis by PLN Staff. Detailed procedures are described in the CDM Monitoring Manual.
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Data / Parameter:	PE_{FC,i,y}
Data unit:	tCO ₂ /yr
Description:	CO ₂ emissions from fossil fuel combustion in the operation of the power plant (diesel genset and fire pump) in year y
Measured /Calculated /Default:	Calculated
Source of data:	Calculated according to procedure outlined in the 'Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion'
Value(s) of monitored parameter:	See VER spreadsheets
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	Calculated on the monthly basis
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Detailed procedures are described in the CDM Monitoring Manual

Data / Parameter:	FC_{i,i,y}
Data unit:	ton/yr
Description:	Quantity of diesel fuel combusted in power plant operation during the year y
Measured /Calculated /Default:	Measurement
Source of data:	Measurement of diesel fuel consumption for emergency genset and fire pump multiplied with the national data of the diesel fuel density
Value(s) of monitored parameter:	See VER spreadsheets
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Flowmeter at the inlet of the daily tank for the diesel fuel consumption for emergency genset Serial Number: AO-FQ-2033 Calibration Frequency : annually Flowmeter at the inlet diesel tank for the fire pump Serial Number: AO-FQ-2032 Calibration Frequency : annually

	Refer to Annex 2 Monitoring Equipments for further details
Measuring/ Reading/ Recording frequency:	The data is collected monthly
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Detailed procedures are described in the CDM Monitoring Manual

Data / Parameter:	NCV_{i,y}
Data unit:	GJ/ton
Description:	Weighted average net calorific value of diesel fuel in year y
Measured /Calculated /Default:	Default
Source of data:	National value
Value(s) of monitored parameter:	42.73
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	The value is recorded annually
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Detailed procedures are described in the CDM Monitoring Manual

Data / Parameter:	EF_{CO₂,i,y}
Data unit:	tCO ₂ /GJ
Description:	Weighted average CO ₂ emission factor of diesel fuel in year y
Measured /Calculated /Default:	Default
Source of data:	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) of monitored parameter:	0.0748
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	The value is recorded annually
Calculation method (if applicable):	N/A

QA/QC procedures applied:	Detailed procedures are described in the CDM Monitoring Manual
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SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

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The formula used for determination of the baseline emissions are described in section B.6.1 of the Project Design Document v3 dated 2 December 2010, and available upon the UNFCCC website (<http://cdm.unfccc.int/Projects/DB/TUEV-SUED1260194062.48/view>).

Baseline emissions are calculated as follows:

$$BE_y = (EG_y - EG_{baseline}) \cdot EF_{grid,CM,y}$$

Where:

- BE_y = Baseline emission in year y (tCO₂/yr)
- EG_y = Electricity supplied by the project activity to the grid (MWh)
- $EG_{baseline}$ = Baseline electricity supplied to the grid in the case of modified or retrofit facilities (MWh). For new power plants this value is taken as zero
- $EF_{grid,CM,y}$ = Combined margin CO₂ emission factor for grid connected power generation in year y (calculated by using “tool to calculate the emission factor for an electricity system version 01.1”)

The project activity is the installation of additional power units at an existing grid-connected renewable power plant:

$$EG_{baseline} = \text{MAX} (EG_{historical}, EG_{existing,y}), \text{ until } DATE_{BaselineRetrofit}$$

$$EG_{baseline} = EG_y, \text{ on/after } DATE_{BaselineRetrofit}$$

Where:

- $EG_{baseline}$ (MWh) = Baseline electricity supplied to the grid in the case of modified or retrofit facilities
- $EG_{historical}$ = Average of historical electricity delivered by the existing facility to the grid (MWh)
- $EG_{existing,y}$ = Electricity supplied by the existing grid-connected power plant (MWh)
- $DATE_{BaselineRetrofit}$ = Point in time when the existing equipment would need to be replaced in the absence of the project activity (date)

Calculation of $EG_{historical}$

$EG_{historical}$ was calculated based on the historical electricity delivered by Wayang Windu Phase 1 from the start of its operation in June 2000 up to February 2009, i.e. 912,476 MWh/year

Calculation of $DATE_{BaselineRetrofit}$

The technical lifetime of the existing facility, i.e. Wayang Windu Phase 1, in the absence of the project activity is taken to be 30 years. This is a conservative number, considering many of the power plants in Indonesia are operated even after its technical lifetime.

Wayang Windu 1 started operation in June 2000, hence the $DATE_{BaselineRetrofit}$ is 01 June 2030.

$EF_{grid,CM,y}$

The value applied is 0.891 tCO₂/yr based on ex-ante calculation in the registered PDD.

Monitored data for Baseline Emission Calculation

EG ¹	Electricity supplied by the project activity to the grid	3,358,209.40	MWh
EG _{existing} ²	Monitored	1,657,757.32	MWh
Duration Monitoring Period	4 Mar 2009 – 1 Dec 2010	638	days
EG _{historical,y}	Yearly average of historical electricity delivered by the existing facility to the grid	912,476.00	MWh
EG _{historical,MP}	638/365*912476	1,594,958.05	MWh
EG _{baseline}	MAX (EG _{historical,MP} , EG _{existing,MP})	1,657,757.32	MWh
EG - EG _{baseline}		1,700,452.08	MWh
BE	(EG - EG _{baseline}) . EF _{grid,CM,y}	1,514,252	tCO ₂ e

E.2. Project emissions calculation

>>

The formula used for determination of the project emissions are described in section B.6.1 of the Project Design Document v3 dated 2 December 2010, and available upon the UNFCCC website (<http://cdm.unfccc.int/Projects/DB/TUEV-SUED1260194062.48/view>).

Project emissions are calculated as follows:

$$PE_y = PES_y + PEFF_y$$

Where:

PE_y = Project emission in year y (tCO₂/yr)

PES_y = Project emission of CH₄ and CO₂ due to the release of non-condensable gases from the stream produced in geothermal power plant in year y (tCO₂/yr)

$PEFF_y$ = Project emission from combustion of fossil fuels related to the operation of the geothermal power plant in year y (tCO₂/yr)

Project emission of CO₂ and CH₄ due to the release of non-condensable gases from the steam produced in the geothermal power plant is calculated as:

$$PES_y = (\omega_{main,CO2} + \omega_{main,CH4} \cdot GWP_{CH4}) \cdot M_{S,y}$$

Where:

PES_y = Project emission of CH₄ and CO₂ due to the release of non-condensable gases from the stream produced in geothermal power plant in year y (tCO₂/yr)

¹Refer to VER spreadsheet for daily generation data from Wayang Windu Phase 1 and Wayang Windu Phase 2 geothermal power project

²Refer to VER spreadsheet for daily generation data from Wayang Windu Phase 1 geothermal power project

ω_{main,CO_2}	= average mass fraction of CO ₂ in the produced steam (non-dimensional)
ω_{main,CH_4}	= average mass fraction of CH ₄ in the produced steam (non-dimensional)
GWP_{CH_4}	= global warming potential of CH ₄ valid for the relevant commitment period (tCO ₂ /tCH ₄)
$M_{S,y}$	= Quantity of steam produced during the year y (tonnes)

Project emissions from combustion of fossil fuel related to the operation of geothermal power plant is calculated as:

$$PEFF_y = PE_{FC,j,y}$$

Where:

$PEFF_y$	= Project emission from combustion of fossil fuels related to the operation of the geothermal power plant in year y (tCO ₂ /yr)
$PE_{FC,j,y}$	= CO ₂ emissions from fossil fuel combustion in process j during the year y (tCO ₂ /yr). This parameter will be calculated by the “tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion version 02”

$$PE_{FC,j,y} = \sum FC_{diesel,j,y} \cdot COEF_{i,y}$$

Where:

$FC_{diesel,j,y}$	= quantity of diesel combusted in emergency genset and fire pump multiplied with the national data of the diesel fuel density (ton)
$COEF_{i,y}$	= CO ₂ emission coefficient of diesel fuel (tCO ₂ /ton)

$COEF_{i,y}$ is calculated based on net calorific value and CO₂ emission factor of diesel fuel, as follows:

$$COEF_{i,y} = NCV_{diesel,y} \cdot EF_{CO_2,diesel,y}$$

Where:

$NCV_{diesel,y}$	= weighted average net calorific value of diesel fuel in year y (Values provided by the fuel supplier, or regional or national average default values, or IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories) (GJ/ton)
$EF_{CO_2,diesel,y}$	= weighted average CO ₂ emission factor of diesel fuel in year y (Values provided by the fuel supplier, or regional or national average default values, or IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories) (tCO ₂ /GJ)

Monitored Project Emission

Month-Year	$FC_{diesel,j,y}$ (litre/month)
Mar 2009 to Jan 2010	8,176
Feb 2010	462
Mar 2010	417
Apr 2010	105
May 2010	49
Jun2010	124
Jul 2010	194
Aug 2010	351
Sep 2010	234

Oct 2010	187
Nov 2010	107
Dec 2010	7
Total	10,413

Refer to Annex 3 for the demonstration and justification of the monitoring of the diesel consumption between the periods of 4 Mar 2009 to 31 Jan 2010.

$\Sigma FC_{\text{diesel}}$	$\Sigma FC_{\text{diesel},j} \cdot \rho_{\text{diesel},j}^3$	9.06	t
$PEFF$	$\Sigma FC_{\text{diesel},j,y} \cdot NCV_{\text{diesel},y} \cdot EF_{CO_2,\text{diesel},y}^4$	28.95	t CO2e
PES_y	$\Sigma ((\omega_{\text{main},CO_2} + \omega_{\text{main},CH_4} \cdot GWP_{CH_4}) \cdot M_{S,y}^5)$	107,433	t CO2e
PE	$PES_y + PEFF_y$	107,463	t CO2e

E.3. Leakage calculation

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Since ACM0002 version 9 does not consider the emission due to power plant construction and fuel handlings, no leakage is considered ($L_y = 0$).

E.4. Emission reductions calculation / table

>>

The emission reduction $ER_y(\text{tCO}_2/\text{yr})$ by the project activity during a given year y is the difference between the baseline emission (BE_y), project emission (PE_y) and emissions due to leakage (L_y), as follows:

$$ER_y = BE_y - PE_y - L_y$$

Baseline Emissions	1,514,252	t CO2e
Project Emissions	107,463	t CO2e
Leakage	0	t CO2e
Total Emission Reduction in MP	1,406,789	t CO2e

Total VERs: 04 Mar 2009 – 1 December 2010 (inclusive of both days) = **1,406,789 tCO₂eq.**

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

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This section shall include a comparison of actual values of the emission reductions achieved during the monitoring period with the estimations in the registered CDM-PDD.

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO₂e)	1,389,323	1,406,789

³Diesel density, Source: national value of 0.87 kg/Litre. Fossil fuel consumption is recorded on the monthly basis.

⁴Diesel net calorific value, Source: Bahan Bakar Minyak ELPIJI dan BBG of 42.73GJ/ton. Diesel effective CO₂ emission factor, Source: IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories of 0.0748 tCO₂/GJ

⁵ PES is recorded on the daily basis

* The value applied in the *ex ante* calculation of the PDD provided here is calculated by pro-rating the annual estimated emission reductions: Values Applied in the Ex-ante Calculation of the PDD for the Monitoring Period = Annual Estimation of Emission reductions in the PDD × Number of Days in the Monitoring Period / Number of Days per Year = 794,832 tCO₂e/year × 638 Days in the Monitoring Period / 365 days per year = 1,389,323tCO₂e.

E.6. Remarks on difference from estimated value in the PDD

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The maximum emission reduction generated by this project activity within the proposed Monitoring period is 1,389,323 ton of CO₂, and the actual emission reduction is 1,406,789 ton of CO₂. The actual CER generation is 1.3% higher than the values applied in ex-ante estimation of the registered PDD.

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ANNEX 1. DOWNTIME AND SHUTDOWN RECORDS

WW Unit# 2 Downtime and Shutdown Records							
TRIP		SYNCHRON		TOTAL OUTAGE HOURS	TOTAL GEN. OPPORTUNITY LOST (MWh)	TYPE OF TRIP	TRIP CAUSED
DATE	TIME	DATE	TIME				
18 Jun '09	16:48	17 Jun '09	17:48	1:00	171.0	Forced Unplanned Outage	Unit house load due to 52S2 trip
24 July '09	13:22	24 July '09	13:50	0:28	114.0	Forced Unplanned Outage	Unit house load due to 52S2 trip
2 sept '09	14:56	2 Sept '09	20:10	5:14	599.0	Forced Unplanned Outage	Earthquake 7.3 SR, Turbine Tripped Manually by operator for safety reason
29 Oct '09	8:47	29 Oct '09	13:10	4:23	499.3	Forced Unplanned Outage	Plant Trip due to High - high condenser level switch active (instrument air pressure is low caused by all compressors are fails so that all pneumatic valve fails to operate including Condenser Inlet Valve)
8 March '10	18:06	8 March '10	21:33	3:27	392.9	Forced Unplanned Outage	Turbine trip due to over speed Transmission kamojang cikasungka trip (all power plant connected with GI Kamojang are tripped)
12 April '10	17:31	12 April '10	20:47	3:16	372.1	Forced Unplanned Outage	Turbine trip due to over speed Transmission kamojang - WW trip as PLN info due to lightning strike
03 Jun 2010	03:58	13 Jun 2010	08:32	244:34	27,855.7	Planned Outage	Turbine Overhaul
03 Jun 2010	11:14	13 Jun 2010	12:30	1:16	144.3	Planned Outage	Turbine overspeed test after overhaul

WW Unit# 1 Downtime and Shutdown Records							
TRIP		SYNCHRON		TOTAL OUTAGE HOURS	TOTAL GEN. OPPORTUNITY LOST (MWh)	TYPE OF TRIP	TRIP CAUSED
DATE	TIME	DATE	TIME				
18-Jun- 09	16:48	18 Jun '09	18:40	1:52	263,7	Forced Unplanned Outage	Unit trip due to HH WCP active after Unit-2 house load operation
2-Sep- 09	14:56	2 sept '09	20:10	5:14	494.9	Forced Unplanned Outage	Earthquake 7.3 SR, Turbine Tripped Manually by operator for safety reason
28-Oct- 09	21:40	11-Nov- 09	18:08	332:28	36,837.3	Planned Outage	Turbine Overhaul

ANNEX 2. MONITORING INSTRUMENTS

Parameter	Measurement Device	Technical Specifications / Type	Accuracy Class	Tag (serial number)	Calibration - I	Calibration - II	Calibration - III	Calibration - IV	Calibration - V	Calibration - VI	Calibration - VII	Next Calibration Scheduled	Remarks	
					Date	Date	Date	Date	Date	Date	Date			
Msvy	Differential Pressure Transmitter - Venturi Flow Meter	3051CD3A03A1AM5S5Q4	0.065% of span	A2-FIT-0106 (1882270)	6-Oct-08	14-Apr-09	7-Oct-09	8-Mar-10	22-Jul-10	The differential pressure transmitter (Rosemount) and the static pressure transmitter (Rosemount) were replaced with a multi-variable transmitter (Yokogawa S/N 91GA08958738) which measures both differential pressure and static pressure on 23 November 2011			Steam flow to WW-2 turbine	
	Pressure Transmitter - Venturi Flow Meter	2088G3S33A1M5B4Q4	0.065% of span	A2-PIT-0106 (0350337)	6-Oct-08	7-Apr-09	15-Oct-09	8-Mar-10	22-Jul-10					
	Multi Variable Transmitter	EJX910AEMS4G	DP acc: 0.04% of span, SP acc: 0.1% of span	A2-FIT-0106-DP (S/N 91GA08958738)	New installation of a rented multi-variable transmitter (Yokogawa S/N 91GA08958738) to replace the differential pressure transmitter (Rosemount) and the static pressure transmitter (Rosemount) on 23 November 2011					22-Nov-10	The rented multi-variable transmitter (Yokogawa S/N 91GA08958738) was replaced with the new multi-variable transmitter (Yokogawa S/N 91L410293) owned by SEG(WW)L on 31 May 2011			
				A2-FIT-0106-DP (S/N 91L410293)	New installation of a multi-variable transmitter (Yokogawa S/N 91L410293) owned by SEG(WW)L to replace the rented multi-variable transmitter (Yokogawa S/N 91GA08958738) on 31 May 2011					26-May-11	22-Nov-11			
Mso,y	Differential Pressure Transmitter - Orifice Plate	PTHDDF-1222-2	0.1% of span	FIT-2301 (S/n 8G201612)	29-Aug-08	15-Feb-09	13-Jul-09	13-Jan-10	9-Jul-10		31-Dec-10	30-Jun-11	30-Dec-11	MBB-1 Well steam flow
	Pressure Transmitter - Orifice Plate	3051TG4A2B31AB4M5T1Q48S5A0005	0.065% of span	PIT-2302 (S/n 01830135)	21-Aug-08	13-Apr-09	14-Oct-09	13-Jan-10	1-Jul-10	06-Jan-11	14-Jun-11	11-Dec-11		
Mso,y	Differential Pressure Transmitter - Orifice Plate	3051CD2A03A1AM5T1P1S5Q4Q8A005	0.065% of span	FIT-2501 (S/n 01830374)	28-Aug-08	24-Feb-09	13-Jul-09	5-Jan-10	8-Jul-10		28-Dec-10	13-Jun-11	13-Dec-11	MBA-1 Well steam flow
	Pressure Transmitter - Orifice Plate	3051TG4A2B31AB4M5T1Q48S5A0005	0.065% of span	PIT-2502 (s/n 01830130)	22-Aug-08	14-Apr-09	16-Nov-09	11-Jan-10	1-Jul-10	6-Dec-10	6-Jun-11	6-Dec-11		
Mso,y	Differential Pressure Transmitter - Orifice Plate	PTHDDF-1222-2	0.1% of span	FIT-2502 (S/n 8G201617)	28-Aug-08	14-Feb-09	2-Jul-09	5-Jan-10	9-Jul-10		28-Dec-10	28-Jun-11	28-Dec-11	MBA-2 Well steam flow
	Pressure Transmitter - Orifice Plate	3051TG4A2B31AB4M5T1Q48S5A0005	0.065% of span	PIT-2504 (s/n 01830131)	21-Aug-08	14-Apr-09	14-Oct-09	7-Jan-10	1-Jul-10	9-Dec-10	6-Jun-11	6-Dec-11		
Mso,y	Differential Pressure Transmitter - Orifice Plate	3051CD3A03A1AM5T1P1S5Q4D8A0005	0.065% of span	FIT-2503 (s/n 01830360)	29-Aug-08	14-Feb-09	2-Jul-09	4-Jan-10	9-Jul-10		27-Dec-10	13-Jun-11	13-Dec-11	MBA-3 Well steam flow
	Pressure Transmitter - Orifice Plate	3051TG4A2B31AB4M5T1Q48S5A0005	0.065% of span	PIT-2506 (s/n 01830132)	22-Aug-08	14-Apr-09	14-Oct-09	7-Jan-10	2-Jul-10	8-Dec-10	7-Jun-10	7-Dec-11		
Mso,y	Differential Pressure Transmitter - Orifice Plate	3051CD3A03A1AM5T1P1S5Q4D8A0005	0.065% of span	FIT-2504 s/n 01830361	29-Aug-08	14-Feb-09	1-Jul-09	4-Jan-10	8-Jul-10		27-Dec-10	10-Jun-11	10-Dec-11	MBA-4 Well steam flow
	Pressure Transmitter - Orifice Plate	3051TG4A2B31AB4M5T1Q48S5A0005	0.065% of span	PIT-2508 s/n 01830133	21-Aug-08	13-Apr-09	9-Sep-09	7-Jan-10	2-Jul-10	8-Dec-10	7-Jun-11	7-Dec-11		

Legends

	Historical calibration by Internal Lab
	Historical calibration by External Lab
	Future calibration to be conducted
	Equipment replaced/installed

Mso,y	Differential Pressure Transmitter - Orifice Plate	3051CD3A03A1AM5T1P1S5Q4D8A0005	0.065% of span	FTT-2505 s/n 01830359	29-Aug-08	14-Feb-09	1-Jul-09	4-Jan-10	9-Jul-10	24-Dec-10	9-Jun-11	9-Dec-11	MBA-5 Well steam flow
	Pressure Transmitter - Orifice Plate	3051TG4A2B31AB4M5T1Q48SSA0005	0.065% of span	PIT-2510 01830134	21-Aug-08	14-Apr-09	14-Oct-09	5-Jan-10	5-Jul-10	9-Dec-10	7-Jun-11	7-Dec-11	
Mso,y	Differential Pressure Transmitter - Orifice Plate	3051CD3A1AM5ESH2L4S604	0.065% of span	FIT501 S/n 01845811	4-Aug-08	3-Mar-09	9-Sep-09	12-Jan-10	8-Jul-10	30-Dec-10	16-Jun-11	16-Dec-11	MBD-5 Well steam flow
	Pressure Transmitter - Orifice Plate	3051TG3A2B31AE5M5T1Q4S5	0.065% of span	PIT506 s/n 01593780	4-Aug-08	3-Mar-09	22-Sep-09	11-Jan-10	5-Jul-10	20-Dec-10	13-Jun-11	13-Dec-11	
Msb,y	Differential Pressure Transmitter	PTHDDC 1222-2	0.08% of span	FIT-984 (S/n 0G238876)		25-Dec-08	22-Jul-09	14-Jan-10	9-Jul-10	10-Jan-11	10-Jul-11	10-Jan-12	WWW-1 Brine Injection Well
	Pressure Transmitter	PTHPGJ	0.1% of span	PIT-918 (S/n 8F196683)		23-Dec-08	29-Jun-09	24-Dec-09	22-Jun-10	18-Nov-10	31-May-11	30-Nov-11	
FC _{dest,EDG}	Flow Totalizer	SERIES 900	2%	AO-FQ-2033	Emergency Diesel Generator (EDG) Fuel Flowmeter installed on 15 Jan 2010				15-Jan-10	31-Jan-11		31-Jan-12	Emergency diesel generator
FC _{dest,fire pump}	Flow Totalizer	SERIES 800	1%	AO-FQ-2032	Diesel Fire Pump Fuel Flowmeter installed on 15 Jan 2010				15-Jan-10	31-Jan-11		31-Jan-12	Fire pump
EG _y (Unit-1)	Unit-1, "Meter Utama" kWh meter reading (main meter owned by PLN)	Input CT 5A (CT: Ratio 800-1600/5A, Class 0.2, Power 40VA) Input PT 100V (PT: Ratio 150kV/100VA, Class 0.2, Power 100VA)	0.2S	MT-0809A063-01	10-Oct-08							10-Oct-13	WW-1 electricity meter
	Unit-1, "Meter Pembanding" kWh meter reading (check meter owned by SEG)	Input CT 5A (CT: Ratio 800-1600/5A, Class 0.2, Power 40VA) Input PT 100V (PT: Ratio 150kV/100VA, Class 0.2, Power 100VA)	0.2S	PT-0807A249-01	12-Jan-09							06-Jan-13	
EG _y (Unit-2)	Unit-2, "Meter Utama" kWh meter reading (main meter owned by PLN)	Input CT 5A (CT: Ratio 750/1A, Class 0.1, Power 15VA) Input PT 100V (PT: Ratio 150kV/110VA, Class 0.1, Power 50VA)	0.2S	MT-0806A388 - 01	10-Oct-08							10-Oct-13	WW-2 electricity meter
	Unit-2, "Meter Pembanding" kWh meter reading (check meter owned by SEG)	Input CT 5A (CT: Ratio 750/1A, Class 0.1, Power 15VA) Input PT 100V (PT: Ratio 150kV/110VA, Class 0.1, Power 50VA)	0.2S	PT-0805A318-01	24-Oct-08	25-Aug-09					6-Jan-11	06-Jan-13	

**ANNEX 3. DIESEL CONSUMPTION 04 MARCH 2009 TO 31 JANUARY 2010**

Based on the registered PDD, diesel consumption for the emergency genset and fire pump would be monitored using the onsite measurement and record of diesel fuel consumption. However, the flowmeters to measure the diesel consumption for both the emergency genset and fire pump were not installed and calibrated until 15 January 2010 due to the processing time taken to purchase and delivery the flowmeters on site.

As diesel consumption for the emergency genset and fire pump are reported on the monthly basis, the diesel consumption for the emergency genset and fire pump from 4 Mar 2009 (the date when the project started operations) to 31 Jan 2010 was based on the running hours recorded from the equipments and the specification of the equipments.

Records of the running hours of the emergency genset and fire pump

During the period of 4 Mar 2009 to 31 Jan 2010, the emergency genset and fire pump were only run for testing purposes on interval based (mostly weekly). Therefore the records of the running hour counter on the dates that were closest to 4 Mar 2009 and 31 Jan 2010 were used, i.e.

	Initial running hour counter record to indicate the running hour counter on 4 Mar 2009	Final running hour counter record to indicate the running hour counter on 31 Jan 2010	Total running hour (hours)
Emergency Genset	Records of the running hour before being tested on 5 Mar 2009, i.e. 1,373.7	Records of the running hour after being tested on 28 Jan 2010 (and before being tested next on 4 Feb 2010), i.e. 1,399.4	$1399.4 - 1373.7 = 26.9$
Fire pump	Records of the running hour after being tested on 24 Feb 2009 (and before being tested next on 30 Mar 2009), i.e. 130.5	Records of the running hour after being tested on 25 Jan 2010 (and before being tested next on 8 Feb 2010), i.e. 145.7	$145.7 - 130.5 = 15.2$

Consumption rate based on the specification of the emergency genset and fire pump

Fuel consumption based on the specification of the emergency genset as follows⁶:

Fuel Consumption (Prime Duty):

	Ltrs/Hr
110% Load	321.0
100% Load	274.0
75% Load	213.0
50% Load	149.0

As the emergency genset was run for testing purposes during the monitoring period, the load would be less than 50%. However, for conservativeness, fuel consumption for the 100% load was used in the calculation, i.e. 274 liters/hour.

⁶ Detail specification is available during verification



Fuel consumption based on the specification of the fire pump as follows⁷:

DDFP-L6FA INSTALLATION & OPERATION DATA (Continued)

	1470	1760	2100	2350
Exhaust System				
Exhaust Flow - ft. ³ /min. (m ³ /min.)	1570 (44)	1930 (55)	2320 (66)	2440 (69)
Exhaust Temperature - °F (°C)	723 (383)	680 (360)	649 (343)	639 (337)
Maximum Allowable Back Pressure -				
in. H ₂ O (kPa)	19 (4.7)	26 (6.6)	28 (7.1)	30 (7.6)
Minimum Exhaust Pipe Dia. - in. (mm)**	5 (127)	5 (127)	6 (152)	6 (152)
Fuel System				
Fuel Pressure - lb./in. ² (kPa)	58 (400)	62 (428)	64 (442)	65 (449)
Fuel Consumption - gal./hr. (L/hr.)	12 (45)	14 (53)	17 (64)	17 (64)

Based on the specification of the fire pump, a consumption rate of 53 liters/hour was used in the calculation.

Diesel consumption calculation

Based on the above, the diesel consumption for the emergency genset and fire pump from 4 Mar 2009 (the date when the project started generating emission reductions) to 31 Jan 2010 was calculated as following:

	Running Hour (hour)	Consumption Rate (Ltrs/hour)	Diesel Consumed (Ltrs)
Emergency genset	26.9	274	7,371
Fire pump	15.2	53	805
		Total	8,176

As the flowmeters to measure the diesel consumption for both the emergency genset and fire pump were installed and calibrated on 15 January 2010, the monthly reading from the flowmeters were used for the measurement of the diesel consumption for the emergency genset and fire pump from 1 February 2010 onwards.

It is to be noted that although flowmeters have been installed and readings are taken on the monthly basis, the running hours of the emergency genset and fire pump are still being recorded whenever the equipments are being used for the energy balance check as part of the monitoring quality procedures.

⁷ Detail specification is available during verification