



**Monitoring report form for CDM project activity
(Version 06.0)**

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT

Title of the project activity	Korea East-West Power Dangjin small hydro power plant project(5MW)	
UNFCCC reference number of the project activity	2366	
Version number of the PDD applicable to this monitoring report	Version 13 (05/Jun/2009) (In case of Monitoring plan, It was revised in 04/Jul/2012)	
Version number of this monitoring report	Version 01	
Completion date of this monitoring report	02/04/2018	
Monitoring period number	2nd monitoring period	
Duration of this monitoring period	01/04/2011 ~ 31/12/2011	
Monitoring report number for this monitoring report	2	
Project participants	Korea East-West Power Co., Ltd.	
Host Party	Republic of Korea	
Sectoral scopes	Sectoral scope : 1 - Energy industries (renewable / non-renewable sources)	
Applied methodologies and standardized baselines	AMS.I.D. Grid connected renewable electricity generation, version 13.0	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	12,208 tCO ₂ e	-
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	11,374 tCO ₂ e * This amount was recalculated by multiplying the day of this monitoring period over a year to the yearly estimated emission reductions in PDD(effective in 2011), 15,096 tCO ₂ e (15,096 tCO ₂ e / 365 days × 275 days = 11,374 tCO ₂ e)	

SECTION A. Description of project activity

A.1. General description of project activity

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The purpose of the project activity is to generate electricity from the potential energy in the circulating cooling water discharged from Dangjin thermal power plant and export the net electricity to the grid.

Since hydro power technology can generate electricity without emitting any greenhouse gas (GHG), this project activity contributes to the reduction of GHG by displacing at least one of fossil fuel-fired power plants which would have generated electricity with emitting GHG.

Brief description of installed technology and equipment

The Dangjin thermal power plant is operated and maintained by Korea East-West Power Co., Ltd. (EWP). The proposed project of generating capacity is 4.998 MW (each turbine capacity, 1,666 kW x 3 unit).

Table 1 : installed equipment specification

Classification		Dangjin
Turbine	Type	Pit, Horizontal, Bulb type
Generator	Capacity	1,666 kW
	Unit	3

Total GHG emission reductions achieved in this monitoring period

The total amount of emission reductions achieved in this monitoring period is summarized in the table below;

Table 3 : Total amount of emission reductions

Monitoring period	Total net electricity	Total emission reductions
01/04/2011 – 31/12/2011	22,563MWh	12,208tCO ₂ eq

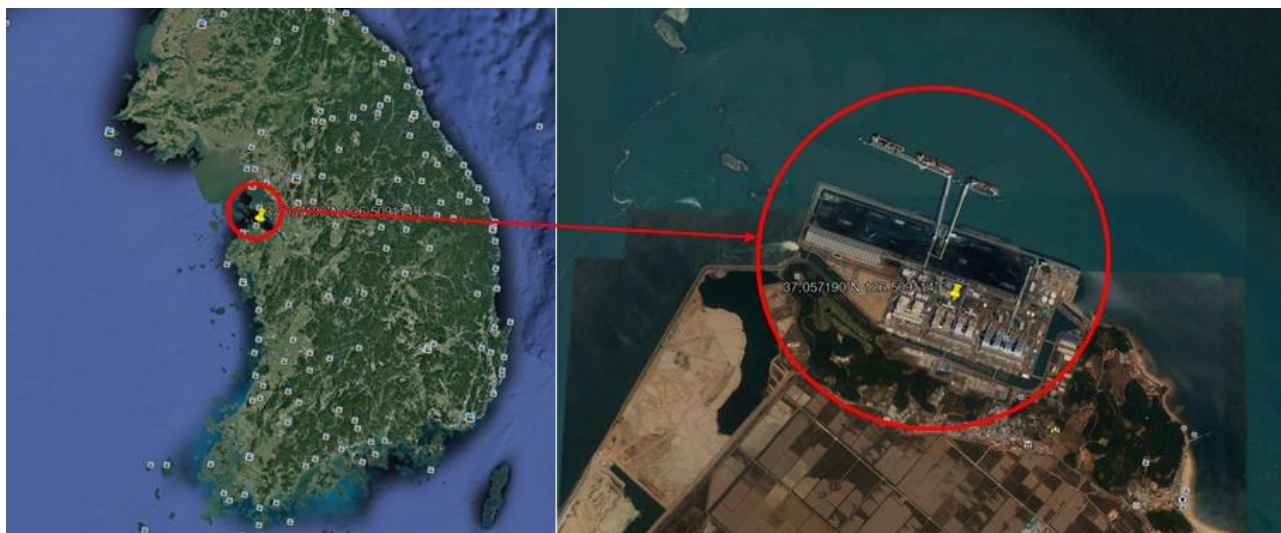
A.2. Location of project activity

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The project activity has been being performed on four places in Republic of Korea. And the host party is the Republic of Korea. The <Table 4> shows the geographic locations of the power plant of project site. The specific address of the power plant of each project site is described as below;

Table 4 : The address of the power plant of project site

Plant	Geographical location
Dangjin	Gyoro-Ri, Seckmun-Moen, Dangjin-city, Chungcheong Nam-do, Republic of Korea Latitude : 37.057190°N Longitude: 126.509114°E



A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Korea(host)	Private entity: Korea East-West Power Co., Ltd	No

A.4. Reference to applied methodologies and standardized baselines

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Title of approved baseline and monitoring methodology

Renewable electricity generation for a grid in accordance with approved small scale methodology "AMS-I.D."

Type : 1 – Renewable Energy Projects

Sectoral Scope : 01, Energy Industries

Category I.D.: Grid connected renewable electricity generation, Version 13.0

<https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTFQOQFQQH4SBK>

Reference : Appendix B of the Simplified Modalities and Procedures for small-scale CDM project activities

<http://cdm.unfccc.int/Reference/COPMOP/08a01.pdf#page=52>

Standardized baseline

Not applicable

A.5. Crediting period type and duration

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Length of the total crediting period: 10 years (Fixed)

The start date of the crediting period: 01/01/2010

The end date of the crediting period: 31/12/2019

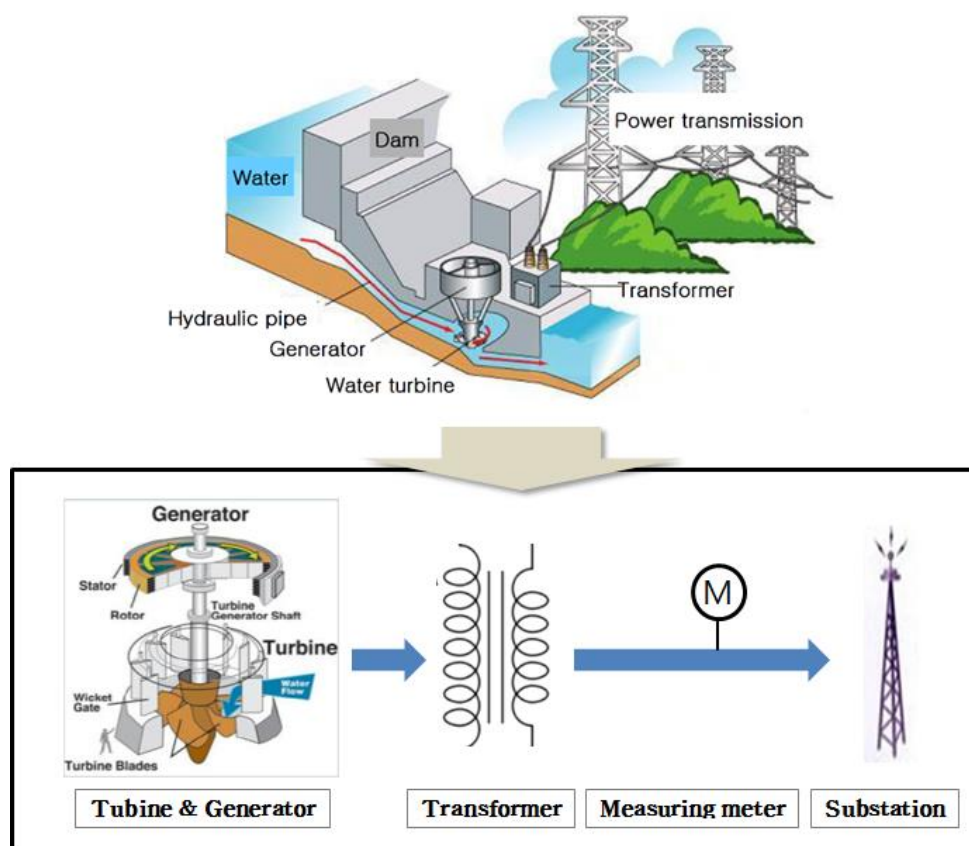
The period of 2nd verification & issuance: 01/04/2011 – 31/12/2011

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

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The project activity is the generation of hydropower using outflows from existing dams. This hydroelectric power plant utilizes potential energy of water. And this energy is converted to a kinetic energy, which generates electricity without emitting any GHG through rotating water turbines. Generated electricity by the project activity is transmitted to the KEPCO grid and is measured continuously, respectively by each of installed watt-hour meter on site. The total installed capacity is 4.988MW. Schematic diagram of the project activity;



<Figure B.1> Schematic diagram of small-scale hydroelectric power plants

Classification		Dangjin
Wheel	Type	Pit, Horizontal, Bulb type
	Rated Output power	1,736 kW
	Rotation	138.4
	Flow rate(unit)	35 m ³ /sec
	Unit	3
Generator	Type	3-phase, Synchronous
	Rated Output power	1,666 kW
	Rotation	138.4
	Unit	3

The capacities of the project equipments were not changed during this monitoring period and no emergency incidents occurred during this period which may change the applicability of the methodology or change the emission reductions. Further, the plant was in continuous operation during the monitoring period

The power plant during the monitoring period has trivial events, but it has no impact on generation.

Relevant dates for the project activity

The project started on 25/01/2008; the starting date of activity is the contract date for manufacturing and purchasing of hydroelectric power generation facilities. The relevant dates for the project activity are summarized in the table below;

Table 5 : Relevant dates for the project activity

Description	Dangjin
Completion of construction	31/12/2009
Commissioning date	18/12/2009~30/12/2009
Starting date of operation	01/01/2010
Continued operation	01/01/2010~Present

B.2. Post-registration changes**B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies or standardized baselines**

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Not applicable

B.2.2. Corrections

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Not applicable

B.2.3. Changes to the start date of the crediting period

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Not applicable

B.2.4. Inclusion of monitoring plan

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Not applicable

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools

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Changes that have been approved by the Board as applicable from the period prior to this monitoring period

- Approved revision of the monitoring plan covers the change of measurement method, QA/QC procedures and the supplement of monitoring point. Korea East-West power updated the change of the monitoring plan including that #7 and #8 thermal power plants(M3) will be used only emergency situation when KEPCO could not supplied to the project activity due to unpredictable situation.
 - The approval date of the revised monitoring plan: 04/Jul/2012

B.2.6. Changes to project design

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Changes that have been approved by the Board as applicable from the period prior to this monitoring period

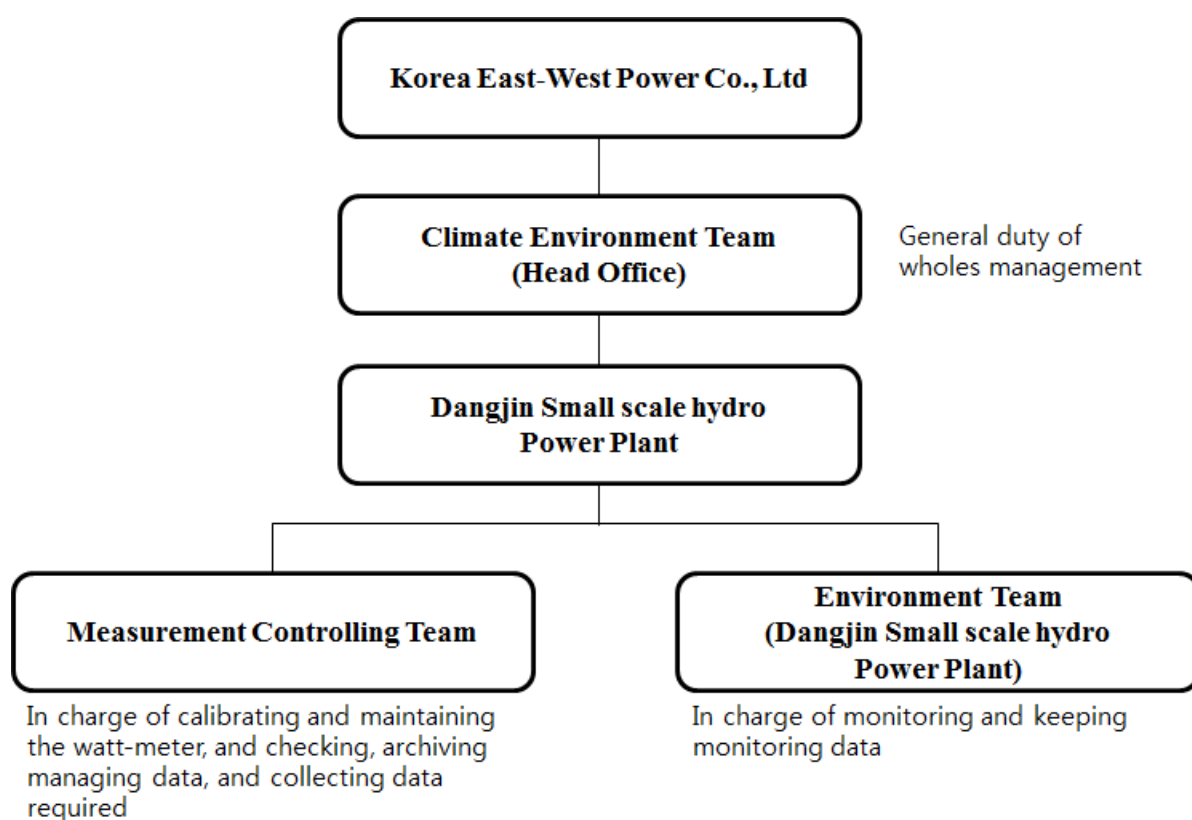
- Korea East-West power updated the change of the monitoring plan at the revised monitoring plan.
- The approval date of the revised monitoring plan: 04/Jul/2012

SECTION C. Description of monitoring system

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Management structure of Monitoring

The project operator assigns the person in charge of CDM project with assistance of the Management controlling team and Climate Environment team¹. The structure shows as the following Figure C-1



<Figure C.1> Schematic diagram of small-scale hydroelectric power plants

- Environment & Chemistry Team

The Environment & Chemistry Team of the Head office manages the overall monitoring procedure for the management of emissions reduction. The Environment & Chemistry Team of the Head office is responsible for collecting the monitoring result and managed monitoring report and approvals.

¹ The structure of the monitoring organization and responsibility related to the project activity remains unchanged since start of the project. Only the names of monitoring organization had been changed from the re-organization of Korea East-West Power as follows: Environment & Chemistry team → Climate Environment Team

- **Dangjin small scale hydro Power Plant**

The General Manager of Dangjin small scale hydro power Plant is responsible for the monitoring of the CDM project and provided the monitoring result regularly to the Environment & Chemistry team of the Head Office. The General Manager of Dangjin small scale hydro power Plant provides the monitoring guidelines and trains the staff in charge by the help of the contents of the UNFCCC in order to improve the skill relating to monitoring and makes a final check and review on the monitoring data which are used for CDM project.

- **Measurement Controlling Team**

The General Manager of the Measurement Controlling Team shall manage tasks regarding calibration of the Watt- hour meters, system management and select a person in charge of the monitoring installation management. Also the General Manager should arrange roles for the person in charge of the monitoring installation management.

- **Environment Team**

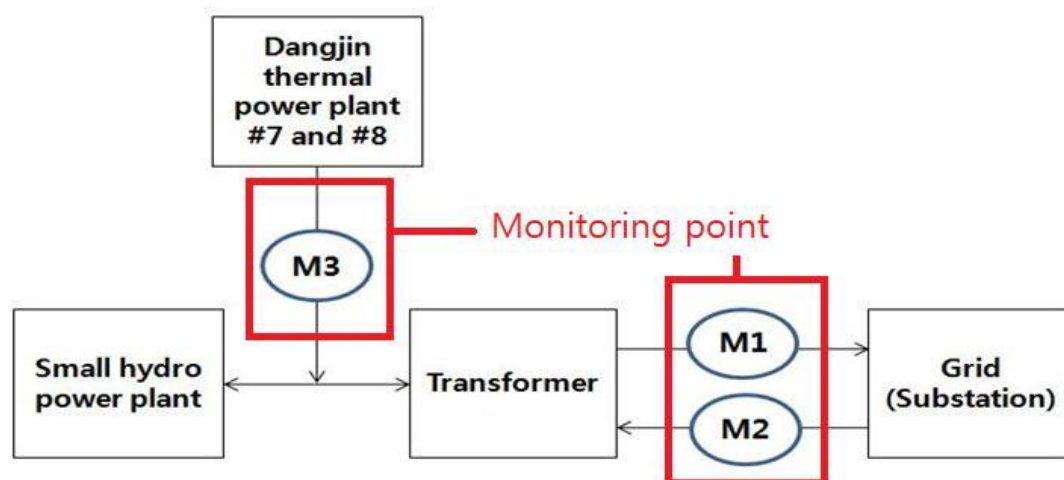
The General Manager of Environment team is responsible for collecting and documentation of the net electricity data supplied to the grid, and check and review the collected monitoring data (net electricity).

Quality control (QC) and quality assurance (QA) procedures

- **Monitoring equipment**

The monitoring point of the proposed project is as follow:

The amount of electricity supplied to the KEPCO Grid is monitored by watt-hour meters with accuracy range $\pm 0.5\%$ and the amount of electricity supplied from the KEPCO Grid and the Dangjin thermal #7,#8 power plant is monitored by watt-hour meters with accuracy range $\pm 1.0\%$



M1 : Watt-hour meter for electricity supplied to the grid

M2 : Watt-hour meter for electricity imported from the grid

M3 : Watt-hour meter for electricity imported from Dangjin thermal power plant #7 & #8

The watt- hour meters were set up transparently in accordance with “Measures Act (Law regarding measurement)” and “Act on operation of electricity market” then sealed after affirmation of Korea Power Exchange.

The meters are authorized through the due formal certifying process (the valid period for the authorized certification: 7 years). Export watt-hour-meter (M1) and import watt-hour-meter (M3) are re-calibrated within 3 years after installed or calibrated as per paragraph 17 (c) of "General guidelines to SSC CDM methodologies". Another import watt-hour-meter (M2) were re-calibrated by KEPCO as per national regulation.

- **Monitoring data**

Electricity supplied to the grid was continuously monitored by watt-hour meter installed. The electricity sales receipt or equivalent evidence was provided by Korea Power Exchange for the project owner's double check of the amount of electricity supplied and accepted by Korea Power Exchange. And the participants monitored the imported electricity by metering device.

- **Management of monitoring**

The person in charge of monitoring and electricity safety attended the following courses

- Course on 'Act on operation of electricity market'
- Course on Electricity safety

If the responsible for monitoring and electricity safety is transferred to another person, it is needed to be approved by final decision-maker.

ISO 14001 system has already existed in the object site and ISO 14001 system will be connected with monitoring system of this project.

Emergency procedure

In case unexpected accident which affects Emission Reductions is occurred, the person in charge of monitoring should report to the responsible department (Environment & Chemistry Team) and act according to the internal manual in emergency.

In case Watt- hour meters are improperly operated or the transfer of data is in error, internal investigation and correction procedure shall be followed and be certified by the final decision-maker and Korea Power exchange.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data/Parameter	EF _y
Unit	tCO ₂ e/MWh
Description	CO ₂ emissions factor in power in year y
Source of data	Calculated
Value(s) applied	0.5411
Choice of data or measurement methods and procedures	This value of data was calculated according to Tool to calculate the emission factor for an electricity system (version 01.1). Applied value was calculated by referring Statistics of Electric Power in 2004(KEPCO 2005), Statistics of Electric Power in 2005(KEPCO 2006), Statistics of Electric Power in 2006(KEPCO 2007), and Status of Generation facility in 2006(KPX 2007)
Purpose of data/parameter	Calculation of baseline emission
Additional comments	The same value of data will be applied during the first crediting period without updating.

Data/Parameter	EF _{om,y}
Unit	tCO ₂ e/MWh
Description	Operating Margin emission factor
Source of data	Calculated
Value(s) applied	0.7075
Choice of data or measurement methods and procedures	This value of data was calculated according to Tool to calculate the emission factor for an electricity system (version 01.1). Applied value was calculated by referring Statistics of Electric Power in 2004(KEPCO 2005), Statistics of Electric Power in 2005(KEPCO 2006), Statistics of Electric Power in 2006(KEPCO 2007), and Status of Generation facility in 2006(KPX 2007)

Purpose of data/parameter	Calculation of baseline emission
Additional comments	The same value of data will be applied during the first crediting period without updating.

Data/Parameter	EF_{BM,y}
Unit	tCO ₂ e/MWh
Description	Build Margin emission factor
Source of data	Calculated
Value(s) applied	0.3747
Choice of data or measurement methods and procedures	This value of data was calculated according to Tool to calculate the emission factor for an electricity system (version 01.1). Applied value was calculated by referring Statistics of Electric Power in 2004(KEPCO 2005), Statistics of Electric Power in 2005(KEPCO 2006), Statistics of Electric Power in 2006(KEPCO 2007), and Status of Generation facility in 2006(KPX 2007)
Purpose of data/parameter	Calculation of baseline emission
Additional comments	The same value of data will be applied during the first crediting period without updating.

Data/Parameter	EF_{CO2, thermal power}
Unit	tCO ₂ e/MWh
Description	CO ₂ emission factor from Dangjin #7 & #8 thermal power plant in year y.
Source of data	The value in the PDD is from "Methodological tool (Tool to calculate baseline, project and/or leakage emissions from electricity consumption),
Value(s) applied	1.3
Choice of data or measurement methods and procedures	The project activity can be supplied the electricity consumption sources from Dangjin #7 & #8 thermal power plants. These thermal power plants are also connected to the electricity grid. As per scenario C of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", the project activity applies to an emission factor of 1.3tCO ₂ /MWh, which used to project electricity consumption sources.
Purpose of data/parameter	Calculation of project emission
Additional comments	N/A

D.2. Data and parameters monitored

Data/Parameter	EG_y
Unit	MWh
Description	Net Electricity supplied to the grid by the project in year y.
Measured/calculated/default	Directly Measured
Source of data	Actual data obtained from quantity of net electricity supplied to the grid in year y are the difference between the Watt-hour meter quantities of the grid through on-site export and the import Watt-hour meter. $EG_y = EG_{out} - EG_{in,1}$
Value(s) of monitored parameter	Total values in this monitoring period: 22,563.042 MWh (a) The total electricity supplied to the grid is 22,599.645 MWh (b) The total electricity imported from the grid and consumed by the plant is 36.603 MWh For the detail value in the monitoring period, refer to the ER spreadsheet.

Monitoring equipment	- EG_{out} (M1) Measurement equipment: Watt-hour meter 1.Type: AC3P4W 2. Accuracy: 0.5S. 3. Serial number: 51002207 4. Calibration frequency : within 3years 5. Date of last calibration: 18/05/2009 6. Validity period: 18/05/2009 - 17/05/2012 - EG_{in, 1} (M2) Measurement equipment: Watt-hour meter 1.Type: AC3P3W 2. Accuracy: 1.0S. 3. Serial number: 0906377 4. Calibration frequency: compliance with the “Measures Act” (Controlled by KEPCO). 5. Date of last calibration: installed on 29/12/2009 6. Validity period: 29/12/2009 - 28/12/2016.
Measuring/reading/recording frequency	EG _{out} : Continually Measured and hourly Recorded EG _{in, 1} : Continually Measured and monthly Recorded
Calculation method (if applicable)	N/A
QA/QC procedures	The allowable error range for the meters: EG _{out} (M1) : 0.5S (±0.5%) EG _{in,1} (M2) : 1.0S (±1.0%)
Purpose of data/parameter	Baseline emission calculations
Additional comments	N/A

Data/Parameter	EG _{out}
Unit	MWh
Description	Electricity supplied to the grid by the project in year y.
Measured/calculated/default	Directly measured
Source of data	Measured by watt-hour meter (M1)
Value(s) of monitored parameter	Total values in this monitoring period: 22,599.645MWh For the detail value in the monitoring period, refer to the ER spreadsheet.
Monitoring equipment	- EG_{out} (M1) Measurement equipment: Watt-hour meter 1.Type: AC3P4W 2. Accuracy: 0.5S. 3. Serial number: 51002207 4. Calibration frequency : within 3years 5. Date of last calibration: 18/05/2009 6. Validity period: 18/05/2009 - 17/05/2012
Measuring/reading/recording frequency	Continually Measured and hourly Recorded
Calculation method (if applicable)	N/A
QA/QC procedures	The allowable error range for the meters: 0.5S(±0.5%). The watt-hour meter will be calibrated every 3 years. Data measured by meter was cross checked by electricity sales receipt. If the data are different, project participant shall be followed “Act on operation of electricity market”. In case meters are improperly operated equipments, internal audit and correction procedures shall be followed and be certified by the final decision-maker and Korea Power Exchange.
Purpose of data/parameter	Baseline emission calculations
Additional comments	N/A

Data/Parameter	EG _{in,1}
Unit	MWh
Description	Electricity supplied from the grid in year y.
Measured/calculated/default	Directly measured
Source of data	Measured by watt-hour meter (M2)
Value(s) of monitored parameter	Total values in this monitoring period: 36.603MWh For the detail value in the monitoring period, refer to the ER spreadsheet.
Monitoring equipment	- EG_{in,1}(M2) Measurement equipment: Watt-hour meter 1.Type: AC3P3W 2. Accuracy: 1.0S. 3. Serial number: 0906377 4. Calibration frequency: compliance with the “Measures Act” (Controlled by KEPCO). 5. Date of last calibration: installed on 29/12/2009 6. Validity period: 29/12/2009 - 28/12/2016.
Measuring/reading/recording frequency	Continually Measured and monthly Recorded
Calculation method (if applicable)	N/A
QA/QC procedures	The allowable error range for the meters: 1.0S(±1.0%). The watt-hour meter will be calibrated by KEPCO (The import watt-hour meter is under KEPCO's control). Data measured by meters was cross checked by electricity bills.
Purpose of data/parameter	Baseline emission calculations
Additional comments	N/A

Data/Parameter	EG _{in,2}
Unit	MWh
Description	Electricity supplied from the Dangjin thermal #7 and #8 power plant in year y
Measured/calculated/default	Directly measured
Source of data	Measured by watt-hour meter (M3)
Value(s) of monitored parameter	Total values in this monitoring period: 0MWh The emission from EG _{in,2} (M3) is not be considered.
Monitoring equipment	- EG_{in,3}(M3) Measurement equipment: Watt-hour meter 1.Type: AC3P3W 2. Accuracy: 1.0S. 3. Serial number: 0091301 4. Calibration frequency : within 3years 5. Date of last calibration: 29/12/2009 (installed date) 6. Validity period: 29/12/2009 - 28/12/2012
Measuring/reading/recording frequency	Continually Measured and monthly Recorded
Calculation method (if applicable)	N/A
QA/QC procedures	The allowable error range for the meters: 1.0S (±1.0%). The wathour meter will be calibrated every 3 years.
Purpose of data/parameter	Project emission calculations
Additional comments	EG _{in,2} will be supplied from thermal power during emergency (black out from KEPCO grid). If the emission from EG _{in,2} (M3) is less than 1% of total annual emission reductions, the emission from EG _{in,2} (M3) will not be considered.

D.3. Implementation of sampling plan

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Not Applicable

SECTION E. Calculation of emission reductions or net anthropogenic removals**E.1. Calculation of baseline emissions or baseline net removals**

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Follow the registered PDD in accordance with AMS-ID (version 13), the Baseline emissions (BE_y) during the monitoring period is calculated as follows:

$$BE_y = EG_y * EF_y$$

Where;

 BE_y : Baseline Emissions in year y (tCO_2e) EG_y : Net electricity amount supplied to the grid by the project in year y. (MWh) EF_y : CO_2 emissions factor in power in year y (tCO_2e/MWh)

Quantity of the net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (EG_y) = $EG_{out} - EG_{in,1}$

According to the above,

$$\begin{aligned} EG_y &= EG_{out} - EG_{in,1} \\ &= 22,599.645MWh - 36.603MWh \\ &= 22,563.042MWh \end{aligned}$$

Therefore,

$$\begin{aligned} BE_y &= EG_y \times EF_y \\ &= 22,563.042 \times 0.5411 \\ &= \mathbf{12,208 \text{ tCO}_2e \text{ (Rounded down conservatively)}} \end{aligned}$$

E.2. Calculation of project emissions or actual net removals

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Meter is installed to measure the imported electricity from Dangjin thermal power plant.#7, #8. During this monitoring period, the imported electricity from Dangjin thermal power plant is 0MWh. Thus, $PE_y = 0 \text{ tCO}_2e$

E.3. Calculation of leakage emissions

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Follow the registered PDD in accordance with AMS-ID (version 13), leakage does not need to be considered. Thus, $LE_y = 0 \text{ tCO}_2e$

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or baseline net GHG removals (t CO ₂ e)	Project GHG emissions or actual net GHG removals (t CO ₂ e)	Leakage GHG emissions (t CO ₂ e)	GHG emission reductions or net anthropogenic GHG removals (t CO ₂ e)		
				Before 01/01/2013	From 01/01/2013	Total amount
2011	12,208	0	0	12,208	0	12,208
Total	12,208	0	0	12,208	0	12,208

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period (t CO ₂ e)	Amount estimated ex ante (t CO ₂ e)
12,208	11,374 (15,096 tCO ₂ e / 365 days × 275 days = 11,374 tCO ₂ e)

E.6. Remarks on increase in achieved emission reductions

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This project was estimated to reduce 11,374 tCO₂e according to the registered PDD for this monitoring period. However, actual reduction is 12,208 tCO₂e and the net electricity supplied to the grid is 22,563.042 MWh. This shows that the actual value is larger by 833 tCO₂e than the estimated value in the PDD. The amount of net electricity supplied to the grid(22,563.042MWh) is larger than the estimated value(21,019.587MWh, recalculated by multiplying the day of this monitoring period over a year to the yearly estimated electricity generation in PDD). The increase of the amount of electricity was due to plant rated head. The amount of power generation is determined as rated head(Hr) and discharge. However, rated head(Hr) of this project is affected by the tide level of Samgilpo. Due to Lowest tide level during high tide satisfied to an effective head, project power generation has increased during the monitoring period.

