



**Monitoring report form
(Version 05.1)**

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.

MONITORING REPORT

Title of the project activity	K-water hydropower VI	
UNFCCC reference number of the project activity	7140	
Version number of the monitoring report	Version 01.0	
Completion date of the monitoring report	26/01/2017	
Monitoring period number and duration of this monitoring period	1st monitoring period, 01/12/2012 – 30/06/2016	
Project participant(s)	Korea Water Resources Corporation (K-water)	
Host Party	Republic of Korea	
Sectoral scope(s)	Sectoral scope : 1 - Energy industries (renewable / non-renewable sources)	
Selected methodology(ies)	AMS.I.D. Grid connected renewable electricity generation, version 17.0	
Selected standardized baseline(s)	Not Applicable	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	181,944 tCO _{2e} * This amount was recalculated by multiplying the day of this monitoring period over a year to the yearly estimated emission reductions in PDD, 50,772 tCO _{2e} (50,772 tCO _{2e} / 365 days × 1,308 days = 181,944 tCO _{2e})	
Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	5,688	163,918

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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Purpose of project activity

The project activity aims at meeting the increasing demand for utilizing renewable energy resources to generate electricity and supporting the social-economic development of the local areas and the host country by means of the construction of hydropower plants. As the project activity will displace a part of the generated electricity from fossil fuel power plants, the project activity will lead to avoidance of CO₂ emission and environmental pollution caused by fossil fuel consumption.

Description of project activity

“K-water hydropower VI”(hereinafter referred to as the project activity) was performed by Korea Water Resources Corporation(hereinafter referred to as K-water). The project is a new run-of-river hydropower plant at a site there was no renewable energy power plant operating prior to implementation of the project activity. The generated electricity from a hydropower plant will be transmitted to the grid of Korea Electric Power Corporation(hereinafter referred to as the KEPCO grid) which is a company in charge of exclusively managing the grid of Republic of Korea.

Brief description of installed technology and equipment

As a bundled CDM project, the project activity consists of three hydropower plants as Ipo, Yeosu, and Gangcheon. The installed equipment is the following;

- Ipo hydropower plant
 - (a) Turbine Type : Horizontal Shaft Kaplan Tubular
 - (b) Electricity Generation : 17,838 MWh/y
 - (c) Installed Capacity : 3,000 (kW)
 - (d) Generator voltage : 3.3 (kV)
- Yeosu hydropower plant
 - (a) Turbine Type : Horizontal Shaft Kaplan Tubular
 - (b) Electricity Generation : 29,739 MWh/y
 - (c) Installed capacity : 4,950 (kW)
 - (d) Generator voltage : 0.69 (kV)
- Gangcheon hydropower plant
 - (a) Turbine Type : Horizontal Shaft Kaplan Tubular
 - (b) Electricity Generation : 28,829 MWh/y
 - (c) Installed Capacity : 4,995 (kW)
 - (d) Generator voltage : 6.6 (kV)

Relevant dates for the project activity

The project started on 26/10/2009(Ipo), 27/10/2009(Yeosu), 27/10/2009(Gangcheon); the Starting date of activity is the date signed on the contract of turnkey-base project for each of hydropower plants. The duration of the first crediting period is from 01/12/2012, which is the current period.

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

Table 1 : Total amount of emission reductions

Monitoring period	Total electricity	Total emission reductions
01/12/2012 – 30/06/2016	255,238.872 MWh	169,606 tCO _{2e}

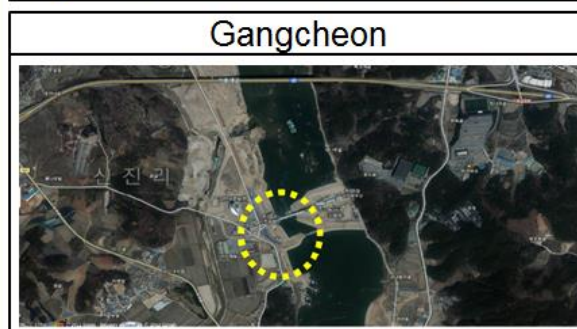
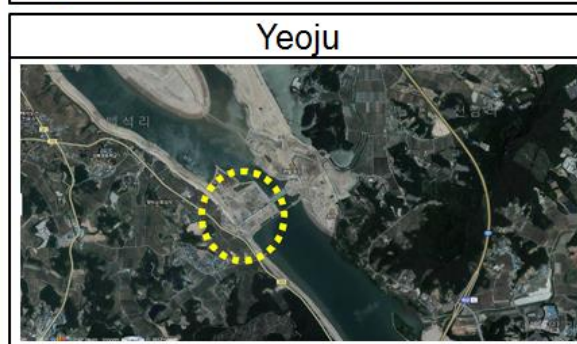
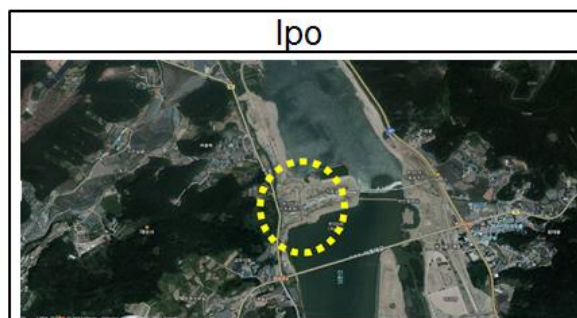
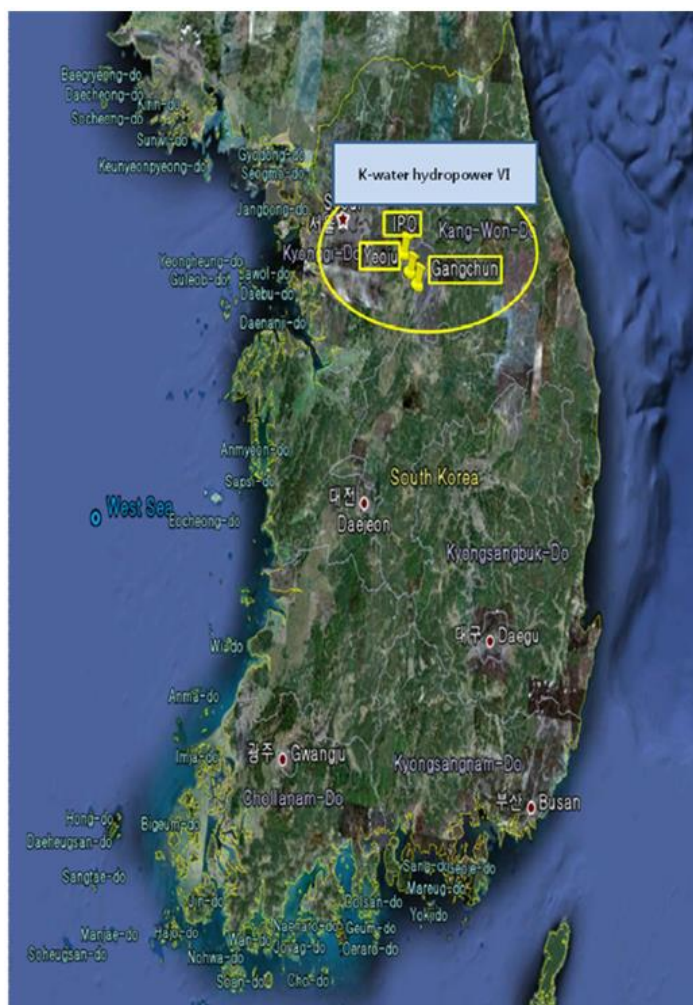
A.2. Location of project activity

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The project activity has been being performed on Han River in Republic of Korea. And the host party would be the Republic of Korea. The <Table 2> shows the geographic locations of the power plant of each project site. The specific address of the power plant of each project site is described as below;

Table 2 : The address of the power plant of each project site

Plant	Geographical location
Ipo	380, Ipo-ri, Geumsa-myeon, Yeosu-gun, Gyeonggi-do The latitude of 37.404065°N and the longitude of 127.536698°E
Yeoju	1008, Wangdae-ri, Neungseo-myeon, Yeosu-gun, Gyeonggi-do The latitude of 37.326298°N and the longitude of 127.605249°E
Gangcheon	22-4, Danhyeon-ri, Yeosu-eup, Yeosu-gun, Gyeonggi-do The latitude of 37.276777°N and the longitude of 127.681493°E



A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate whether the Party involved wishes to be considered as project participant (yes/no)
Republic of Korea (host)	Public entity : Korea Water Resources Corporation (K-water)	No
Switzerland		

A.4. Reference of applied methodology and standardized baseline

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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 17.0

<http://cdm.unfccc.int/methodologies/DB/RSCTZ8SKT4F7N1CFDXCSA7BDQ7FU1X>

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

https://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid21.pdf

Tool reference

"Tool to calculate the emission factor for an electricity system" Version 02.2.1

<http://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-07-v2.2.1.pdf>

Standardized baseline

Not applicable

A.5. Crediting period of project activity

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The chosen crediting period is : 10 year, (fixed)

The start date of the crediting period : 01/12/2012

The end date of the crediting period : 30/11/2022

The period of first verification & issuance is : 01/12/2012 – 30/06/2016

A.6. Contact information of responsible persons/entities

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The responsible persons/entities;

- Deog-je Kim, Principal Specialist / Korea Water Resources Corporation (K-water)
E-mail: kdj@kwater.or.kr, Telephone : 82-42-629-2988, Fax : 82-42-629-2999

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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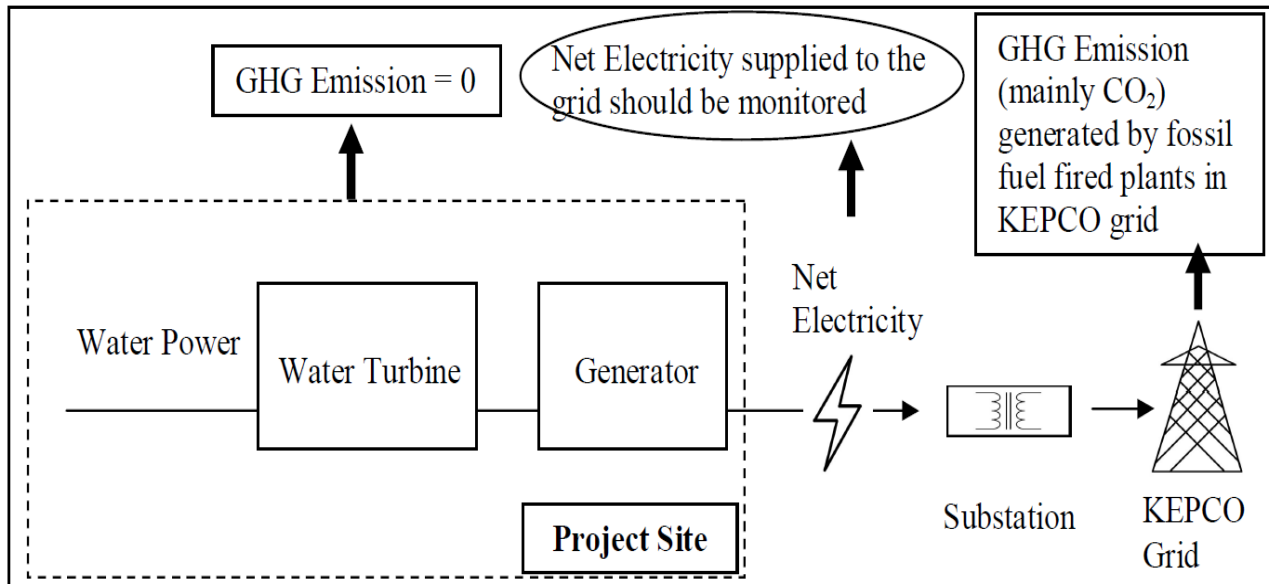
The project activity is the generation of hydropower using running water from a weir to the powerhouse. The horizontal shaft Kaplan turbines coupled to synchronous generators are used to convert the flow of water to electrical energy. The generated electricity by the project activity is

transmitted to the KEPCO grid and is measured continuously, respectively by each of installed watt-hour meter on site. In the absence of the project activity, equivalent amount of electricity would have been produced from other sources of energy such as fossil fuels in KEPCO grid which would have released greenhouse gases into the atmosphere.

For the project activity, the project boundary is from the point of water power to the point of electricity supply to the interconnection point. Thus the project boundary is as follows;

- Water Power
- Water Turbine
- Generator

Schematic Diagram of the project Activity:



<Figure B.1> Project Boundary

The Capacities of the project equipments are 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.

B.2. Post-registration changes

B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

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Not applicable

B.2.2. Corrections

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Not applicable

B.2.3. Changes to start date of crediting period

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Not applicable

B.2.4. Inclusion of a monitoring plan to the registered PDD that was not included at registration

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Not Applicable

B.2.5. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

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- The recording frequency of the electricity exported to the grid is revised to monthly from hourly. Because the recording frequency at the registration stage is not consistent with that of the actual recording of electricity data.
- The monitoring organization and responsibility is changed according to the company reorganization.
- Switzerland is involved as a party of this project activity.

B.2.6. Changes to project design of registered project activity

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Not Applicable

B.2.7. Types of changes specific to afforestation or reforestation project activity

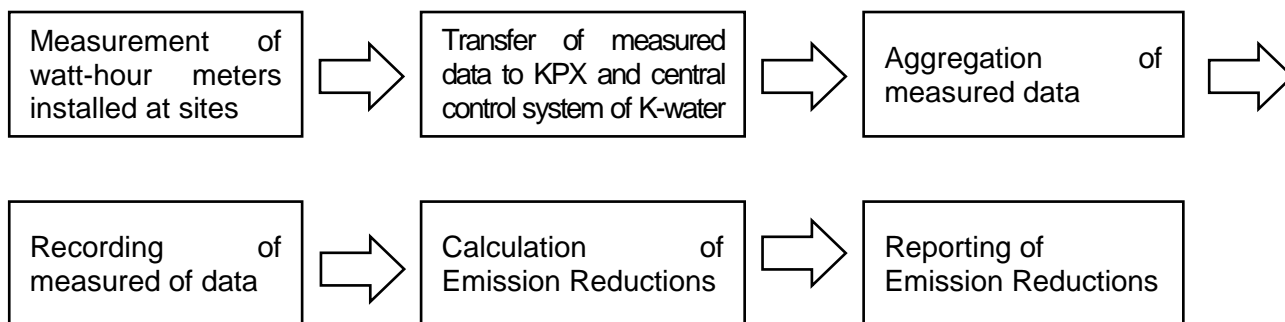
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Not Applicable

SECTION C. Description of monitoring system

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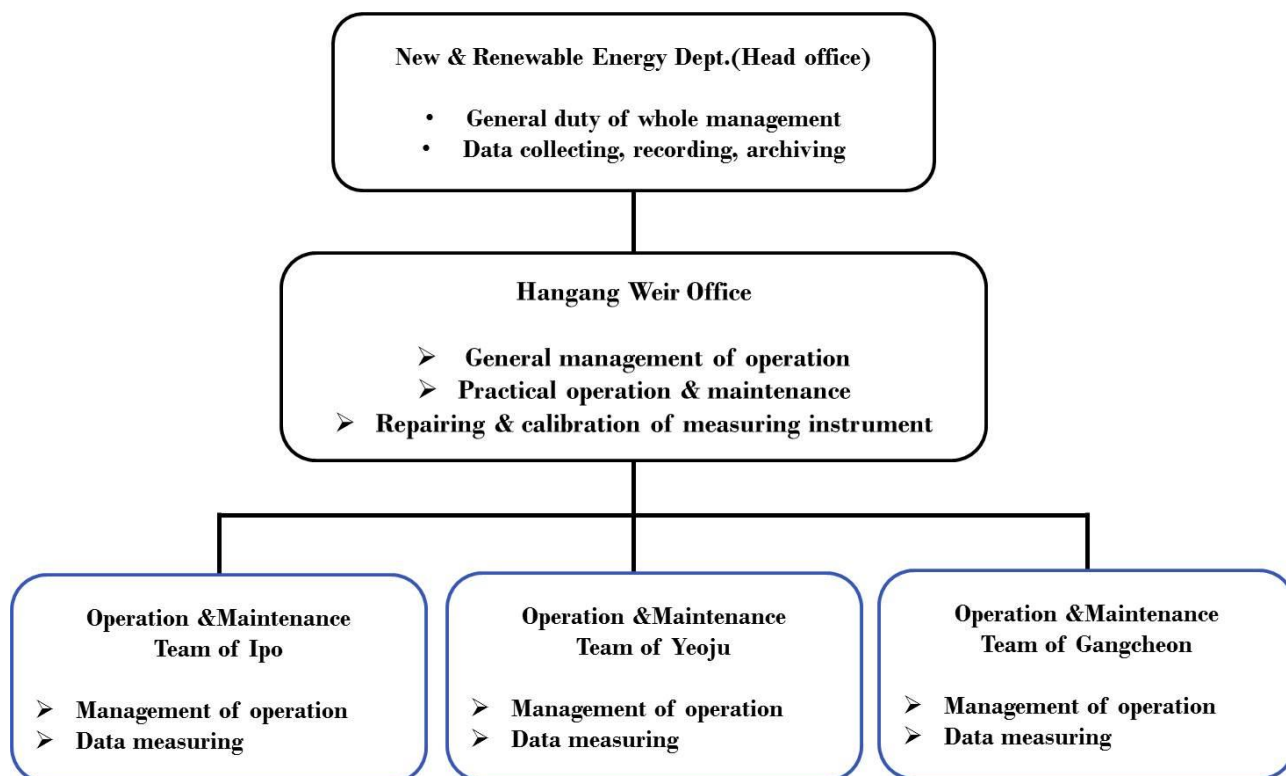
The objective of the monitoring plan is to assure the complete, consistent, clear, and accurate monitoring and calculation of the project emission reductions during the whole crediting period.



Procedure	Unit	Methods	Frequency	Remarks
Data Measuring	kWh	Electronically	Continuously	
Measured Data Transfer	kWh	Electronically	Daily	
Measured Data Aggregation	kWh	Electronically	Weekly	
Measured Data Recording	kWh	Electronically	Monthly	

Emission Reductions Calculation	tCO ₂ e	Manual	After the related monitoring periods	
Emission Reductions Reporting	tCO ₂ e	Manual	After the related monitoring periods	

1. Monitoring Organization



<Figure C.1> Monitoring organization and responsibility

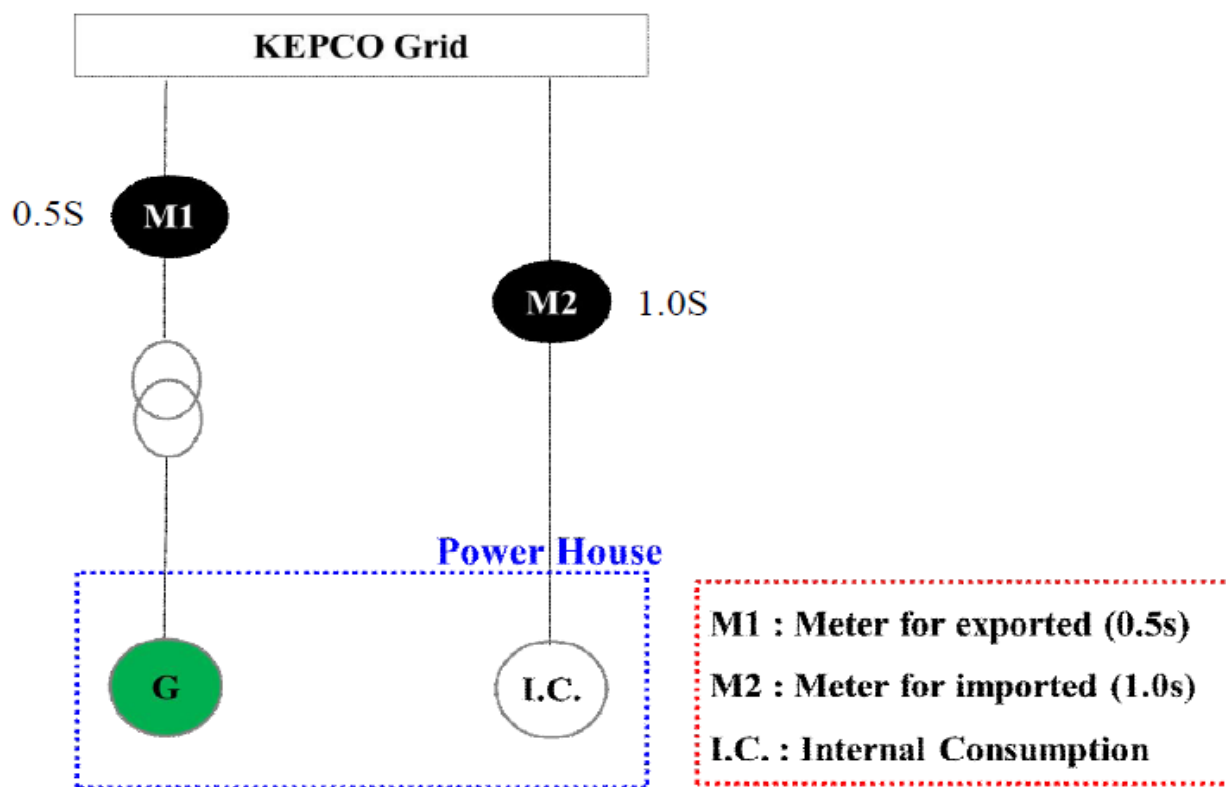
As shown in the figure, each Operation & Maintenance Team of the plant observes monitoring system's operation and transmission of overall data to Hangang Weir Office. Hangang Weir Office takes the responsibility for electrical engineering work and safety management including repair and calibration of the watt-hour meter. And the New & Renewable Energy Dept. of Head office monitors data of electricity supplied to KEPCO grid from the power house on site and 'Power Generation Total Information System' which is the database systems owned by K-water. Title of the Dept, Regional Headquarters and Team may be altered in accordance with a reorganization of K-water. And corresponding responsibility and authority of each division of K-water also may be altered after confirmation of consolidated operating procedures.

2. Main monitoring parameters

As the project's Emission Factor of the grid is determined ex-ante, the net electricity supplied to the grid is the main basis of the Emission Reduction calculation, therefore the monitoring plan was designed aiming at the net electricity supplied to the grid ($EG_{\text{export},y} - EG_{\text{import},y}$)

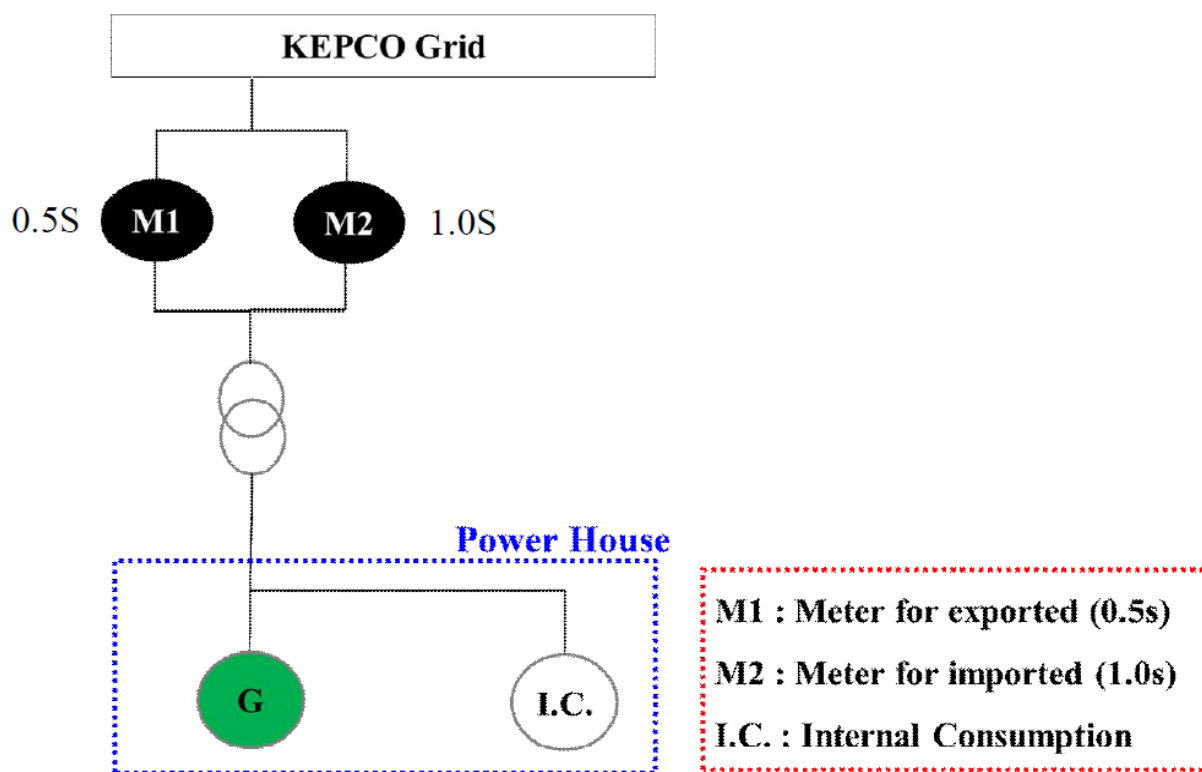
3. Installation of meters

In the case of Ipo, Gangcheon hydropower plants, the watt-hour meters for measuring the both amount of electricity exported to the grid and imported from the grid are installed in two lines separately, respectively. The auxiliary power consumed for the power house is supplied from KEPCO grid all the time regardless of the generator's operation.



<Figure C.2> A single-line diagram for Ipo, Gangcheon power plant

In the case of Yeosu hydropower plants, the watt-hour meters for measuring the both amount of electricity exported to the grid and imported from the grid are installed in a single line. The auxiliary power consumed for the power house is supplied internally from the generated electricity during the generator's operation. Otherwise, the auxiliary power is supplied from KEPCO grid when the generator is stopped.



<Figure C.3> A single-line diagram for Yeosu power plant

4. Data Recording

Electricity exported to the grid

The data were continuously measured by the watt-hour meter and monthly recorded by the person in charge of CDM in New & Renewable Energy Dept. And also, the data of electricity exported to KEPCO grid were hourly transferred on Korea Power Exchange (hereinafter referred to as KPX) and 'Power Generation Total Information System' of K-water

Electricity imported from the grid

The data were continuously measured by the watt-hour meter and monthly recorded by the person in charge of CDM in New & Renewable Energy Dept. And also, the data of electricity imported from KEPCO grid were monthly checked by receipt of KEPCO in the case of Yeosu. In the case of Ipo and Gangcheon, the data of electricity imported from KEPCO grid were monthly checked by each plant's jobsheet of K-water.

5. Data management

All data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the crediting period. And there was an appropriate training for the person in charge of safety and monitoring on a regular basis during the crediting period after CDM registration. The training is composed of how to measure the meters, being aware of the related regulations, managing and writing data, and operating the equipment safely based on 'Electric Utility Act'.

6. Disposing process of abnormality

If any previous months, readings of the watt-hour meter are inaccurate by more than the allowable error, or otherwise functioned improperly, K-water and KEPCO, KPX will ensure informing the counterparty immediately for conducting appropriate action.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data/parameter:	EF_{m,y}
Unit	tCO ₂ e/MWh
Description	CO ₂ emissions factor in power unit <i>m</i> in year <i>y</i>
Source of data	Calculated
Value(s) applied	0.6645 tCO ₂ e/MWh
Choice of data or measurement methods and procedures	This value was calculated according to "Tool to calculate the emission factor for an electricity system (version 02.2.1)." The applied value was calculated by referring "2008, 2009, 2010 Statistics of Electric Power in Korea (2009, 2010, 2011)" (KEPCO) and "2010 Status of Generation Facility (2011)" (KPX).
Purpose of data	Calculation of baseline emission
Additional comments	<ul style="list-style-type: none">- This data was calculated at the time of PDD submission to the DOE for validation and will not be changed during the crediting period without updating.- This value is the ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period.

Data/parameter:	EF_{OM,y}
Unit	tCO ₂ e/MWh
Description	Operating Margin emission factor
Source of data	Calculated
Value(s) applied	0.6933 tCO ₂ e/MWh
Choice of data or measurement methods and procedures	This value was calculated according to “Tool to calculate the emission factor for an electricity system (version 02.2.1).” The applied value was calculated by referring “2008, 2009, 2010 Statistics of Electric Power in Korea (2009, 2010, 2011)” (KEPCO).
Purpose of data	Calculation of baseline emission
Additional comments	<ul style="list-style-type: none"> - This data was calculated at the time of PDD submission to the DOE for validation and will not be changed during the crediting period without updating. - This value is the ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period.

Data/parameter:	EF_{BM,y}
Unit	tCO ₂ e/MWh
Description	Build Margin emission factor
Source of data	Calculated
Value(s) applied	0.6357 tCO ₂ e/MWh
Choice of data or measurement methods and procedures	This value was calculated according to “Tool to calculate the emission factor for an electricity system (version 02.2.1).” The applied value was calculated by referring “2010 Statistics of Electric Power in Korea (2011)” (KEPCO) and “2010 Status of Generation Facility (2011)” (KPX).
Purpose of data	Calculation of baseline emission
Additional comments	<ul style="list-style-type: none"> - This data was calculated at the time of PDD submission to the DOE for validation and will not be changed during the crediting period without updating. - This value is the ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period.

Data/parameter:	FC_{i,m,y}
Unit	Mass: Bituminous, LNG Volume: Heavy oil, Diesel
Description	<p>Amount of fossil fuel type <i>i</i> consumed by power plant/unit <i>m</i> in year <i>y</i></p> <p><i>i</i> : bituminous, heavy oil, diesel, LNG</p> <p><i>m</i> : All power units serving the grid in year <i>y</i> except low-cost/must-run power units</p> <p><i>y</i> : year</p>
Source of data	2010 Statistics of Electric Power in Korea (2011) 2009 Statistics of Electric Power in Korea (2010) 2008 Statistics of Electric Power in Korea (2009)
Value(s) applied	See the EF calculation spreadsheet at the registration stage

Choice of data or measurement methods and procedures	The applied value was derived from “2008, 2009, 2010 Statistics of Electric Power in Korea (2009,2010,2011)” (KEPCO)
Purpose of data	Calculation of baseline emission
Additional comments	<ul style="list-style-type: none"> - This data was calculated at the time of PDD submission to the DOE for validation and will not be changed during the crediting period without updating. - This value is the ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period.

Data/parameter:	EG_{m,y}
Unit	MWh
Description	Net quantity of electricity generated and delivered to the grid by power unit m in year y
Source of data	2010 Statistics of Electric Power in Korea (2011) 2009 Statistics of Electric Power in Korea (2010) 2008 Statistics of Electric Power in Korea (2009)
Value(s) applied	See the EF calculation spreadsheet at the registration stage
Choice of data or measurement methods and procedures	The applied value was derived from “2008, 2009, 2010 Statistics of Electric Power in Korea (2009,2010,2011)” (KEPCO)
Purpose of data	Calculation of baseline emission
Additional comments	<ul style="list-style-type: none"> - This data was calculated at the time of PDD submission to the DOE for validation and will not be changed during the crediting period without updating. - This value is the ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period

Data/parameter:	NCV_{i,y}
Unit	kcal/ mass or volume unit
Description	Net calorific value of fuel <i>i</i> : bituminous, heavy oil, diesel oil, LNG
Source of data	2010 Statistics of Electric Power in Korea (2011) 2009 Statistics of Electric Power in Korea (2010) 2008 Statistics of Electric Power in Korea (2009)
Value(s) applied	See the EF calculation spreadsheet at the registration stage
Choice of data or measurement methods and procedures	The applied value was derived from “2008, 2009, 2010 Statistics of Electric Power in Korea (2009,2010,2011)” (KEPCO)
Purpose of data	Calculation of baseline emission
Additional comments	<ul style="list-style-type: none"> - This data was calculated at the time of PDD submission to the DOE for validation and will not be changed during the crediting period without updating. - This value is the ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period

Data/parameter:	EF_{CO₂,i,y}
Unit	tCO ₂ e/GJ
Description	CO ₂ emission factor of fossil fuel type <i>i</i> <i>i</i> : bituminous, heavy oil, diesel oil, LNG
Source of data	Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	See the EF calculation spreadsheet at the registration stage
Choice of data or measurement methods and procedures	IPCC default values at the lower limit of the uncertainty at 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol.2 (Energy) were used.
Purpose of data	Calculation of baseline emission
Additional comments	<ul style="list-style-type: none"> - This data was calculated at the time of PDD submission to the DOE for validation and will not be changed during the crediting period without updating. - This value is the ex-ante value which is calculated at the time of PDD submission and will be applied during the crediting period

D.2. Data and parameters monitored

(Copy this table for each piece of data and parameter)

Data/parameter:	EG_{BL,y}
Unit	MWh
Description	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y
Measured/calculated/default	Calculated
Source of data	Actual data was obtained from quantity of net electricity supplied to the grid in year y is the difference between the Watt-hour meter quantities of the grid through on-site export and the import Watt-hour meter.
Value(s) of monitored parameter	<p>Total electricity exported = 256,416.823 MWh Total electricity imported = 1,177.987 MWh Total net electricity = 255,238.836 MWh</p> <p>- (1) EG_{BL,y,lpo,exported} 56,561.663 MWh EG_{BL,y,lpo,imported} 535.505 MWh EG_{BL,y,lpo,exported} - EG_{BL,y,lpo,imported} = EG_{BL,y,lpo} EG_{BL,y,lpo} = 56,561.663 – 535.505 = 56,026.158 MWh</p> <p>- (2) EG_{BL,y,Yeouju,exported} 101,927.156 MWh EG_{BL,y,Yeouju,imported} 65.040 MWh EG_{BL,y,Yeouju,exported} - EG_{BL,y,Yeouju,imported} = EG_{BL,y,Yeouju} EG_{BL,y,Yeouju} = 101,927.156 – 65.040 = 101,862.116 MWh</p> <p>- (3) EG_{BL,y,Gangcheon,exported} 97,928.004 MWh EG_{BL,y,Gangcheon,imported} 577.442 MWh EG_{BL,y,Gangcheon,exported} - EG_{BL,y,Gangcheon,imported} = EG_{BL,y,Gangcheon} EG_{BL,y,Gangcheon} = 97,928.004 - 577.442 = 97,350.562 MWh</p> <p>According to the calculation above, baseline total net electricity is 255,238.872 MWh (EG_{BL,y,lpo} + EG_{BL,y,Yeouju} + EG_{BL,y,Gangcheon}).</p>

Monitoring equipment	Value has been calculated from Electricity export and import values, which were recorded in the export and import Watt-hour meter each.
Measuring/reading/recording frequency:	Measuring : Continuously Reading : Hourly Recording : Monthly
Calculation method (if applicable):	Calculated monthly with on-site monitored data of EG_{export,y} and EG_{import,y} Using the formula EG_{BL,y} = EG_{export,y} - EG_{import,y}
QA/QC procedures:	More detail QA/QC procedures are described in the monitoring system in the “Section C. Description of monitoring system”.
Purpose of data:	Calculation of baseline emission
Additional comments:	-

Data/parameter:	EG_{export,y}
Unit	MWh
Description	Electricity supplied to the grid by the proposed project in year y
Measured/calculated/default	Measured
Source of data	Electricity export values were monitored and recorded on-site through export Watt-hour meter.
Value(s) of monitored parameter	<p>The total electricity supplied to the grid from the Watt-hour meter readings on site is total 256,416.823 MWh</p> <p>(1) Ipo Power plant - EG_{export,y,Ipo} : 56,561.663 MWh</p> <p>(2) Yeoju power plant - EG_{export,y,Yeoju} : 101,927.156 MWh</p> <p>(3) Gangcheon power plant - EG_{export,y,Gangcheon} : 97,928.004 MWh</p>

Monitoring equipment	<p>(1) Ipo power plant Measuring equipment : Watt-hour meter Accuracy : Allowable error range ± 0.5 % Serial number : 97787648 Calibration information - Calibration Frequency : within 4 years - Date of last calibration : 10/12/2014 (*previous : 30/09/2011) - Validity period : 10/12/2014 – 09/12/2018</p> <p>(2) Yeoju power plant Measuring equipment : Watt-hour meter Accuracy : Allowable error range ± 0.5 % Serial number : 53127544 Calibration information - Calibration Frequency : within 4 years - Date of last calibration : 10/12/2014 (*previous : 31/12/2012) - Validity period : 10/12/2014 – 09/12/2018</p> <p>(3) Gangcheon power plant Measuring equipment : Watt-hour meter Accuracy : Allowable error range ± 0.5 % Serial number : 53101540 Calibration information - Calibration Frequency : within 4 years - Date of last calibration : 10/12/2014 (*previous : 31/07/2011) - Validity period : 10/12/2014 – 09/12/2018</p>
Measuring/reading/recording frequency:	Measuring : Continuously Reading : Hourly Recording : Monthly
Calculation method (if applicable):	N/A
QA/QC procedures:	<ul style="list-style-type: none"> - The amount of electricity transmitted to the grid was electronically measured and transferred to KPX and K-water, so it was double checked by both entities. - The watt-hour meter was set up transparently in accordance with 'Measures act' and 'Rules on the operation of the electricity market'. - The watt-hour meter was calibrated regularly in accordance with 'Measures act', 'Rules on the operation of the electricity market' and 'General guidelines to SSC CDM methodologies'.
Purpose of data:	Calculation of baseline emission
Additional comments:	N/A

Data/parameter:	EG_{import,y}
Unit	MWh
Description	Electricity imported from the grid by the proposed project in year y
Measured/calculated/default	Measured
Source of data	Electricity import values were monitored and recorded on-site through import Watt-hour meter. In the case of Ipo and Gangcheon, the data of electricity imported from KEPCO grid were monthly checked by each plant's jobsheet of K-Water.

Value(s) of monitored Watt-hour meter	<p>Consumed electricity in the plant from the Watt-hour meter readings on site is total 1,177.987 MWh</p> <p>(1) Ipo Power plant - $EG_{import,y,Ipo}$: 535.505 MWh</p> <p>(2) Yeosu power plant - $EG_{import,y,Yeosu}$: 65.040 MWh</p> <p>(3) Gangcheon power plant - $EG_{import,y,Gangcheon}$: 577.442 MWh</p>
Monitoring equipment	<p>(1) Ipo power plant * Before replacement (*replaced 03/11/2015) Measuring equipment : Watt-hour meter Accuracy : Allowable error range ± 1.0 % Serial number : 19002057 Calibration information <ul style="list-style-type: none"> - Calibration Frequency : within 7 years - Date of last calibration : 31/05/2011 - Validity period : 31/05/2011 – 30/05/2018 </p> <p>Measuring equipment : Watt-hour meter Accuracy : Allowable error range ± 1.0 % Serial number : 59002384 Calibration information <ul style="list-style-type: none"> - Calibration Frequency : within 7 years - Date of last calibration : 30/09/2015 - Validity period : 30/09/2015 – 29/09/2022 </p> <p>(2) Yeosu power plant Measuring equipment : Watt-hour meter Accuracy : Allowable error range ± 0.5 % Serial number : 25112004478 Calibration information <ul style="list-style-type: none"> - Calibration Frequency : within 7 years - Date of last calibration : 31/07/2011 - Validity period : 31/07/2011 – 30/07/2018 </p>

	(3) Gangcheon power plant * Before replacement (*replaced 27/10/2015) Measuring equipment : Watt-hour meter Accuracy : Allowable error range ± 1.0 % Serial number : 19000520 Calibration information - Calibration Frequency : within 7 years - Date of last calibration : 31/03/2011 - Validity period : 31/03/2011 – 30/03/2018 Measuring equipment : Watt-hour meter Accuracy : Allowable error range ± 1.0 % Serial number : 59002367 Calibration information - Calibration Frequency : within 7 years) - Date of last calibration : 30/09/2015 - Validity period : 30/09/2015 – 29/09/2022
Measuring/reading/recording frequency:	Measuring : Continuously Reading : Hourly Recording : Monthly
Calculation method (if applicable):	N/A
QA/QC procedures:	<ul style="list-style-type: none"> - The amount of electricity imported from the grid was checked by jobsheet of K-water in the case of Ipo and Gangcheon. - The amount of electricity imported from the grid was checked by receipt of KEPCO in the case of Yeosu. - The watt-hour meter was set up transparently in accordance with 'Measures act'. - The watt-hour meter was calibrated regularly in accordance with 'Measures act' and 'General guidelines to SSC CDM methodologies'.
Purpose of data:	Calculation of baseline emission
Additional comments:	N/A

D.3. Implementation of sampling plan

>>

Not Applicable

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

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The baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in MWh of electricity produced by the renewable generating unit by the grid emission factor.

$$BE_y = EG_{BL,y} \times EF_{CO_2,grid,y}$$

Where:

BE_y = Baseline emissions in year y (tCO₂e/MWh)

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

$EF_{CO_2,grid,y}$ = CO₂ emission factor of the grid in year y (tCO₂e/MWh)

Quantity of the electricity supplied to the grid as a result of the implementation of the CDM project activity in year y ($EG_{BL,y}$) = Total Electricity Exported to the grid (EG_{export}) – Total Electricity Imported from the grid (EG_{import}).

Thus, $EG_{BL,y} = EG_{export} - EG_{import}$

(1) $EG_{BL,y,Ipo,exported} : 56,561.663 \text{ MWh}$
 $EG_{BL,y,Ipo,imported} : 535.505 \text{ MWh}$

(2) $EG_{BL,y,Yeju,exported} : 101,927.156 \text{ MWh}$
 $EG_{BL,y,Yeju,imported} : 65.040 \text{ MWh}$

(3) $EG_{BL,y,Gangcheon,exported} : 97,928.004 \text{ MWh}$
 $EG_{BL,y,Gangcheon,imported} : 577.442 \text{ MWh}$

According to the calculation above,

$$\begin{aligned} EG_{exported} &= 56,561.663 + 101,927.156 + 97,928.004 \text{ MWh} \\ &= \mathbf{256,416.823 \text{ MWh}} \\ EG_{imported} &= 535.505 + 65.040 + 577.442 \text{ MWh} \\ &= \mathbf{1,177.987 \text{ MWh}} \end{aligned}$$

$$\begin{aligned} \text{Thus, } EG_{BL,y} &= EG_{export} - EG_{import} \\ &= (256,416.823 - 1,177.987) \text{ MWh} \\ &= \mathbf{255,238.836 \text{ MWh}} \end{aligned}$$

Therefore,

$$\begin{aligned} BE_y &= EG_{BL,y} \times EF_{CO_2,grid,y} \\ &= 255,238.836 \times 0.6645 \\ &= \mathbf{169,606 \text{ tCO}_2\text{e (Rounded down conservatively)}} \end{aligned}$$

E.2. Calculation of project emissions or actual net GHG removals by sinks

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Since no fossil fuel used at the project site due to project activity during the monitoring period the project emissions are zero.

Thus, $PE_y = 0 \text{ tCO}_2\text{e}$

E.3. Calculation of leakage

>>

There is no leakage in the project activity.

$LE_y = 0 \text{ tCO}_2\text{e}$

E.4. Summary of calculation of emission reductions or net GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (tCO ₂ e)	Project emissions or actual net GHG removals by sinks (tCO ₂ e)	Leakage (tCO ₂ e)	GHG emission reductions or net GHG removals by sinks (tCO ₂ e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
2012	5,688	0	0	5,688	0	5,688
2013	46,569	0	0	0	46,569	46,569
2014	54,206	0	0	0	54,206	54,206
2015	39,612	0	0	0	39,612	39,612
2016	23,531	0	0	0	23,531	23,531
Total	169,606	0	0	5,688	163,918	169,606

E.5. Comparison of actual emission reductions or net GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (tCO ₂ e)	181,944	169,606

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

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There is no increase in the emission reductions during the current monitoring period compared to the estimation in the registered CDM-PDD. The generation achieved during the monitoring period is marginally lower than projected, which was due to a pause of power generation facilities in the increased inflow during the rainy season for each power plant. In the case of Yeosu, the plant operation was suspended owing to repair works and the increased inflow of floating material.

Appendix 1. Contact information of project participants and responsible persons/entities

Project participant and/or responsible person/ entity	<input checked="" type="checkbox"/> Project participant <input checked="" type="checkbox"/> Person/entity responsible for completing the CDM-MR-FORM
Organization name	Korea Water Resources Corporation (K-water)
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Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: <ul style="list-style-type: none"> • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: <ul style="list-style-type: none"> • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from <i>F-CDM-MR</i> to <i>CDM-MR-FORM</i>; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.
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