



Monitoring report form (Version 03.1)

Monitoring report

Title of the project activity	Sihwa Tidal Power Plant CDM Project
Reference number of the project activity	0349
Version number of the monitoring report	Ver. 01
Completion date of the monitoring report	30/04/2013
Registration date of the project activity	18/06/2006
Monitoring period number and duration of this monitoring period	3rd, 01/11/2012~31/03/ 2013
Project participant(s)	Korea Water Resources Corporation(K-water)
Host Party(ies)	Republic of Korea
Sectoral scope(s) and applied methodology(ies)	1: Energy industries(renewable/non-renewable sources / ACM0002 - Consolidated baseline methodology for grid-connected electricity generation from renewable sources(version 4)
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	131,433 tCO ₂ e * This amount was recalculated by multiplying the ratio of this monitoring period over a year to the yearly estimated emission reductions in PDD, 315,440 tCO ₂ e (315,440 tCO ₂ e × 5/12 =131,433 tCO ₂ e)
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	135,052 tCO ₂ e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

- **Purpose of the project activity**

K-water Tidal Power Plant in Sihwa is a tidal power plant on the west side of Republic of Korea. The tidal power plant generates electricity utilizing the difference of flux and reflux in the morning and evening which emits zero greenhouse gas (hereinafter GHG) into the atmosphere, and increase of sea/inner water circulation by this activity will improve the water quality that has been decreased during Sihwa Lake's salt-to-fresh water process. The project supports the government policy which promotes development of renewable energy technology in Republic of Korea. The project also contributes to decrease the dependence on the electricity generated by fossil fuel-fired power plants.

In conclusion, the aim of this project activity is to generate electricity and to supply it to the grid by using tidal power instead of the fossil fuel, which contributes to mitigation of climate change & sustainable development.

- **Brief description of the installed technology and equipment :**

This proposed project consists in 10 units of 25.4MW turbines and generates electricity of 552.7GWh per year from the tidal power plant.

- **Relevant dates for the project activity :**

- Construction period : 31/12/2004 – 14/11/2011
- Starting date of operation : 13/04/2011
- (*commissioning period : 28/03/2011 –29/02/2012)
- Starting date of commercial operation : 01/03/2012
- Continued operation : 13/04/2011 – Present

- **Total GHG emission reductions achieved in this monitoring period: 135,052 tCO₂e**

A.2. Location of project activity

- Host Party(ies) : Republic of Korea
- Region/State/ Province, etc : Gyeonggi-do
- City/Town/Community, etc : Daebudong-dong, Danwon-gu, Ansan city
- Physical/Geographical location : K-water Sihwa Tidal Power Plant
(latitude of 37°18'46"N and longitude of 126°36'36"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 if 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

* Ecoeye Co. Ltd (consultant) withdrew from the project participation on 22nd August 2009 as it can be confirmed in UNFCCC web page, and has no right for this CDM project anymore.

** The full name of project participant in the registered CDM-PDD is the same as of the past, "Korea Water Resources Corporation", and only its nickname was changed from "KOWACO" to "K-water" in parenthesis.

A.4. Reference of applied methodology

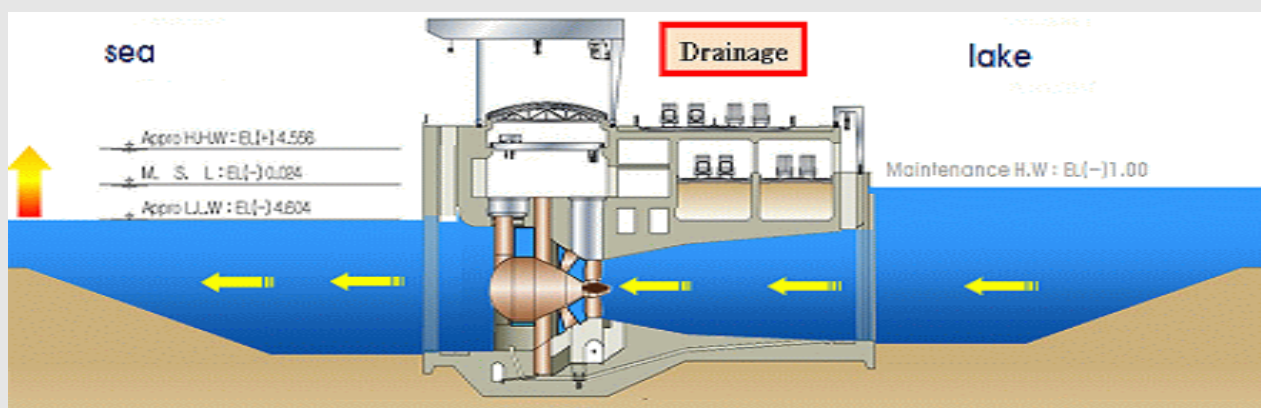
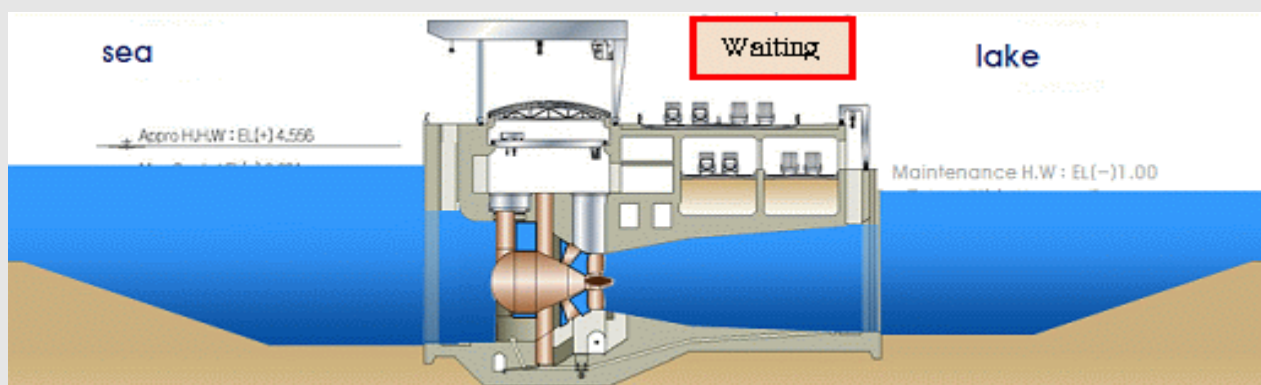
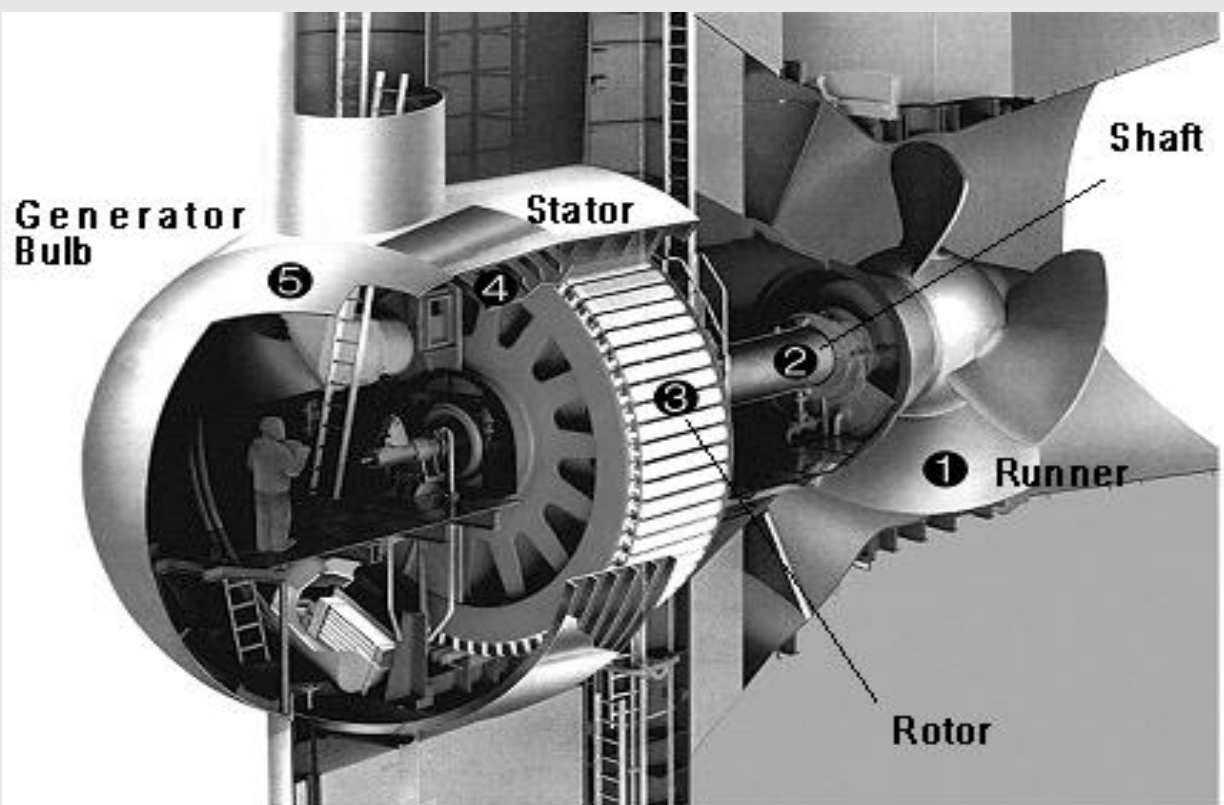
- The applied methodology : ACM0002 – "Consolidated baseline methodology for grid- connected electricity generation from renewable sources" (version 4)
- * In the registered CDM-PDD, ACM0002(ver. 3) was applied, in contrast, ACM0002(ver.4) was applied in the validation report and indicated on UNFCCC CDM web page.
Considering the grace period having already gone by, ACM0002 (ver.4) was applied to this project activity.
- Any tools and other methodologies to which the applied methodology refers : "Tool to calculate the emission factor for an electricity system"

A.5. Crediting period of project activity

- Start date of the first crediting period: 01/07/2011
- Length of the crediting period corresponding to this monitoring period : 7 years (01/07/2011 ~ 30/06/2018)
- * changed from : 01/07/2009~30/06/2016

SECTION B. Implementation of project activity**B.1. Description of implemented registered project activity**

- Technology/Measure of the project activity
Sihwa tidal power plants utilize the sea water when it is coming into Sihwa Lake which is an artificial lake made by the tide embankment, which generates electricity without emitting any GHG. The total installed capacity is 254MW. Refer to the diagrams and tables below.



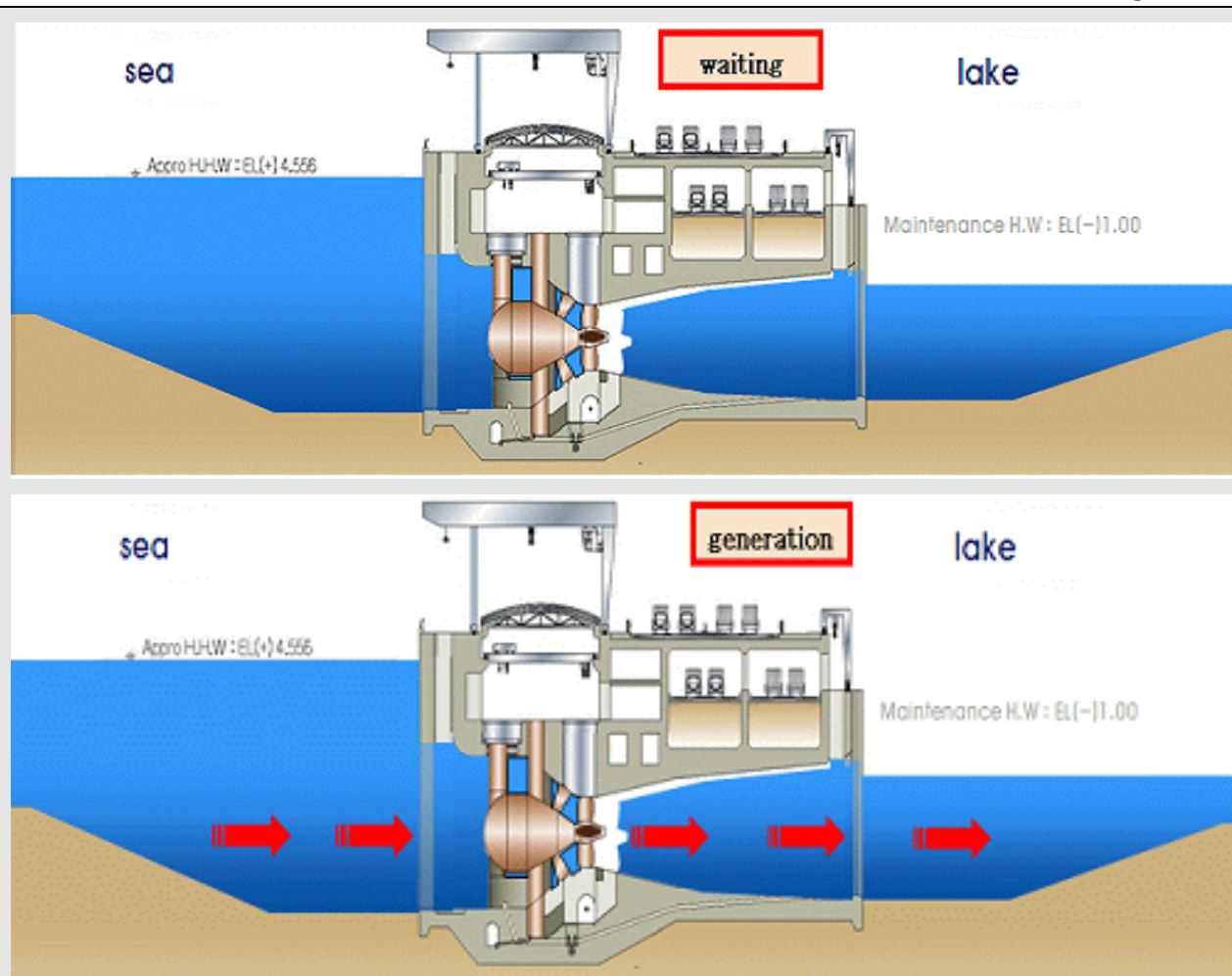


Figure 1. System Diagram of Sihwa Tidal Power Plant

Table 1. Technical Specifications of the tidal power plant

Item	The Tidal Power Plant in Sihwa
Rated Output	25,400kW X 10 (Generator)
Bulb Diameter	8.2m
Runner Diameter	7.5m
Rated Head Drop	5.82 m (Max. 7.5m, Min. 1.0m) * Spring range - 7.804m, Mean range – 5.570m Neap range -3.336m
Rated Voltage	10,200V
Velocity	64.29rpm
Rotation Direction	Clockwise rotation looking at the sea

B.2. Post registration changes**B.2.1. Temporary deviations from registered monitoring plan or applied methodology**

Not applicable

B.2.2. Corrections

- Withdrawal of Ecoeye Co. Ltd from the project participation
- The full name of project participant in the registered CDM-PDD is the same as of the past, Korea Water Resources Corporation” and only its nickname was changed from “KOWACO” to “K-water” in parenthesis.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

- The amount of electricity consumed in the plant and electricity transmission to a grid was measured not by bidirectional in the CDM-PDD but by unilateral meters.
- In the CDM-PDD of date Nov. 18, 2005(ver.2), this project applied the baseline and monitoring methodology ACM 0002(ver.3), however, this methodology was revised and became effective as of 28 Nov. 2005. On the other hand, the request of registration was submitted on 29 Mar. 2006.
- It exceeded four (4) weeks after the methodology was revised. It means the request of registration had not been submitted prior to the expiry of the grace period for the use of the previous version. Accordingly, this project shall apply the revised ACM0002(ver.4) . The revised ACM0002 (ver.4) baseline and monitoring methodology did not influence any changes or result of this project because ACM0002 (ver.3) is the same with ACM0002 (ver.4) with the exception of new guidance for project participants to define the grid boundary as referred to in the revised ver.4.
- In the CDM-PDD, frequency of meter for measuring electricity imported from grid is every 2 years, however, it is against national law, so-called, “Measures Act” that it provides every 7 years for calibration frequency of the meter. It is not within the control of the project participant, therefore, it needs to revise the initial monitoring plan to avoid non-conformity provided in PDD as registered.
- As a result, K-water as the project participant calibrates the meters for imported electricity every 7 years according to the national law.
- In the registered PDD, a watt-hour meter for imported electricity has no detail information about “allowable error” , “the equipment of sub-meters” and “ calibration frequency” . Accordingly, we clarify that the watt-hour meters are being used as below.

Sort of Meters	Watt-hour meters for exported electricity		Watt-hour meters for imported electricity	
	Main	Sub	Main	Sub*
Number	3	3	3	1
Allowable error	±0.2%	±0.5%	±0.5%	±0.5%
Calibration frequency	within 2 years	within 2 years	changed from 2 years to 7 years	changed from 2 years to 7 years

* The sub watt-hour meter for imported electricity is established at the site of 22.9kV Sub Transmission Line(T/L) for back-up in emergency such as the main Transmission Line (T/L) cannot take the electricity from the designated substation.

B.2.4. Changes to project design of registered project activity

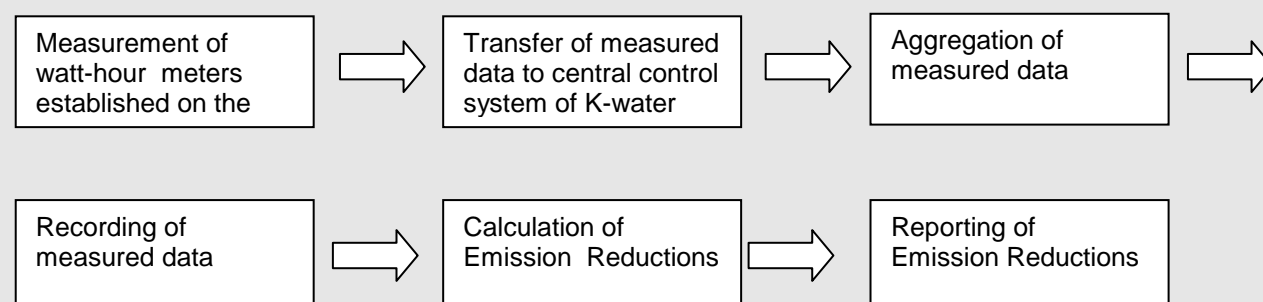
Not applicable

B.2.5. Changes to start date of crediting period

Changed from 01/07/2009 to 01/07/2011

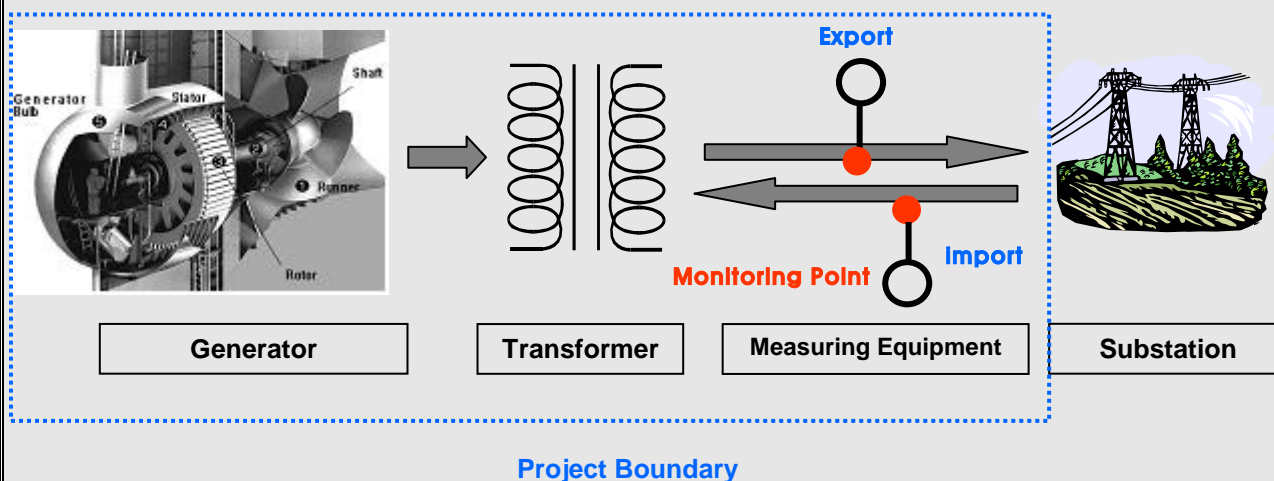
B.2.6. Types of changes specific to afforestation or reforestation project activity

Not applicable

SECTION C. Description of monitoring system

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	

- Monitoring Points for the Project**



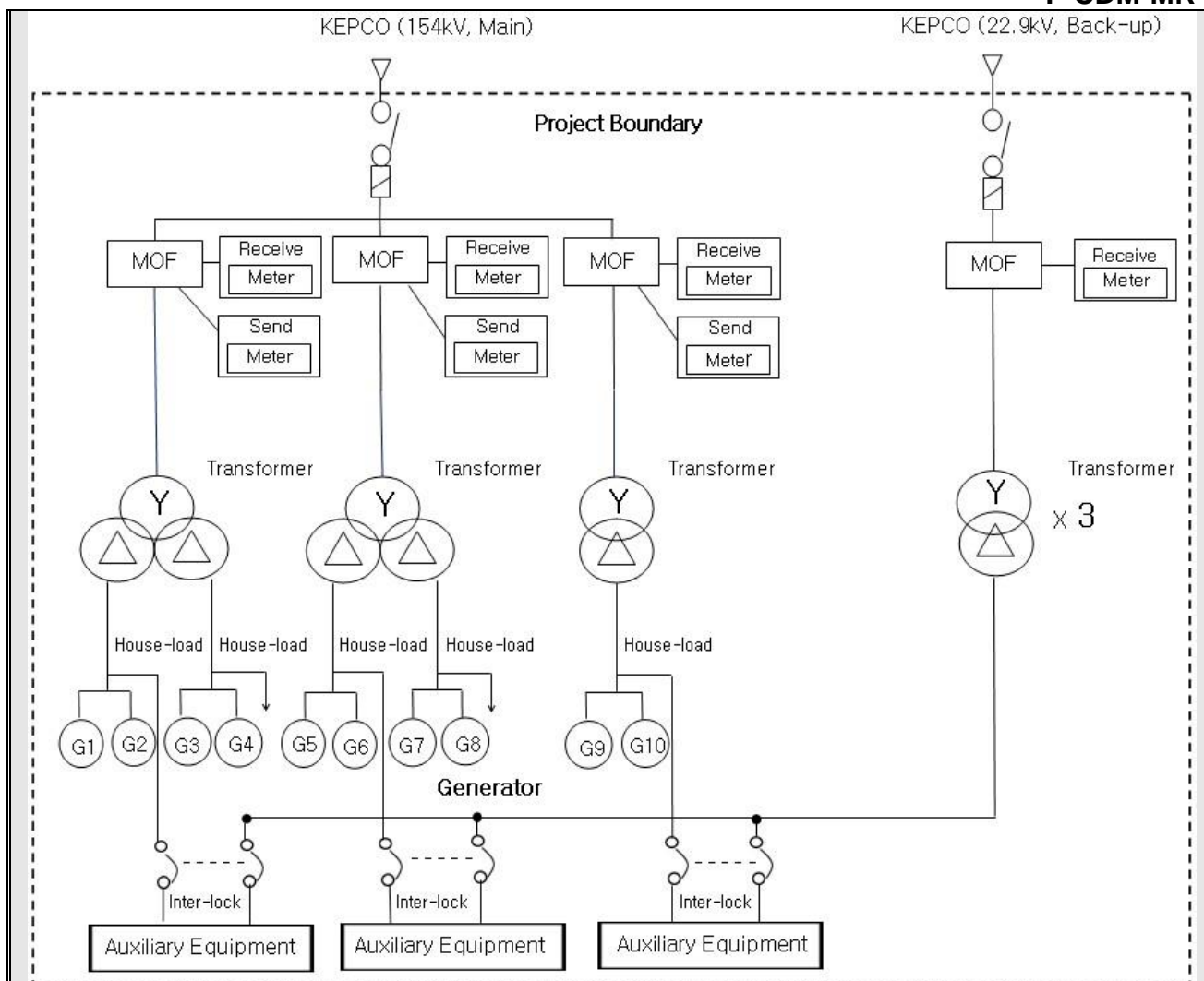


Figure 2. Skeleton diagram of the tidal power plant

Monitoring Points are located at the tidal power plant. Electricity monitored by watt-hour meter with accuracy range $\pm 0.2\%$ is delivered to the grid by the project. Electricity imported from the grid is measured by watt-hour meter with accuracy range $\pm 0.5\%$.

- **QA/QC procedures**

- (Monitoring equipment)

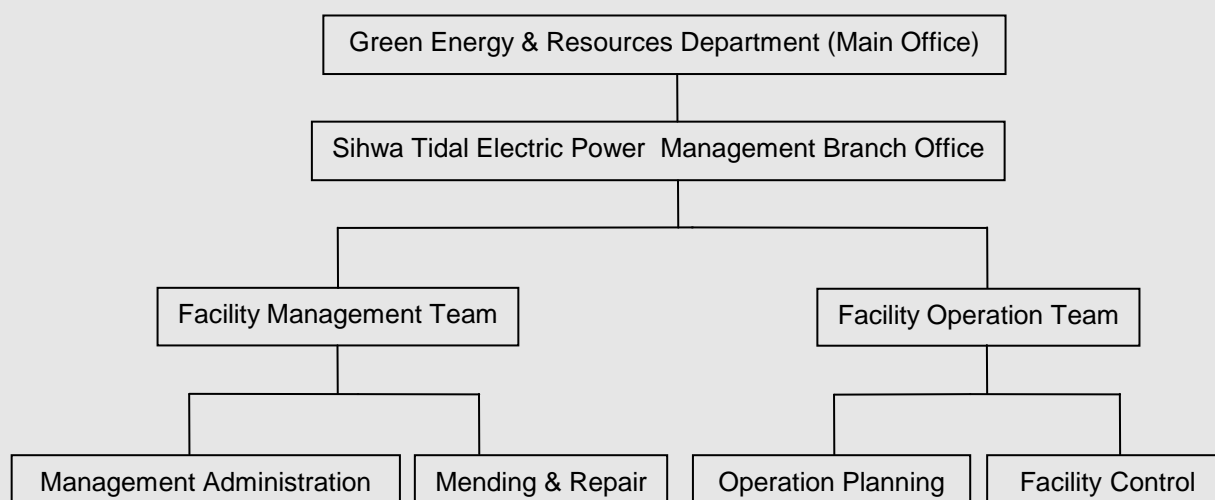
- Measuring meter of electricity exported to the grid was set up transparently in accordance with “Law regarding measurement” and “Act on operation of electricity market” then sealed after affirmation of Korea Power Exchange.
 - The meters for exported electricity were calibrated when they were installed and those were supposed to be re-calibrated every two years after installation.
 - The meters for imported electricity are calibrated every seven years according to the national law.

- (Monitoring of amount electricity)

- The amount of electricity exported to the grid is measured electronically by established meters.
 - The measured data is simultaneously transferred to central control system of K-water and Korea Power Exchange.
 - The measured amount of electricity is collected daily, weekly, and monthly and is archived in electronic way. The collected data of electricity exported to the grid was double checked with those of Korea Power Exchange.

(Management of monitoring and electricity safety)

- The person in charge of monitoring and electricity safety are appointed by the final decision-maker and in the case of absence of the responsible person, the second responsible person shall be selected.

(Monitoring organization structure, roles and responsibilities)

Department in charge of monitoring for the project and responsible department are as follows :

- Department and Position in charge of monitoring (including Operation & Maintenance of facilities-etc.) : Sihwa Tidal Electric Power Management Branch Officer
- Responsible Department and position (project management, Emission Reductions calculation and reporting) : Renewable Energy Management Team Manager
- * The name of department, team or position in charge can be changed according to reorganization in K-water.

(Emergency procedure)

- In case unexpected accident which affects Emission Reductions is occurred, the person in charge of monitoring should report to the responsible department(Renewable Energy Management Team) and act according to the internal manual, namely, "Sihwa Tidal Power Plant Operation Manual" in emergency.
- In case measuring meters of the electricity exported to the grid are improperly operated or the transfer of data is in error, internal investigation and correction procedure shall be followed and certified by the final decision-maker and Korea Power exchange.

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

Data / Parameter:	EF _{OM}
Unit:	tCO ₂ /MWh
Description:	operating margin emission factor
Source of data:	calculated
Value(s) applied:	0.7710
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks - This value was calculated according to <i>Tool to calculate the emission factor for an electricity system</i> . Applied value was calculated by referring Statistics of Electric Power in KOREA (2002, 2003, 2004) (from Korea Electric Power Corporation, hereinafter, "KEPCO") - This value is used for CO ₂ emissions factor of grid (EF).
Additional comment:	This value is supposed to be calculated once at the time of PDD submission.

Data / Parameter:	EF _{BM}
Unit:	tCO ₂ /MWh
Description:	build margin emission factor
Source of data:	calculated
Value(s) applied:	0.5690
Purpose of data:	Calculation of baseline emissions - This value was calculated according to <i>Tool to calculate the emission factor for an electricity system</i> . Applied value was calculated by referring Statistics of Electric Power in KOREA (2009, 2010, 2011) (KEPCO). - This value is used for CO ₂ emissions factor of grid (EF).
Additional comment:	This value is supposed to be calculated at the time of PDD submission and recalculated at the time of this monitoring. * changed from 0.4718 to 0.5690

Data / Parameter:	EF _y
Unit:	tCO ₂ /MWh
Description:	CO ₂ emissions factor of grid
Source of data:	calculated
Value(s) applied:	0.6700
Purpose of data:	Calculation of baseline emissions - This value was calculated according to <i>Tool to calculate the emission factor for an electricity system</i> . Applied value was calculated by referring Statistics of Electric Power in KOREA (KEPCO). - This value is used for baseline emission calculations
Additional comment:	This value is supposed to be calculated at the time of PDD submission and recalculated at the time of this monitoring due to the update of EF _{BM} * changed from 0.6214 to 0.6700

D.2. Data and parameters monitored

Data / Parameter:	EG _y
Unit:	MWh
Description:	Electricity exported to the grid from Sihwa Tidal Power Plant
Measured/ Calculated / Default:	Measured
Source of data:	Watt-hour meter
Value(s) of monitored parameter:	Total electricity generation is 203,157.697MWh.

Monitoring equipment:	<p>Measurement equipment: Watt-hour meter Accuracy: Allowable error range $\pm 0.2\%$ Serial Number : PT-0909A407-01, PT-0909A408-01, PT-0909A409-01 Calibration information - Number of meters : 3 meters* - Calibration Frequency : within 2 years - Date of last calibration : 01/11/2011(* manufacturing date : Nov. 2009) - Validity period : 01/11/2011 – 30/10/2013 * The below is the information of additional 3 sub-meters Accuracy : Allowable error range $\pm 0.5\%$ Serial Number : 53048162, 53048163, 53048164 Calibration information - Number of meters : 3 meters - Calibration Frequency : within 2 years - Date of last calibration : 01/11/2011(* manufacturing date : Nov. 2009) - Validity period : 01/11/2011~30/10/2013</p>
Measuring/ Reading/ Recording frequency:	<p>Measuring : Continuously Reading : hourly Recording : monthly</p>
Calculation method (if applicable):	N/A
QA/QC procedures:	The amount of electricity transmitted to the grid was electronically measured and transferred to Korea Power Exchange (KPX) and K-water, so it was double checked by both entities.
Purpose of data:	Calculation of baseline emissions
Additional comment:	

Data / Parameter:	El_y
Unit:	MWh
Description:	Electricity imported from the grid for Sihwa tidal power plant
Measured/ Calculated / Default:	Measured
Source of data:	Watt-hour meter (* owned by KEPCO)
Value(s) of monitored parameter:	Total imported electricity is 1,587.036MWh..
Monitoring equipment:	<p>Measurement equipment : Watt-hour meter Accuracy : Allowable error range $\pm 0.5\%$ Serial number : 9000071, 9000072, 9000073 Calibration information - Number of meters : 3 meters - Calibration Frequency : within 7 years* - Date of last calibration : N/A (Manufacturing date : Oct. 2010) - Validity period : Oct. 2010– Sep. 2017 * The below is the information of the one sub watt-hour meter to measure the imported electricity from 22.9kV T/L in emergency. Accuracy : Allowable error range $\pm 0.5\%$ Serial Number : 25102001711 Calibration information - Number of meters : 1 meter - Calibration Frequency : within 7 years - Date of last calibration : N/A (Manufacturing date : Nov. 2010) - Validity period : Nov. 2010 ~ Oct. 2017 * These meters will not be recalibrated every 2 years in the CDM-PDD but every 7 years according to the national law</p>

Measuring/ Reading/ Recording frequency:	Measuring : Continuously Reading : hourly Recording : monthly
Calculation method (if applicable):	N/A
QA/QC procedures:	The amount of electricity transmitted to the grid was electronically measured and transferred to Korea Power Exchange (KPX) and K-water, so it was double checked by both entities.
Purpose of data:	Calculation of baseline emissions
Additional comment:	-

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**According to the formula below, baseline emissions for this project is **135,052tCO₂e**

$$BE_y = EG_y^* \times EF_y$$

BE_y	=	Baseline emissions(tCO ₂ e)
EG_y^*	=	Net electricity generation(MWh) : $EG_y - EI_y$
EF_y	=	Baseline emission factor(tCO ₂ e/MWh)

Year	Month	Electricity (kWh)	Baseline Emission Factor (tCO ₂ e /MWh)	Emission Reductions (tCO ₂ e)
2012	Nov	38,928,797.376	0.6700	26,082.200
2012	Dec	40,326,673.464	0.6700	27,018.800
2013	Jan	40,631,017.056	0.6700	27,222.700
2013	Feb	38,392,135.992	0.6700	25,722.700
2013	Mar	44,879,072.952	0.6700	30,068.900
Total Electricity exported to the grid(A)		203,157,696.840		136,115.300
2012	Nov	332,928	0.6700	223.000
2012	Dec	338,508	0.6700	227.800
2013	Jan	309,120	0.6700	207.100
2013	Feb	288,960	0.6700	193.600
2013	Mar	317,520	0.6700	212.700
Electricity imported from the grid(B)		1,587,036		1,063.200
Net electricity generation (A-B)		201,570,660.840	0.6700	135,052

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

GHG emissions due to the project activity are not occurred.

Project emission is zero;

PE = 0

E.3. Calculation of leakage

No leakage occurs in accordance with ACM0002 (ver4)

PL = 0.

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

Item	Baseline emissions or baseline net GHG removals by sinks (t CO ₂ e)	Project emissions or actual net GHG removals by sinks (t CO ₂ e)	Leakage (t CO ₂ e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO ₂ e)
Total	135,052	-	-	135,052

E.5. Comparison of actual emission reductions or net anthropogenic 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 (t CO₂e)	131,433*	135,052

* 315,440 tCO₂e , yearly emission reductions in the registered PDD was recalculated by month, resulting in 131,433 tCO₂e for this monitoring period (1st Nov. 2012 ~ 31st Mar. 2013).
(315,440 tCO₂ x5/12 =131,433 tCO₂e)

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

This project was estimated to reduce 131,433 tCO₂e according to the registered CDM-PDD for the relevant monitoring period. However, actual reduction is 135,052 tCO₂e and the net electricity supplied to the grid was 201,570,660.840kWh. This shows that actual value was higher by 3,619 tCO₂e than the estimated value in CDM-PDD with the result of unexpected tidal difference activity.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (tCO ₂ e)	52,651	82,401

Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
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 anthropogenic 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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