Project design document form for small-scale CDM project activities

(Version 08.0)

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for small-scale CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	K-water hydropower VIII
Version number of the PDD	Version 05.0
Completion date of the PDD	10/02/2017
Project participant(s)	Korea Water Resources Corporation (K-water)
Host Party	Republic of Korea (host)
Applied methodology(ies) and, where applicable, applied standardized baseline(s)	AMS.I.D. Grid connected renewable electricity generation, version 17.0
Sectoral scope(s) linked to the applied methodology(ies)	Sectoral scope : 1 - Energy industries (renewable / non-renewable sources)
Estimated amount of annual average GHG emission reductions	38,654 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>>

Description of the project activity

"K-water hydropower VIII"(hereinafter referred to as the proposed project) performed by Korea Water Resources Corporation (hereinafter referred to as K-water) is a renewable energy power generation project by means of installing a new run-of-river hydropower plant at a site there was no renewable energy power plant operating prior to implementation of the proposed project activity. The proposed project utilizing a renewable energy resource to generate electricity will contribute to reduction of GHG emission by substituting the electricity generated by fossil fuel consumption. 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.
As a bundled CDM project, the proposed project activity consists of four hydropower plants named as Nakdan, Gumi, Chilgok and GangjeongGoryeong. Nakdan, Gumi, Chilgok hydropower plants are located in Gyeongsangbuk-do and have an installed capacity of 3,000kW respectively. And, GangjeongGoryeong hydropower plant having a installed capacity of 3,000kW is located in Daegu city.
After the implementation of the proposed project, the total amount of annual power generation supplied to the grid is expected to be 58,170 MWh and the estimated annual emission reduction will reach 38,654 tCO_2e.

Purpose of the project activity

The proposed project 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 proposed project will displace a part of the generated electricity from fossil fuel power plants, the proposed project will lead to avoidance of CO_2 emission and environmental pollution caused by fossil fuel consumption.

The contribution of the project activity to sustainable development

By using a source of renewable energy, the proposed project activity will contribute to sustainable development in Republic of Korea as follows:

i. Social aspects
- The proposed project would generate employment during construction and operation phase, resulting in social well being of the local people.

ii. Economical aspects
- The proposed project would bring economical benefits to host country by decreasing in import of fossil fuel for electricity generation.
- Creation of new employment opportunities would result in economic well being of the local people.

iii. Environmental aspects
- Replacement of fossil fuel (Carbon intensive electricity source) by hydropower would lead to reduction of any GHG emission like CO_2, SO_2, NO_X.
- As a renewable energy source, the hydropower is harmless to environment and also can be used as continuous alternative energy resources for future development.

iv. Technological aspects
- The proposed project would contribute to transmitting the advanced technical know-how of plant operation to the operators on site and enhancing awareness about sustainable sources of energy generation in the nearby region.

A.2. Location of project activity

A.2.1. Host Party

>>
Republic of Korea

A.2.2. Region/State/Province etc.

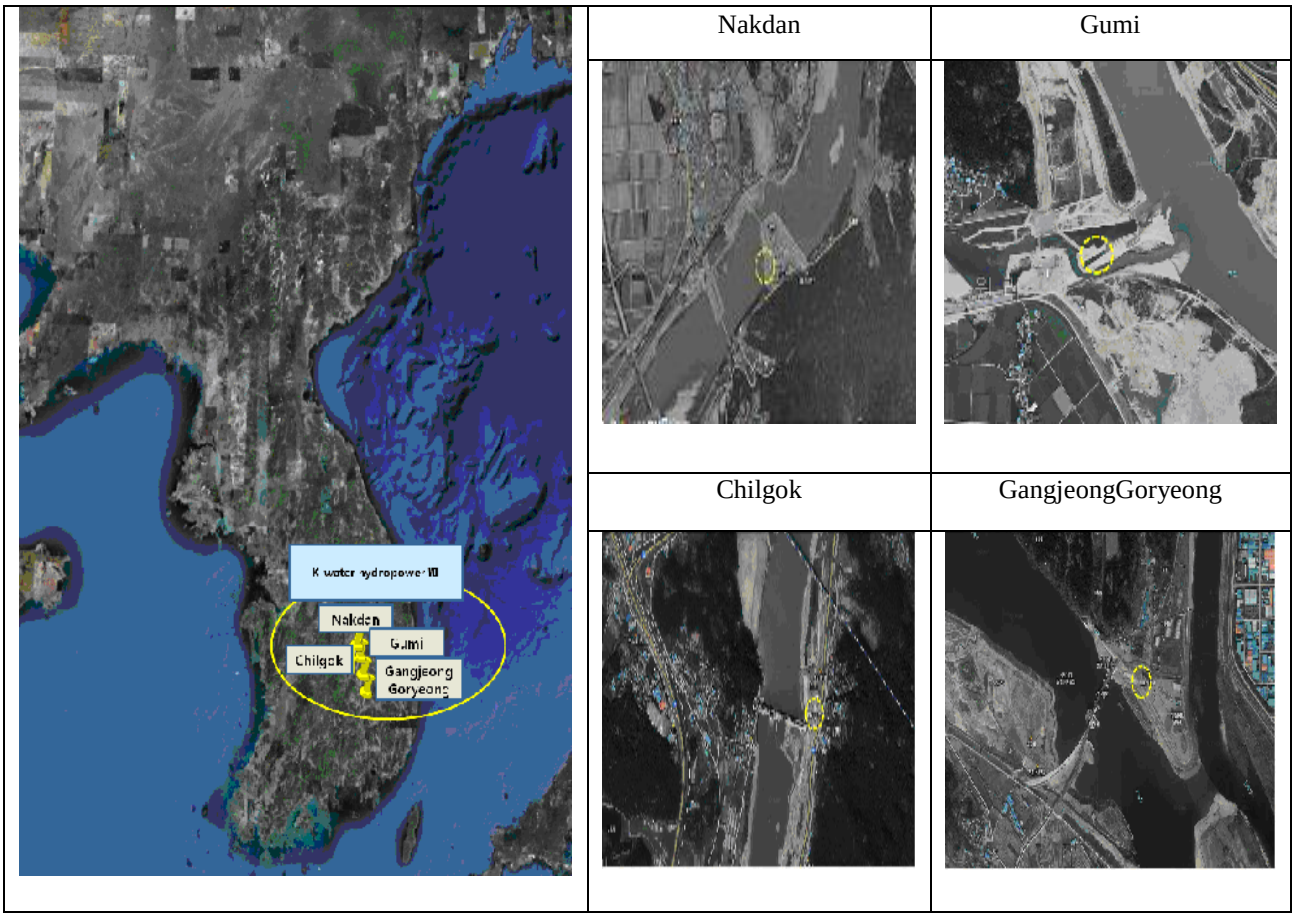
>>
- Nakdan hydropower plant: Gyeongsangbuk-do
- Gumi hydropower plant: Gyeongsangbuk-do
- Chilgok hydropower plant: Gyeongsangbuk-do
- GangjeongGoryeong hydropower plant: Daegu city

A.2.3. City/Town/Community etc.

>>
- Nakdan hydropower plant: Uiseong-gun
- Gumi hydropower plant: Gumi-si
- Chilgok hydropower plant: Chilgok-gun
- GangjeongGoryeong hydropower plant: Dalseong-gun

A.2.4. Physical/Geographical location

>>



<Figure A.1> The geographic location of each project site

The proposed project of "K-water hydropower Ⅷ" has been performed on Nakdong River.

The <Figure A.1> shows the geographic location of the power plant of each project site. The specific address of the power plant of each project site is described as below.

<Table A.1> The address of the power plant of each project site

Plant	Geo Coordination
Nakdan	806, Nakjeong-ri, Danmil-myeon, Uiseong-gun, Gyeongsangbuk-do The latitude of 36.359094N° and the longitude of 128.306820E°
Gumi	1057-26, Won-ri, Sunsan-eup, Gumi-si, Gyeongsangbuk-do The latitude of 36.238665N° and the longitude of 128.348292E°
Chilgok	627-1, Jungji-ri, Seokjeok- eup, Chilgok- gun, Gyeongsangbuk-do The latitude of 36.015443N° and the longitude of 128.400404E°
Gangjeong Goryeong	806, Jukgok-ri, Dasa-eup, Dalseong- gun, Daegu-city The latitude of 35.841659N° and the longitude of 128.461459E°

A.3. Technologies and/or measures

>>

The type and category

According to Appendix B of 'Simplified Modalities and procedures for small-scale clean development mechanism project activities', the type and category of the proposed project are defined as follows:

- Type : I – Renewable Energy Projects
- Category : I.D. – Grid connected renewable electricity generation

Since the total capacity of hydropower plants in a bundled CDM project activity is 12MW, the proposed project satisfies the requirement that the total capacity of the proposed project should be 15 MW at the most for a small scale CDM project activity.

Prior to implementation of the proposed project activity, an equivalent amount of electricity will be supplied by the KEPCO grid which is dominated by traditional fossil fuel power plants, which is also the baseline scenario to the proposed project activity. After implementation of the proposed project activity, the hydro energy which is one of the renewable energy resources will be used to generate electricity transmitted to KEPCO grid.

Technology/measure of the project

The hydropower plant of the proposed project generates electricity by using running water from a weir to the powerhouse. The horizontal shaft Kaplan turbines coupled to synchronous generators will be used to convert the flow of water to electrical energy. The generated electricity by the proposed project will be transmitted to the KEPCO grid and will be measured continuously, respectively by each of installed watt-hour meter on site. By performing the proposed project, the advanced know-how of operating the Kaplan turbine made in overseas country is able to be spontaneously transferred by manufacturer's experts specializing in installing and managing the Kaplan turbine.

The specific technical data of the water turbine/generator and transformer units of each hydropower plant are listed in following table.

<Table A.2> Nakdan hydropower plant

Classification		Unit	Value
Water Turbine	Type	-	Horizontal Shaft Kaplan Tubular
	Capacity	kW	1,626
	Quantity	Unit	2
Generator	Type	-	3-Phase Synchronous generator
	Quantity	Unit	2
	Rated voltage	kV	3.3
	Output	kW	1,500
Transformer	Type	-	Mold-Type
	Capacity	kVA	2,000
	Quantity	Unit	2

<Table A.3> Gumi hydropower plant

Classification		Unit	Value
Water Turbine	Type	-	Kaplan Pit
	Capacity	kW	1,693
	Quantity	Unit	2
Generator	Type	-	3-Phase Synchronous generator
	Quantity	Unit	2
	Rated voltage	kV	6.6
	Output	kW	1,500
Transformer	Type	-	Mold-Type
	Capacity	kVA	2,000
	Quantity	Unit	2

<Table A.4> Chilgok hydropower plant

Classification		Unit	Value
Water Turbine	Type	-	Horizontal Shaft Kaplan bevel-gear
	Capacity	kW	1,582
	Quantity	Unit	2
Generator	Type	-	3-Phase Synchronous generator
	Quantity	Unit	2
	Rated voltage	kV	0.69
	Output	kW	1,500
Transformer	Type	-	Mold-Type
	Capacity	kVA	1,750
	Quantity	Unit	2

<Table A.5> GangjeongGoryeong hydropower plant

Classification		Unit	Value
Water Turbine	Type	-	Kaplan Pit
	Capacity	kW	1,649
	Quantity	Unit	2
Generator	Type	-	3-Phase Synchronous generator.
	Quantity	Unit	2
	Rated voltage	kV	3.3
	Output	kW	1,500
Transformer	Type	-	Mold-Type
	Capacity	kVA	2,000
	Quantity	Unit	2

A.4. Parties and project participants

Party involved (host) indicates 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
Switzerland		

A.5. Public funding of project activity

>>
There is no public funding from Annex I parties for the proposed project.

A.6. Debundling for project activity

>>
According to Appendix C of 'Simplified Modalities and procedures for small-scale clean development mechanism project activities', a proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

K-water has registered 7 CDM projects so far and nowadays, K-water is additionally carrying out 4 CDM hydropower projects. As all sites of K-water's CDM projects do not fall within 1km of the project boundary each other, the proposed project is not a part of any large scale project or program and do not have any debundled component of a large project activity.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

>>
The methodology applied for the proposed project is the approved methodology for small-scale CDM project "AMS.I.D. Grid connected renewable electricity generation" (Version 17).
http://cdm.unfccc.int/methodologies/DB/RSCTZ8SKT4F7N1CFDXCSA7BDQ7FU1X

"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

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

B.2. Project activity eligibility

>>

According to the approved methodology for "simplified modalities and procedures for small scale CDM project activities", applicability of AMS.I.D. methodology to the proposed project is as follows.

<Table B.1> Applicability of AMS-I.D.

<table>
<tr><th>No.</th><th>Applicability</th><th>Justification</th></tr>
<tr><td>1</td><td>This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass:
• Supplying electricity to a national or a regional grid.
• Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.</td><td>Applicable :
The proposed project activity is the generation of hydropower using renewable energy that will be supplied to KEPCO grid.</td></tr>
<tr><td>2</td><td>Illustration of respective situations under each of the methodology (i.e. AMS-I.D., AMS-I.F. and AMS-I.A.) applies is including in following table.
<table>
<tr><th></th><th>Project type</th><th>AMS-I.A.</th><th>AMS-I.D.</th><th>AMS-I.F.</th></tr>
<tr><td>1</td><td>Project supplies electricity to a national/regional grid</td><td></td><td>√</td><td></td></tr>
<tr><td>2</td><td>Project displaces grid electricity consumption (e.g. grid import) and/or captive fossil fuel electricity generation at the user end (excess electricity may be supplied to a grid)</td><td></td><td></td><td>√</td></tr>
<tr><td>3</td><td>Project supplies electricity to an identified consumer facility via national/regional grid (through a contractual arrangement such as wheeling)</td><td></td><td>√</td><td></td></tr>
<tr><td>4</td><td>Project supplies electricity to a mini grid system where in the baseline all generators use exclusively fuel oil and/or diesel fuel</td><td></td><td></td><td>√</td></tr>
<tr><td>5</td><td>Project supplies electricity to household users (included in the project boundary) located in off grid areas</td><td>√</td><td></td><td></td></tr>
</table></td><td>Applicable :
The electricity generated by the proposed project activity is supplied to KEPCO grid.</td></tr>
<tr><td>3</td><td>This methodology is applicable to project activities that (a) install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).</td><td>Applicable :
The proposed project activity is being implemented at a site where there was no renewable energy power plant operating prior to the implementation of the project activity.</td></tr>
</table>

4	Hydropower plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: • The project activity is implemented in an existing reservoir with no change in the volume of reservoir; • The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project Emissions section, is greater than 4 W/m2; • The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project Emissions section, is greater than 4 W/m2.	Not relevant : The proposed project activity is a type of run-of-river hydropower project to generate electricity by utilizing the flow of water that normally runs over a weir. The hydropower plants are associated with neither an existing reservoir nor creation of a new one. Details are involved in clarification SSC_629.
5	If the new unit has both renewable and nonrenewable components (e.g., a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the unit cofires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	Applicable : The total capacities of hydropower plants in a bundle are 12.0MW. It is not greater than the maximum limited capacity of 15 MW for a small scale CDM project. And the project will remain under the 15MW limits over the crediting period.
6	Combined heat and power (co-generation) systems are not eligible under this category.	Not relevant : Heat generation is not involved in the project.
7	In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	Not relevant : There was no power generation on site before the project activity.
8	In the case of retrofit or replacement, to qualify as a small scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.	Not relevant : The proposed project doesn't involve retrofit or replacement of units.

As a result of above analysis for applicability of methodology, AMS-I.D. (version 17) can be applied to the proposed project.

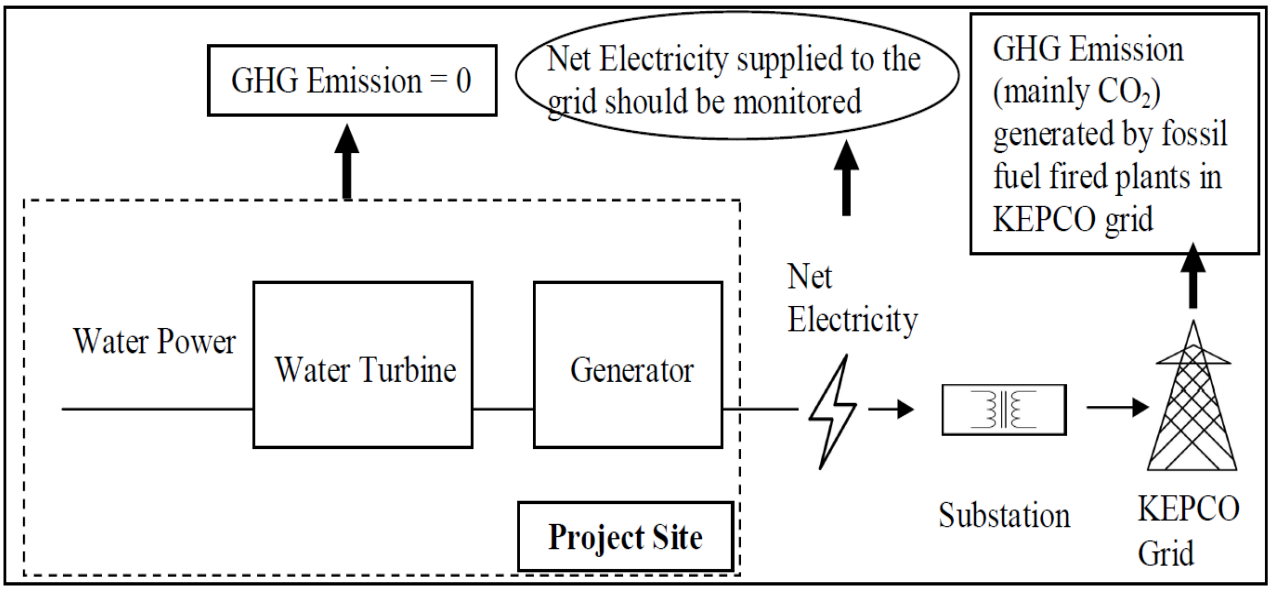
B.3. Project boundary

>>

According to AMS-I.D. (version 17), the spatial extent of the project boundary includes the project's power plant and all power plants connected physically to the electricity system that the project's power plant is connected to.

The power generated by the proposed project will be connected to KEPCO grid, so the project boundary includes the proposed project and all grid-connected power plant in KEPCO grid dominated by fossil fuel fired plants.

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	CO_2 emissions from electricity generation in fossil fuel fired power plants connected to the grid	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project scenario	The proposed project	CO_2	No	According to AMS-I.D. (version 17), project emissions are zero.
		CH_4	No	
		N_2O	No	



<Figure B.1> Project boundary

B.4. Establishment and description of baseline scenario

>>

According to the methodology AMS.I.D. (version 17), the baseline scenario of the proposed project is illustrated as followings:

The electricity delivered to the grid by the proposed project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid. 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.

The grid emission factor is determined as a Combined Margin (CM), consisting of the combination of Operating Margin (OM) and Build Margin (BM) according to the procedures prescribed in the "Tool to calculate the emission factor for an electricity system."

Key information and data used to determine the baseline scenario are listed in the table below.

<Table B.2> Key information and data used to determine the baseline scenario

Variable	Value / Unit	Source
Operational Margin Emission Factor	0.6933 tCO_2e/MWh	- Calculated from the Statistics of Electric Power in KOREA (2008, 2009, 2010) by KEPCO, Status of Generation facility (2010) by Korea Power Exchange(hereinafter referred as the "KPX") - 2006 IPCC Guidelines for National Greenhouse Gas Inventories - Tool to calculate the emission factor for an electricity system
Build Margin Emission Factor	0.6357 tCO_2e/MWh	
Combined Margin Emission Factor	0.6645 tCO_2e/MWh	
Expected power generation by the project in year y	Nakdan : 14,717 MWh Gumi : 14,767 MWh Chilgok : 15,279 MWh GangjeongGoryeong : 13,407 MWh	- License for the electric generation business

B.5. Demonstration of additionality

>>

The table below is only applicable if the proposed project activity is a type of project activity which is deemed automatically additional, as defined by the applied approved methodology, tool, standardized baseline or specific renewable technologies/measures conferring automatic additional microscale CDM project activities proposed by a DNA and approved by the Board.

Specify the methodology, tool, standardized baseline or specific renewable technologies/measures conferring automatic additional microscale CDM project activities proposed by DNAs and approved by the Board, that establish automatic additionality for the proposed project activity (including the version number and the specific paragraph, if applicable).	"Guidelines for demonstrating additionality of microscale project activities, version 04" and "procedure for submission and consideration of microscale renewable energy technologies for automatic additionality, version 01" - In accordance with the "Guidelines for demonstrating additionality of microscale project activities, version 04", The project activity employs specific renewable energy technologies/measures recommended by the host country designated national authority (DNA) and approved by the Board to be additional in the host country. - In accordance with the "procedure for submission and consideration of microscale renewable energy technologies for automatic additionality, version 01", the DNA of Republic of Korea proposed specific renewable technologies/measures for automatic additionality by submitting the F-CDM-RRT form and the supporting documents on 5 Jan 2012. - The SSC WG at 35th meeting undertook an assessment of the submission received from the DNA of Republic of Korea. And also, the SSC WG agreed to recommend the Board to approve the proposed specific renewable technologies/measures as conferring additionality on micro scale CDM project activities implemented in Republic of Korea. Finally, the Board decided to adopt the SSC WG 35 recommendation on 12 March 2012. Accordingly, the project activity is demonstrated to be additional.
Describe how the proposed project activity meets the criteria for automatic additionality in the relevant methodology, tool, standardized baselines or specific renewable technologies/measures conferring automatic additional microscale CDM project activities proposed by a DNA and approved by the Board.	<u>Demonstrating Additionality of Microscale project activity:</u> Based on the "Guidelines for demonstrating additionality of microscale project activities, version 04", project activities up to five megawatts that employ renewable energy technology are additional if any one of the conditions below is satisfied; (a) The geographic location of the project activity is in one of the Least Developed Countries or the Small Island Developing States (LDCs/SIDs) or in a special underdeveloped zone of the host country identified by the Government before 28 May 2010; (b) The project activity is an off grid activity supplying energy to households/communities (less than 12 hrs grid availability per 24 hrs is also considered as 'off grid' for this assessment); (c) The project activity is designed for distributed energy generation (not connected to a national or regional grid) with both conditions (i) and (ii) satisfied; (i) Each of the independent subsystem/measure in the project activity is smaller than or equal to 1500 kW electrical installed capacity; (ii) End users of the subsystem or measure are households/communities/ small and medium enterprises (SMEs). (d) The project activity employs specific renewable energy technologies/measures recommended by the host country

	designated national authority (DNA) and approved by the Board to be additional in the host country. The following conditions shall apply for DNA recommendations: (i) "Specific renewable energy technologies/measures. refers to grid connected renewable energy technologies5 of installed capacity equal to or smaller than 5 MW; (ii) The ratio of installed capacity of the specific grid connected renewable energy technology in the total installed grid connected power generation capacity in the host country shall be equal to or less than 3 per cent; (iii) Most recent available data on the percentage of contribution of specific renewable energy technologies shall be provided to demonstrate compliance with the 3 per cent threshold. In no case shall data older than three years from the data of submission be used; (iv) Technologies/measures recommended by DNAs and approved by the Board to be additional in the host country remain valid for three years from the data of approval. However, additionality of eligible project activities applying the guidelines remains valid for the entire crediting period; (v) DNA submissions shall include the specific grid connected renewable electricity generation technologies that are being recommended and provide the required data as indicated above (e.g. wind power, biomass power, geothermal power, hydropower). The proposed project activity is relevant to the condition of (d) for demonstrating the additionality. In accordance with the "procedure for submission and consideration of microscale renewable energy technologies for automatic additionality, version 01", the DNA of Republic of Korea proposed specific renewable technologies/measures for automatic additionality by submitting the F-CDM-RRT form and the supporting documents on 5 Jan 2012. The SSC WG at 35th meeting undertook an assessment of the submission received from the DNA of Republic of Korea. And also, the SSC WG agreed to recommend the Board to approve the proposed specific renewable technologies/measures as conferring additionality on micro scale CDM project activities implemented in Republic of Korea. Finally, the Board decided to adopt the SSC WG 35 recommendation on 12 March 2012. Accordingly, the project activity is demonstrated to be additional.

Prior Consideration of CDM

According to the Guidelines on the demonstration and assessment of prior consideration of the CDM, the project participant must inform a Host Party designated national authority (DNA) and the UNFCCC secretariat in writing of the commencement of the project activity and of their intention to seek CDM status. Such notification must be made within six months of the project activity start date and shall contain the precise geographical location and a brief description of the proposed project activity, using the standardized form F-CDM-Prior Consideration.

The starting date of a CDM project activity is the earliest date at which either the implementation or construction or real action of a CDM project activity begins. In the case of this proposed project, the date signed on the contract of turnkey-base project can be applied as real action of a CDM project activity.

<Table B.3> Timeline of the implementation of each Hydropower Plant

Description	Date of Nakdan Hydropower Plant	Date of Gumi Hydropower Plant	Date of Chilgok Hydropower Plant	Date of Gangjeong Goryeong Hydropower Plant
Internal plan for CDM project	06/2009	06/2009	06/2009	06/2009
Singed on the contract of turnkey-base project	**27/10/2009**	**27/10/2009**	**27/10/2009**	**23/10/2009**
Submission of an application for license for the electric generation business	01/2010	01/2010	01/2010	01/2010
Signed on CDM Consulting Contract	02/2010	02/2010	02/2010	02/2010
Submission of Prior Consideration form to DNA	**26/02/2010**	**26/02/2010**	**26/02/2010**	**05/04/2010**
Submission of Prior Consideration form to UNFCCC	**26/02/2010**	**26/02/2010**	**26/02/2010**	**05/04/2010**
Getting the license for the electric generation business	04/2010	04/2010	04/2010	03/2010
Re-submission of prior consideration form to DNA as changes in bundle component	**23/05/2011**	**23/05/2011**	**23/05/2011**	**23/05/2011**
Re-submission of prior consideration form to UNFCCC as changes in bundle component	**24/05/2011**	**24/05/2011**	**24/05/2011**	**24/05/2011**
Signed on DOE Contract	07/2011	07/2011	07/2011	07/2011

The starting date of each hydropower plant project is the date when the contract for turnkey-base project was made. K-water has considered CDM project activity seriously prior to the starting date. The evidence is the document for notification of prior consideration of the CDM project submitted to UNFCCC and to DNA within six months of the project activity's starting date. After 1st submission of prior consideration form of the CDM project, the revised prior consideration form of the CDM project was re-submitted to UNFCCC and to DNA. Re-submission of the prior consideration form was made by corresponding changes in bundle configurations.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

>>

The baseline scenario of the project is the continued operation of the existing power plants in the grid system and the addition of new generation sources. The project activity involves the construction of a zero emission power source. Thus, the emission reductions are equal to the baseline emissions.

In accordance with the small scale methodology AMS-I.D., baseline emissions are equal to power generated by the project activity and delivered to the grid, multiplied by the baseline emission factor. According to the small scale methodology AMS-I.D., there are two options for baseline emission factor calculations:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system'.

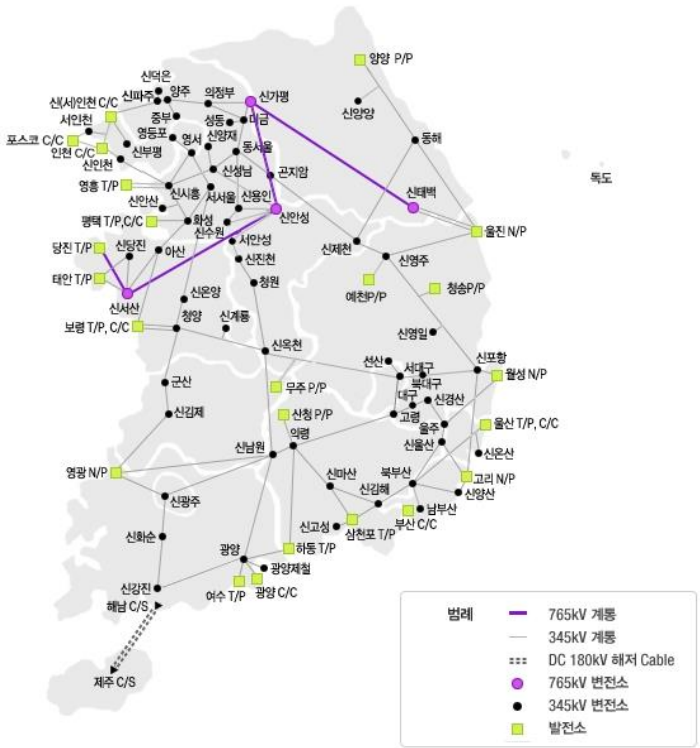
OR

(b) The weighted average emissions (in kg CO_2e/kWh) of the current generation mix. The data from the year, in which project generation occurs, must be used.

For the proposed project, Option (a) was chosen to calculate the baseline emission factor.
According to " Tool to calculate the emission factor for an electricity system (version 02.2.1)", the baseline emission factor is calculated by combined margin (CM), which is the weighted average of the operating margin (OM) and the build margin (BM).
Baseline emissions will be calculated using the following 6 steps.

STEP 1. Identify the relevant electric power system.
STEP 2. Choose whether to include off-grid power plants in the project electricity system.
STEP 3. Select a method to determine the operating margin (OM).
STEP 4. Calculate the operating margin emission factor according to the selected method.
STEP 5. Calculate the build margin (BM) emission factor.
STEP 6. Calculate the combined margin (CM) emissions factor.

STEP 1. Identify the relevant electric power system
For the purpose of determining the electricity emission factors, a project electricity system is defined by the spatial extent of the power plants that are physically connected, through transmission and distribution lines, to the project activity and that can be dispatched without significant transmission constraints.
Similarly, a connected electricity system, e.g. national or international, is defined as an electricity system that is connected by transmission lines to the project electricity system.
Because all power plants-including proposed bundled hydropower plant are physically connected to each other through transmission and distribution lines constituting the grid.
Therefore the KEPCO grid has been chosen as relevant electricity power system for purpose of determining the electricity emission factors.



<Figure B.2> Electric Power Grid Nationwide in Republic of Korea
(Source: http://www.kpx.or.kr/, 2010)

STEP 2. Choose whether to include off-grid power plants in the project electricity system
Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I : Only grid power plants are included in the calculation.
Option II : Both grid power plants and off-grid power plants are included in the calculation.

For the proposed project, Option I is chosen; there are no off-grid power plants included in the calculation.

STEP 3. Select a method to determine the Operating Margin (OM)

The calculation of the Operating Margin emission factor ($EF_{grid, OM,y}$) is based on one of the four following methods:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or
(d) Average OM.

Among the above options, the simple OM method can be used where low cost/must run resources constitute less than or equal to 50% of total grid generation average of the five most recent years.
Low-cost/must-run resources are defined as power plants with low marginal generation costs or power plants that are dispatched independently of the daily or seasonal load of the grid.
During the most 5 year period (2006~2010), the average low-cost/must run generation holds 37.78% of total KEPCO grid generation. Details are shown below on <Table B.4>.

<Table B.4> The yearly proportion of the electricity generation based on the source of energy in Korea

(Unit: GWh)

Item / Year		2006	2007	2008	2009	2010
Hydro*		5,219	5,042	5,563	5,641	6,472
Thermal	Domestic Coal*	4,312	4,470	5,010	5,559	4,613
	Bituminous Coal	134,894	150,204	168,498	187,657	189,156
	Oil	19,195	21,215	15,425	19,912	25,356
	Gas	68,302	78,427	75,809	65,273	96,483
Nuclear*		148,749	142,937	150,958	147,771	148,596
Alternative*		511	829	1,092	1,791	3,984
Total		381,181	403,124	422,355	433,604	474,660
The rate of low cost/must run power generation (%)		37.78				

Source: Statistics of Electric Power in KOREA by KEPCO, 2010 (*: low-operating cost and must-run power plants)

It refers to the host country's gross electricity generation rate by energy source, and an hourly dispatched data is not available at this point of time.
Thus the Simple OM method is employed in order to calculate the OM emission factor. The Simple OM emission factor ($EF_{grid,OM,y}$) is calculated using a 3-year generation-weighted average (ex-ante) of all generating power plants serving the system, based on the most recent data available at the time of submission of the PDD.

STEP4. Calculate the operating margin emission factor according to the selected method.

According to the "Tool to calculate the emission factor for an electricity system", the Simple OM emission factor is calculated as the generation-weighted average emissions per unit net electricity generation (tCO_2e/MWh) of all generating power plants serving the system, not including low-operating cost and must-run power plants/units based on the two following options:

Option A: Based on the net electricity generation and a CO_2 emission factor of each power unit; or
Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.
As the data on fuel consumption and net electricity generation of each power plant is available in Korea, the proposed project can employ Option A. When Option A is used, the simple OM emission factor is calculated as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_{m} EG_{m,y} \cdot EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:

$EF_{grid, OMsimple, y}$	=	Simple operating margin CO_2 emission factor in year y (tCO_2e/MWh)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2e/MWh)
m	=	All power units serving the grid in year *y* except low-cost / must-run power units
y	=	The relevant year as per the data vintage chosen in Step 3

Determination of $EF_{EL, m, y}$

The emission factor of each power unit *m* should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2e/MWh)
$FC_{i,m,y}$	=	Amount of fossil fuel type *i* consumed by power plant *m* in year *y* (mass or volume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ / mass or volume unit)
$EF_{CO2,i,y}$	=	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2e/GJ)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
m	=	All power plants serving the grid in year *y* except low-cost / must-run power units
i	=	All fossil fuel types combusted in power unit *m* in year *y*
y	=	The relevant year as per the data vintage chosen in Step 3

For the proposed project, $NCV_{i,y}$ provided by official data source of Korea is used.
IPCC default value is used as CO_2 emission factor of fuel. Simple OM factor during 3 years (2008~2010) is 0.6933 tCO_2e/MWh and this value is fixed along the credit period.
Detailed baseline information used in the calculation is presented in attached excel file.

STEP 5. Calculate the build margin (BM) emission factor
According to "Tool to calculate the emission factor for an electricity system", in terms of vintage of data, project participants can choose between one of the following two options:

Option 1: For the first crediting period, calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated *ex ante*, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.
And here, Option 1 is selected between the two options proposed by the methodology.

The sample group of power units *m* used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently ($SET_{5\text{-units}}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh);

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET\text{-}\geq 20\%}$, in MWh);

(c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});
Identify the date when the power units in SET_{sample} started to supply electricity to the grid.
If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. Ignore steps (d), (e) and (f).
Otherwise:

(d) Exclude from SET_{sample} the power units which started to supply electricity to the grid more than 10 years ago. Include in that set the power units registered as CDM project activity, starting with power units that started to supply electricity to the grid most recently, until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) to the extent is possible. Determine for the resulting set ($SET_{sample\text{-}CDM}$) the annual electricity generation ($AEG_{SET\text{-}sample\text{-}CDM}$, in MWh);

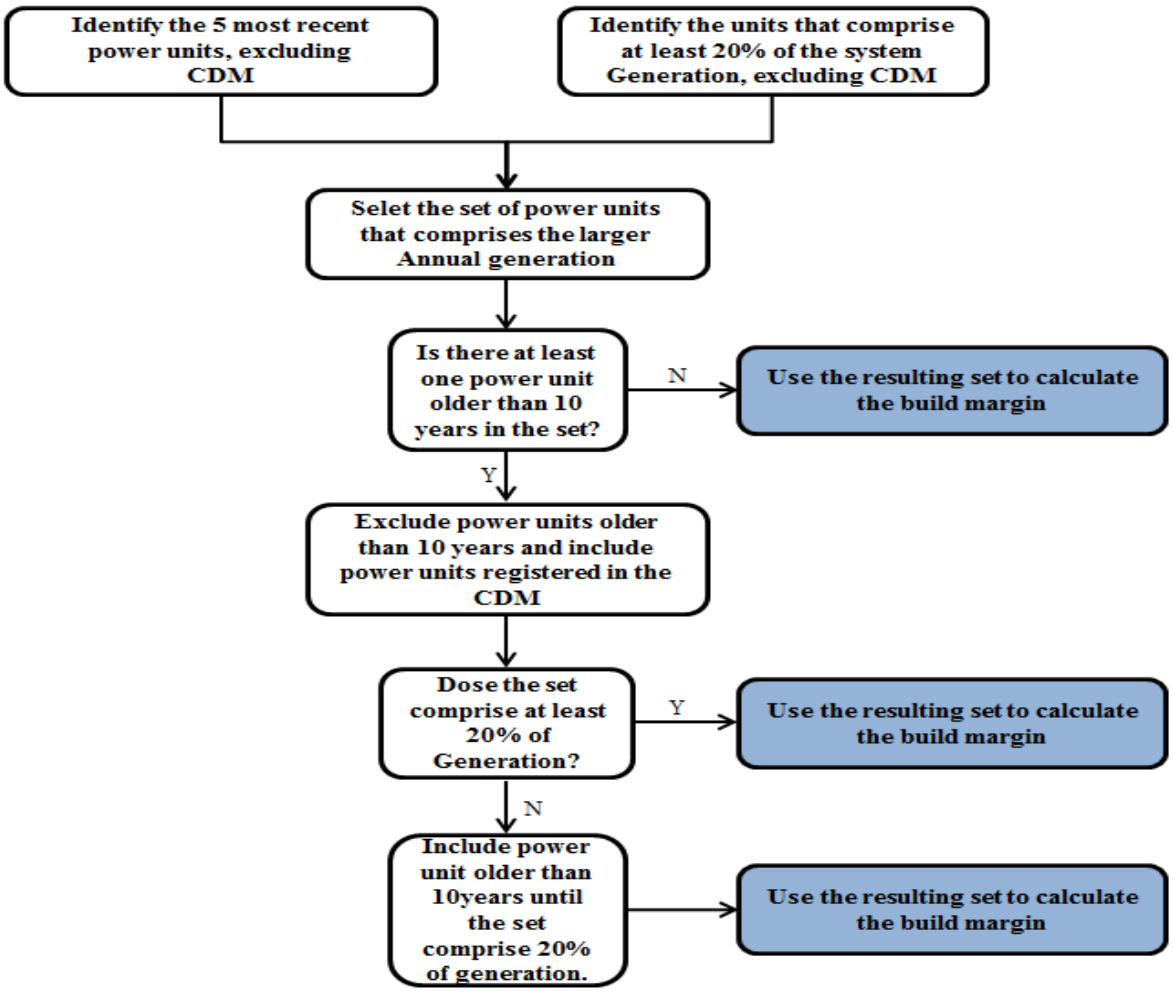
If the annual electricity generation of that set comprises at least 20% of the annual electricity generation of the project electricity system (i.e. $AEG_{SET\text{-}sample\text{-}CDM \geq 0.2} \times AEG_{total}$), then use the sample group $SET_{sample\text{-}CDM}$ to calculate the build margin. Ignore steps (e) and (f).

Otherwise:

(e) Include in the sample group $SET_{sample\text{-}CDM}$ the power units that started to supply electricity to the grid more than 10 years ago until the electricity generation of the new set comprises 20% of the annual electricity generation of the project electricity system (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation);

(f) The sample group of power units m used to calculate the build margin is the resulting set ($SET_{sample\text{-}CDM\text{->}10yrs}$).

The following diagram summarizes the procedure above:



<Figure B.3> Diagram of calculate the build margin (BM) emission factor

The build margin emissions factor is the generation-weighted average emission factor (tCO_2e/MWh) of all power units *m* during the most recent year y for which power generation data is available, calculate as follows:

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year *y* (tCO_2e/MWh)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit *m* in year *y* (tCO_2e/MWh)
m	=	Power units included in the build margin
y	=	Most recent historical year for which power generation data is available

For BM emission factor, $EF_{EL,m,y}$ was calculated by $\sum_{i} FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}$ and divide it by power generation of each plant.

In the project, as the annual generation of "the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently" was 92,308,943 MWh on 2010 and the annual generation of "the five power plants that have been built most recently" in 2010 was 1,281,543 MWh.

Therefore, the former is a larger figure than the latter. In accordance with proposed procedure by the methodology, the former was selected. And none of the power units in former ($SET_{\geq 20\%}$) started to supply electricity to the grid more than 10 years ago. Thus the former applied to calculate the build margin. BM emission factor is 0.6357 tCO_2e/MWh. The detailed data used in the calculation are presented in attached excel file.

The CO_2 emission factor of each power unit, *m* ($EF_{EL,m,y}$), should be determined as per the guidance in step 4 (a) for the simple OM, using option A1, A2, A3, using for y the most recent historical year for which power generation data is available, and using for *m* the power units included in the build margin. For the proposed project step 4 (a) Simple OM, option A1 was chosen.

STEP 6. Calculate the combined emission factor

According to the tool to calculate the emission factor for electricity system (version 02.2.1), the calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is based on one of the following methods:

(a) Weighted average CM; or
(b) Simplified CM.

The weighted average CM method (option a) should be used as the preferred option.

The simplified CM method (option b) can only be used if:

• The project activity is located in a Least Developed Country (LDC) or in a country with less than 10 registered projects at the starting date of validation; and

• The data requirements for the application of step 5 above cannot be met.

In this project, the weighted average CM method (option a) is chosen for calculation of the emission factor.

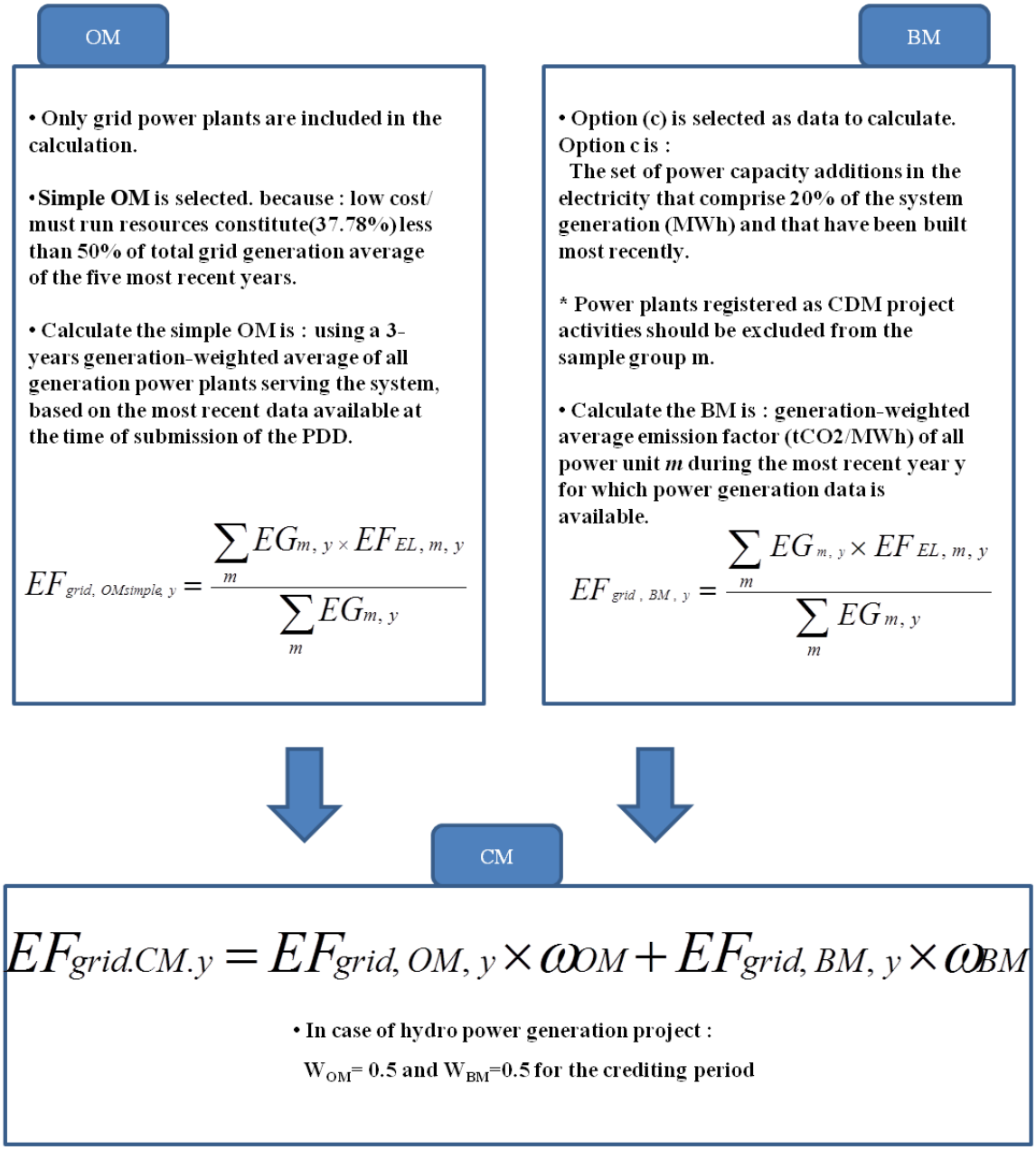
The combined emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year y (tCO_2e/MWh)
$EF_{grid,OM,y}$	=	Operating margin CO_2 emission factor in year y (tCO_2e/MWh)
w_{OM}	=	Weighting of operating margin emissions factor (50% for hydropower project)
w_{BM}	=	Weighting of build margin emissions factor (50% for hydropower project)

$$EF_{grid,CM,y} = 0.6933 \times 0.5 + 0.6357 \times 0.5 = 0.6645 \ (tCO_2e/MWh)$$



<Figure B.4> Method of emission factor calculation

Baseline emissions (BE_y)

Baseline emissions can be calculated as below:

$BE_y = EG_{BL,y} \times EF_{CO2,grid,y}$

Where:

BE_y	=	Baseline emissions in year y (tCO_2e/ 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)
$EF_{CO2,grid,y}$	=	CO_2 emission factor of the grid in year *y* (tCO_2e/MWh)

The project is expected to generate about 58,170 MWh per year, as shown below.

- **Nakdan small hydro power plant**

  - Electricity Generation : 14,717 MWh/y
  - Installed Capacity : 3,000 kW
  - Annual hour : 8,760 hr /y
  - Capacity Factor : 56.00 %

- **Gumi small hydro power plant**

  - Electricity Generation : 14,767 MWh/y
  - Installed Capacity : 3,000 kW
  - Annual hour : 8,760 hr /y
  - Capacity Factor : 56.19 %

- **Chilgok small hydro power plant**

  - Electricity Generation : 15,279 MWh/y
  - Installed Capacity : 3,000 kW
  - Annual hour : 8,760 hr /y
  - Capacity Factor : 58.14 %

- **GangjeongGoryeong small hydro power plant**

  - Electricity Generation : 13,407 MWh/y
  - Installed Capacity : 3,000 kW
  - Annual hour : 8,760 hr /y
  - Capacity Factor : 51.02 %

Therefore the baseline emissions (BE_y) of the proposed project are calculated as below:

$BE_y = EG_{baseline,y} \times EF_{Co2,grid,y}$ = 58,170 MWh × 0.6645 tCO_2e/MWh = 38,654 tCO_2e/ year

Project emission

In the case of most renewable energy project activities, the project emissions are zero, $PE_y = 0$. However, according to the Appendix B of "the Simplified Modalities and procedures for small-scale clean development mechanism project activities", for the following categories of project activities, project emissions should be considered following the procedure described in the most recent version of ACM0002.

- Emission related to the operation of geothermal power plants.
- Emission from water reservoirs of hydropower plants.

The proposed project activity will not give rise to project emissions, as it is run-of-river and there is no reservoir involved. Accordingly, the project emissions are zero.

Leakage

According to the tool to calculate the emission factor for electricity system, if the equipment of generating energy is transferred from another activity, leakage is to be considered. Since no energy generating equipment in the proposed project is transferred from another activity, the leakage emissions are zero.

Estimation of Emission reduction

Emission reductions of the proposed project are same with the emissions from electricity generation in fossil fuel power plants that are displaced due to the project activity.

Project emission reduction can be estimated by following equation.

$$ER_y = BE_y - PE_y - LE_y$$

Where,

ER_y = Emission reductions in year *y* (tCO_2e/yr)
BE_y = Baseline emissions in year *y* (tCO_2e/yr)
PE_y = Project emissions in year *y* (tCO_2e/yr)
LE_y = Leakage emissions in year *y* (tCO_2e/yr)

B.6.2. Data and parameters fixed ex ante

Data / Parameter	**$EF_{m,y}$**
Unit	tCO_2e/MWh
Description	CO_2 emissions factor in power unit *m* in year *y*
Source of data	Calculated
Value(s) applied	0.6645 tCO_2e/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 Statistics of Electric Power in KOREA (2008, 2009, 2010) (KEPCO) and Status of Generation facility (2010) (KPX).
Purpose of data	Calculation of baseline emissions
Additional comment	- 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_2e/MWh
Description	Operating Margin emission factor
Source of data	Calculated
Value(s) applied	0.6933 tCO_2e/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 Statistics of Electric Power in KOREA (2008, 2009, 2010) (KEPCO).
Purpose of data	Calculation of baseline emissions
Additional comment	- 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_2e/MWh
Description	Build Margin emission factor
Source of data	Calculated
Value(s) applied	0.6357 tCO_2e/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 Statistics of Electric Power in KOREA (2010) (KEPCO) and Status of Generation facility (2010) (KPX).
Purpose of data	Calculation of baseline emissions
Additional comment	- 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	2008 STATISTICS OF ELECTRIC POWER IN KOREA 2009 STATISTICS OF ELECTRIC POWER IN KOREA 2010 STATISTICS OF ELECTRIC POWER IN KOREA
Additional comment	- 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	Amount of fossil fuel type i consumed by power plant/unit *m* in year *y* *i* : bituminous, heavy oil, diesel, LNG *m* : All power units serving the grid in year y except low-cost/must-run power units *y* : year
Source of data	2008 STATISTICS OF ELECTRIC POWER IN KOREA 2009 STATISTICS OF ELECTRIC POWER IN KOREA 2010 STATISTICS OF ELECTRIC POWER IN KOREA
Additional comment	- 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* : bituminous, heavy oil, diesel oil, LNG
Source of data	2008 STATISTICS OF ELECTRIC POWER IN KOREA 2009 STATISTICS OF ELECTRIC POWER IN KOREA 2010 STATISTICS OF ELECTRIC POWER IN KOREA
Additional comment	- 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_2e/GJ
Description	CO_2 emission factor of fossil fuel type *i* *i* : bituminous, heavy oil, diesel oil, LNG
Source of data	Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Additional comment	- 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.

B.6.3. Ex ante calculation of emission reductions

>>

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where,

ER_y = Emission reductions in year y (tCO_2e/yr)
BE_y = Baseline emissions in year y (tCO_2e/yr)
PE_y = Project emissions in year y (tCO_2e/yr)
LE_y = Leakage emissions in year y (tCO_2e/yr)

As mentioned above, since project emissions (PE_y) and leakage (L_y) are "zero", the value of emission reductions (ER_y) is the same as the value of baseline emissions (BE_y), as follows:

$$ER_y = EF_{grid} \times EG_y$$

The emission factor of the grid is determined using a combined margin emission factor, consisting of the combination of the OM and the BM factors.
As shown in attached excel file, the OM emission factor results are 0.6933 tCO_2e/MWh and the BM emission factor 0.6357 tCO_2e/MWh. Thus, the emission factor of the grid (EF_{grid}) is:

$$EF_{grid,CM,y} = (0.6933 \times 0.5) + (0.6357 \times 0.5) = 0.6645\ (tCO_2e/MWh)$$

<Table B.5> Emission reduction

Plant	BE_y (tCO_2e/yr)		PE_y (tCO_2e/yr)	LE_y (tCO_2e/yr)	ER_y (tCO_2e/yr)
	$EG_{BL,y}$ (MWh)	$EF_{CO2,grid,y}$ (tCO_2e/MWh)			
Nakdan	14,717	0.6645	0	0	9,779
Gumi	14,767				9,813
Chilgok	15,279				10,153
GangjeongGoryeong	13,407				8,909
Total	58,170	0.6645	0	0	38,654

The annual emission reduction result is

0.6645 tCO_2e/MWh × 58,170 MWh/yr = 38,654 tCO_2e/year

B.6.4. Summary of ex ante estimates of emission reductions

The proposed bundled project adopts crediting period of 10 years and the total amount of emission reductions of the proposed bundled project during the crediting period is estimated to be 386,540 tCO_2e.

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
Year 1	38,654	0	0	38,654
Year 2	38,654	0	0	38,654
Year 3	38,654	0	0	38,654
Year 4	38,654	0	0	38,654
Year 5	38,654	0	0	38,654
Year 6	38,654	0	0	38,654
Year 7	38,654	0	0	38,654
Year 8	38,654	0	0	38,654
Year 9	38,654	0	0	38,654
Year 10	38,654	0	0	38,654
Total	386,540	0	0	386,540
Total number of crediting years	10			
Annual average over the crediting period	38,654	0	0	38,654

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter:	**$EG_{BL,y}$**
Unit	MWh/y
Description	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y
Source of data	The data used in the PDD are obtained from the license for the electric generation business of the proposed project. Actual data will be obtained through on-site measurement.
Value(s) applied	**58,170 MWh/year** - $EG_{BL,y,Nakdan}$: 14,717 MWh/year - $EG_{BL,y,Gumi}$: 14,767 MWh/year - $EG_{BL,y,Chilgok}$: 15,279 MWh/year - $EG_{BL,y,GangjeongGoryeong}$: 13,407 MWh/year
Measurement methods and procedures	Calculated monthly with on-site monitored data of $\mathbf{EG_{export,y}}$ and $\mathbf{EG_{import,y}}$ using the formula $\mathbf{EG_{BL,y} = EG_{export,y} - EG_{import,y}}$
Monitoring frequency	N/A
QA/QC procedures	More detail QA/QC procedures are described in the monitoring system in the "B.7.3. Other elements of monitoring plan".
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter:	**$EG_{export,y}$**
Unit	MWh/y
Description	Electricity supplied to the grid by the proposed project in year y

Source of data	The data used in the PDD are obtained from license for the electric generation business of the proposed project. Actual data will be obtained through on-site measurement.
Value(s) applied	**58,170 MWh/year** - $EG_{export,y,Nakdan}$: 14,717 MWh/year - $EG_{export,y,Gumi}$: 14,767 MWh/year - $EG_{export,y,Chilgok}$: 15,279 MWh/year - $EG_{export,y,GangjeongGoryeong}$: 13,407 MWh/year
Measurement methods and procedures	Continuously measured by the watt-hour meter and monthly recorded by the person in charge of CDM in New & Renewable Energy Department.
Monitoring frequency	Measuring : Continuously Recording : Monthly
QA/QC procedures	**Measuring equipment** - The watt-hour meter shall be set up transparently in accordance with 'Measures act' and 'Rules on the operation of the electricity market'. - The watt-hour meter shall be calibrated regularly in accordance with 'Measures act', 'Rules on the operation of the electricity market' and 'General guidelines to SSC CDM methodologies'. - The amount of electricity transmitted to the grid will be electronically measured and transferred to KPX and K-water, so it will be double checked by both entities. - The allowable error of data measured by the watt-hour meter must be within ± 0.5%.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data / Parameter:	**$EG_{import,y}$**
Unit	MWh/y
Description	Electricity imported from the grid by the proposed project in year y
Source of data	Assumed as zero in the PDD. Actual data will be obtained through on-site measurement.
Value(s) applied	0 - $EG_{Import,y,Nakdan}$: 0 MWh/year - $EG_{Import,y,Gumi}$: 0 MWh/year - $EG_{Import,y,Chilgok}$: 0 MWh/year - $EG_{Import,y,GangjeongGoryeong}$: 0 MWh/year
Measurement methods and procedures	Continuously measured by the watt-hour meter of KEPCO and monthly recorded by the person in charge of CDM in New & Renewable Energy Department.
Monitoring frequency	Measuring : Continuously Recording : Monthly
QA/QC procedures	**Measuring equipment** - The watt-hour meter shall be set up transparently in accordance with 'Measures act'. - The watt-hour meter shall be calibrated regularly in accordance with 'Measures act' and 'General guidelines to SSC CDM methodologies'. - The amount of electricity imported from the grid will be checked by receipt of KEPCO. - The allowable error of data measured by the watt-hour meter must be within ± 1.0%.

Purpose of data	Calculation of baseline emissions
Additional comment	-

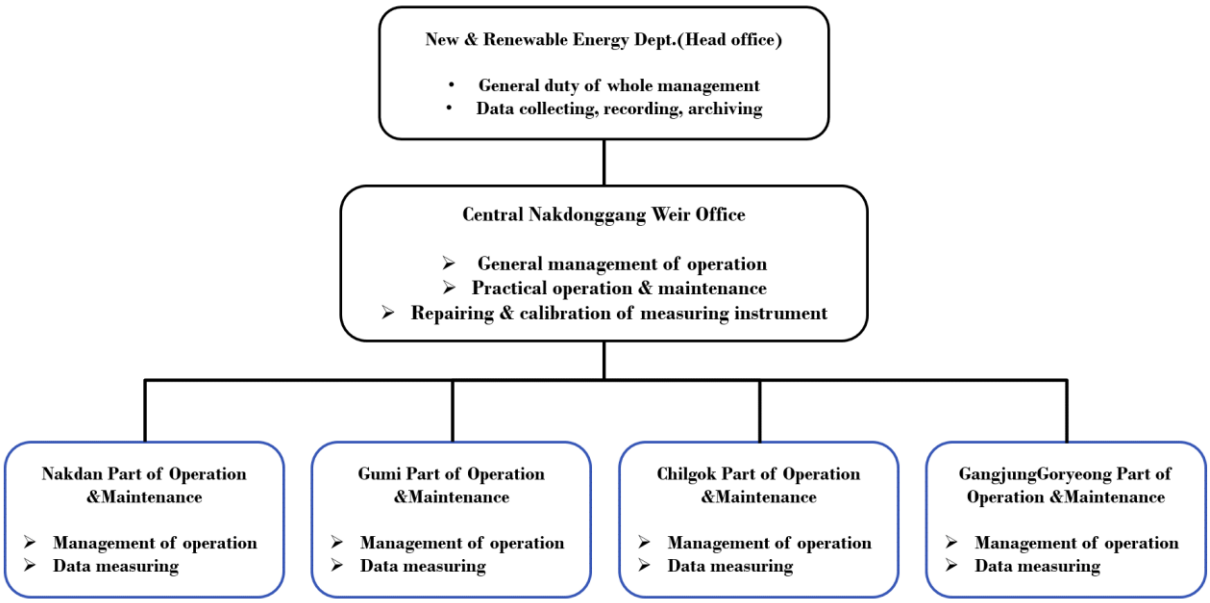
B.7.2. Sampling plan

>>
N/A

B.7.3. Other elements of monitoring plan

>>
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.

1. Monitoring Organization



<Figure B.5> Monitoring organization and responsibility

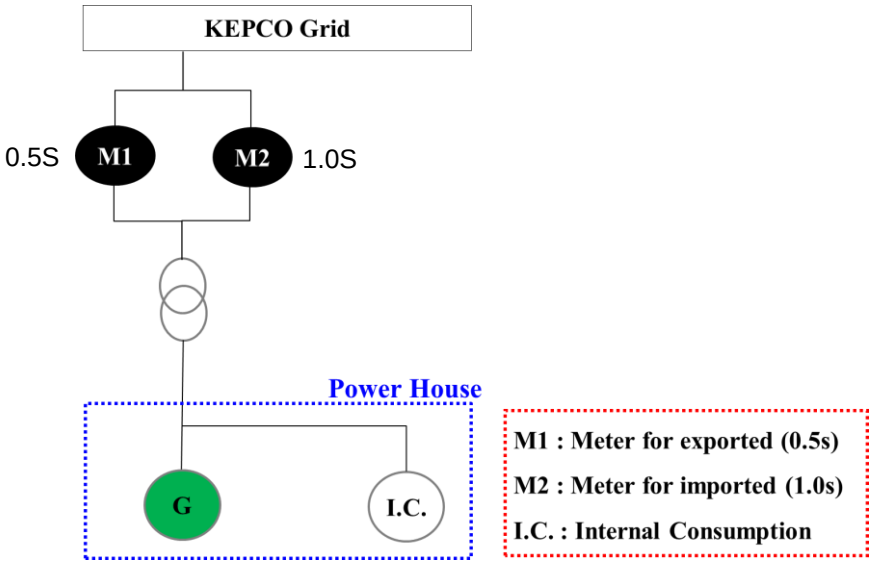
As shown in the figure, each Part of Operation & Management will observe monitoring system's operation and transmission of overall data to the Central Nakdonggang Weir Office. And Central Nakdonggang Weir Office will take the responsibility for electrical engineering work and safety management including repair and calibration of the watt-hour meter. And the New & Renewable Energy Department of Head office will monitor 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 Department, Regional Headquarters and Team may be altered in accordance with a reorganization plan 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 ($\mathbf{EG_{export,y} - EG_{import,y}}$)

3. Installation of meters

In Nakdan, Gumi, Chilgok, GangjungGoryeong 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 as shown in Figure B.6. 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 B.6> A single-line diagram for each power plant

4. Data recording

Electricity exported to the grid
The data will be continuously measured by the watt-hour meter and monthly recorded by the person in charge of CDM in New & Renewable Energy Department. And also, the data of electricity exported to KEPCO grid are hourly transferred to KPX and daily transferred to 'Power Generation Total Information System' of K-water from KPX.

Electricity imported from the grid
The data will be continuously measured by the watt-hour meter and monthly recorded by the person in charge of CDM in New & Renewable Energy Department. And also, the data of electricity imported from KEPCO grid are monthly checked by receipt of KEPCO.

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 will be 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 abnormity

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 accordingly.

B.8. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

>>
Date of completion of the methodology application: The application of the baseline study and monitoring methodology of the project was completed on 01/08/2011.

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 C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>
The starting date of activity is the date signed on the contract of turnkey-base project for each of hydropower plants.

- Nakdan hydropower plant: 27/10/2009
- Gumi hydropower plant: 27/10/2009
- Chilgok hydropower plant: 27/10/2009
- GangjeongGoryeong hydropower plant: 23/10/2009

C.1.2. Expected operational lifetime of project activity

>>
The expected operational lifetime of the project activity is 30 years.

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>
Fixed crediting period

C.2.2. Start date of crediting period

>>
01/12/2012 or the registration date whichever is later.

C.2.3. Length of crediting period

>>
10 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
In compliance with Article 3 of enforcement decree of "Environmental Impact Assessment Act" and its annex 3, Korean government has carried out the Environmental Impact Assessment (hereinafter referred to as EIA) of the river restoration project including the hydropower project. The river restoration project initiated by Korean government is mainly composed of the river conservation work and the weir construction. On the other hand, the hydropower project was initiated voluntarily, attendantly by K-water due to the weir construction.

EIA covers the various environmental impacts in the field of air, water, ocean, land, natural ecology, life and social economy due to the river restoration project. In this connection, the proper actions and systematic plans to minimize the impacts on environment have been progressed clearly in addition to holding a public hearing and a presentation for local stakeholders to collect comments while performing EIA. As a result of EIA, There were no adverse environmental impacts due to the hydropower project.

The procedural performance of EIA was approved by the Ministry of Environment and legally proved to be available.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

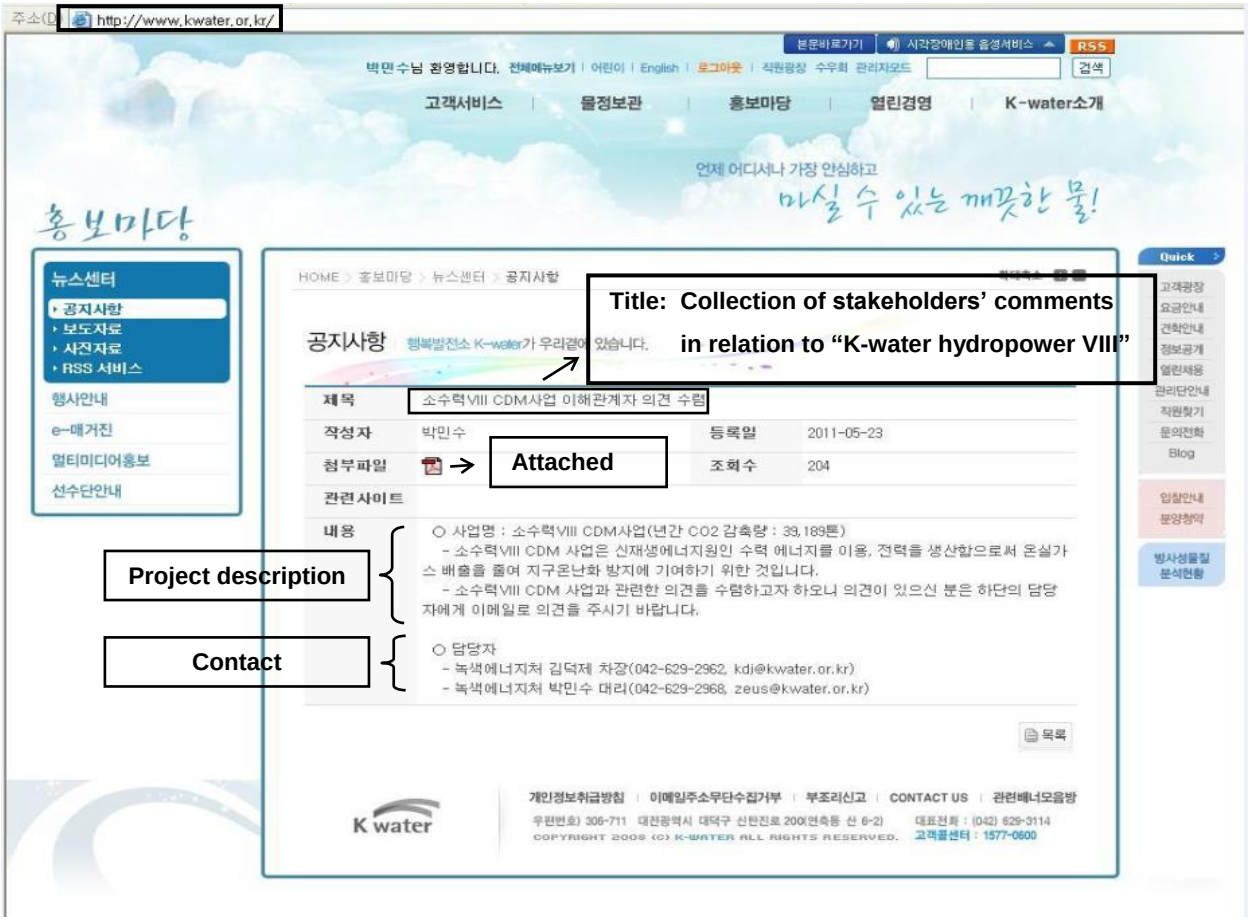
>>

A presentation and a public hearing have been conducted to collect local stakeholder's comments with regard to the social and environmental impacts on local community due to implementation of the river restoration project including a hydropower project. The proposed contents are mainly composed of introduction of the river restoration project and the specifications of facilities.

A presentation	A public hearing
Date : 14 Aug 2009 (Gumi-si) 14 Aug 2009 (Dalseong-gun) 14 Aug 2009 (Andong-si)	Date : 10 Sep 2009 (Gumi-si)
	

In addtion, K-water publicly announced the proposed CDM project activity on the website (http://www.kwater.or.kr/) to collect comments and requests from stakeholders from 23 May 2011 to 19 Jun 2011 shown as below.

The stakeholders are able to obtain the business information about other projects in progress as well as this proposed CDM project through K-water's website.



<Figure E.1> Notice on the website (http://www.kwater.or.kr) for inviting public comments

The introduction document indicating the purpose, summary, plan of this proposed CDM project was placed publicly on the website when inviting the stakeholder's comments. So, anyone who is interested in this project could identify and contact the person in charge.

E.2. Summary of comments received

>>

With regard to a presentation and a public hearing for the EIA of the river restoration project, there were no comments received for the proposed project. And no comment was raised during the period of the public announcement of the proposed CDM project.

E.3. Report on consideration of comments received

>>

Not applicable.

SECTION F. Approval and authorization

>>

In the proposed project, K-water is the project participant and parties involved are Republic of Korea and Switzerland. Project participant has already obtained the letter of approval from the DNA of Republic of Korea(20/07/2012) and Switzerland(23/05/2014).

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

Project participant and/or responsible person/ entity	☒ Project participant ☒ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Korea Water Resources Corporation (K-water)
Street/P.O. Box	200, Sintanjin-Ro, Daedeok-Gu
Building	K-water
City	Daejeon City
State/Region	
Postcode	34350
Country	Republic of Korea
Telephone	+82-42-629-3114
Fax	+82-42-629-2999
E-mail	kdj@kwater.or.kr
Website	http://english.kwater.or.kr
Contact person	Kim, Deog-je
Title	Principal Specialist
Salutation	Mr.
Last name	Kim
Middle name	
First name	Deog-je
Department	New & Renewable Energy Department.
Mobile	
Direct fax	+82-42-629-2999
Direct tel.	+82-42-629-2988
Personal e-mail	kdj@kwater.or.kr

Appendix 2. Affirmation regarding public funding

There is no public funding for this CDM project. Please refer to section. A.5.

Appendix 3. Applicability of methodology and standardized baseline

Please refer to the section “B.2. Project activity eligibility”.

Appendix 4. Further background information on ex ante calculation of emission reductions

Please refer to attached excel file.

Appendix 5. Further background information on monitoring plan

Please refer to section “B.7. Monitoring plan”.

Appendix 6. Summary of post registration changes

- Project participant revised the monitoring plan of the PDD to reflect the actual condition of operation of the measuring equipment and the collecting and recording of electricity data.

- Project participant revised the PDD with respect to the monitoring management structure according to the company reorganization.

- - - - -

Document information

Version	*Date*	*Description*
08.0	22 July 2016	EB 90, Annex 2 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revisions to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Editorial improvement.
05.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the project design document form for small-scale CDM project activities (these instructions supersede the "Guidelines for completing the project design document form for small-scale CDM project activities" (Version 01.1)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from *F-CDM-SSC-PDD* to *CDM-SSC-PDD-FORM*; • Editorial improvement.
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	13 March 2012	EB 66, Annex 9 Revision required to ensure consistency with the “Guidelines for completing the project design document form for small-scale CDM project activities”
03.0	15 December 2006	EB 28, Annex 34 • The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

Version	*Date*	*Description*
02.0	08 July 2005	EB 20, Annex 14 • The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
01.0	21 January 2003	EB 07, Annex 05 Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project design document, SSC project activities