Project design document form for CDM project activities

(Version 08.0)

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

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	Korea Midland Power Co., LTD. (KOMIPO) Boryeong small hydroelectric power plant project
Version number of the PDD	2.0
Completion date of the PDD	30/08/2016
Project participant(s)	Korea Midland Power Co., LTD. (KOMIPO)
Host Party	Republic of Korea
Applied methodology(ies) and, where applicable, applied standardized baseline(s)	AMS I.D - Grid connected renewable electricity generation (ver. 13)
Sectoral scope(s) linked to the applied methodology(ies)	Scope 1 : Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions	13,715 tCO2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>>

The KOMIPO Boryeong small hydroelectric power project is located in OCheon-Myon Boryeong city chungcheongnam-do. The purpose of this project is to make clean energy and maximize the energy efficiency using cooling water from the thermal power generation. The annual production which is generated from six small hydroelectric turbines (each capacity 1.25MW-occupancy rates 86%) annual generation will be 24,950 MWh/year and 13,715 tons/year of CO_2e will be abated. The sea water is used as cooling water in the thermal power plant. The used cooling water returns to the sea and the head which makes electric power is made in this stage. This project activity contributes to make socio-economical benefits in the local and national level as well as generates the electric power. Additionally, the emission of the greenhouse gas emissions would be reduced and amount of fossil fuel import in Korea would be decreased by this project.

According to energy statistics1, the 96% of using energy is imported. Obviously that Korea has a weakness to supply energy stably. Moreover electric generations in Korea rely on fossil fuels more than 50%. It attributes to emit a plenty of Green House Gases (GHGs). That's why Korea ranked as 10th country which generates CO_2 emissions among other country. Nevertheless, until recently there has been just a little effort to mitigate GHGs.

The Korea Midland Power Co. Ltd (KOMIPO) is the owner and developer of the boryeong small hydroelectric power project. By using a new and renewable local source of energy, the project will contribute to the reduction of GHG emissions, and it will decrease the dependence on fossil fuel which is mainly imported. Also it may help to create number of new jobs through this project directly or indirectly. The boryeong small hydroelectric power project will contribute to sustainable development through the following ways:

- Reducing consumption and amount of fossil fuel import
- Slow down the depletion of natural recources
- Making benefit as sustainable alternative energy in the national level
- No emissions such as air pollutants and wastes as well as greenhouse gas
- Diversification of the national energy supply
- Promote national policy on renewable energy

A.2. Location of project activity

A.2.1. Host Party

>>

Republic of Korea

A.2.2. Region/State/Province etc.

>>

Chungcheongnam-do

A.2.3. City/Town/Community etc.

>>

212 OPo-Li OCheon-Myon Boryeong City

A.2.4. Physical/Geographical location

>>

Figure 1. the location drawing for the boryeong small hydroelectric power project

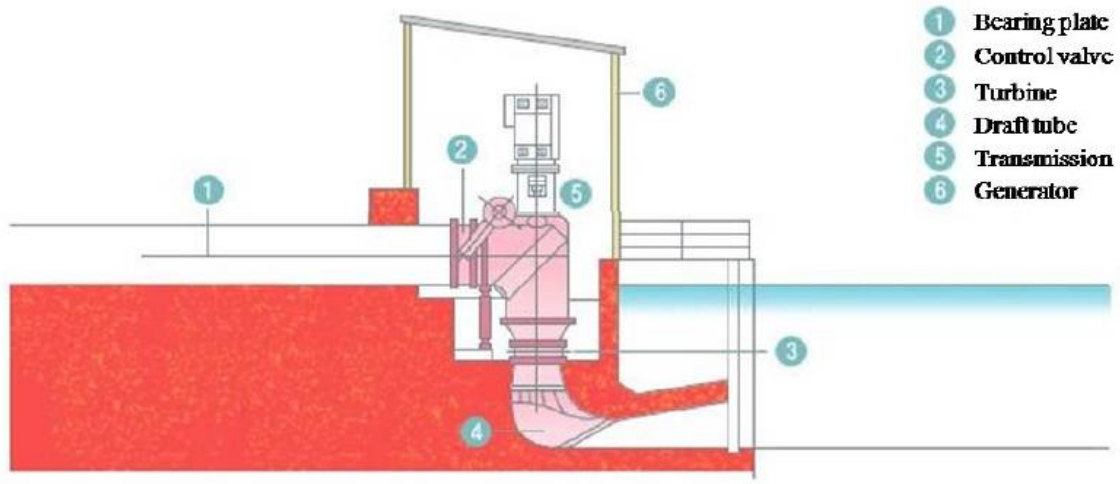
	latitude	longitude
1 small hydroelectric	126° 29' 23.7" N	36° 24' 2.09" E
2 small hydroelectric	126° 29' 28.28" N	36° 24' 21.04" E

A.3. Technologies and/or measures

>>

Boryeong small hydroelectric power project installed nominal capacity of 7.5MW small hydroelectric power which is below the 15MW limit for small scale CDM projects. It uses a renewable source of energy, such as small hydro electricity generation which can generate electricity. This is considered clean technology because there is

the greenhouse gas emissions and the air pollutants in the power generation process.



#1

Turbine	
Type	Kaplan-1.5
Output power	1,250kW
Flux	25m3/sec
Output efficiency	89.1%
Rotation	150rpm
Rated head	5.75m
Generator	
Type	Three-phase alternating current induction generator
Output power	1,250kW
Rated output voltage	3.3kV
Power factor	over 0.90
Frequency	60Hz
Generator efficiency	over 90%

#2

Turbine	
Type	Kaplan-1.5
Output power	1,250kW
Flux	25m3/sec
Output efficiency	85.5%
Rotation	150rpm
Rated head	5.75m

Generator	
Type	Three-phase alternating current induction generator
Output power	1,250kW
Rated output voltage	3.3kV
Power factor	over 0.90
Frequency	60Hz
Generator efficiency	over 95%

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)	**Private entity:** Korea Midland Power Co., LTD. (KOMIPO) – major project participant	**No**

A.5. Public funding of project activity

>>
This project has not received or has searched for any public funding. The funding of this project is completely ensured by KOMIPO.

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

B.1. Reference of methodology and standardized baseline

>>
Project category: AMS I.D - Grid connected renewable electricity generation (ver. 13)
Reference: Appendix B which is the simplified modalities and procedures for small scale CDM project activities

B.2. Applicability of methodology and standardized baseline

>>
According to AMS I.D (ver 13), "Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories", the category comprises renewable energy sources, such as photovoltaic, hydro, tidal/wave, wind, geothermal and biomass, that supply electricity to an electricity distribution system that is or would have been applied by at least one fossil fuel or nonrenewable biomass fired generating unit"
Boryeong small hydroelectric power project comprises hydroelectric renewable energy generation project with an installed capacity lower than 15MW (7.5MW) that will be connected to the national grid.
AMS I.D (ver 13) offers the following two choices to prepare the baseline calculation for the project, 'Renewable Electricity Generation for a Grid (category I.D.)' More information of calculation process is represented in section B.6.3 and specific data will be described in Annex 3.

B.3. Project boundary

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	Grid connected electricity generation	CO_2	Yes	Main emission source
		CH_4	No	Minor source
		N_2O	No	Minor source
Project scenario	small hydroelectric power	CO_2	No	Minor source
		CH_4	No	Minor source
		N_2O	No	Minor source

B.4. Establishment and description of baseline scenario

>>

The baseline to be used in calculating the emission reductions from this project is outlined in the relevant paragraphs of AMS I.D (ver 13). According to AMS I.D version13, the baseline of this project is the kWh produced by the small hydroelectric power plant multiplied by an emission coefficient (measured in kg CO_2e/kwh) calculated in a transparent and conservative manner. Combined margin (OM+BM) manner. This project baseline emissions are calculated like the below.

BEy = EGy * EFy

EGy = the amount of electricity generation
EFy = the project baseline emission factor

A grid connected emission coefficient (measured in kg CO_2e/kwh) is calculated conservatively in "tool to calculate the emission factor for an electricity system". This project baseline emission factor is calculated by the weighted average of the Operating margin emission factor and Build margin emission factor multiplied together. The details of baseline will be explained at Annex 3.

B.5. Demonstration of additionality

>>

Additionality

According to Attachment A to Annex B of the simplified modalities and procedures for CDM small-scale project activities, to prove additionality, of the project, the evidence to why the proposed project is additional should be offered under at least one of the following barrier categories (a) Investment barrier (b) Technological barrier (c) Prevailing practice (d) other barriers. This project will prove additionality with (a) Investment barrier.

The renewable energy projects requiree high capital investments but expectation of return is very low. Due to these reasons, renewable energy is not a very attractive option for power generation. The main reason is the renewable energy projects are unprofitable, because the average price of the system marginal price (SMP) is very low, which is 80.85 KRW/kWh. In 2002, the Korean government first established the law (Alternative Energy Development Promotion Act) to stimulate the renewable energy in Korea. But this law to promote renewable energy policy does not to be taken into account in developing a baseline scenario according to decision of 22nd CDM EB meeting (Annex 3 –Clarifications on the consideration of national and/or sectoral policies and circumstances in baseline scenarios, version 02).

In case of this project, we calculate Net Present Value (NPV) for this category considering the average

price of the system marginal price and expected annual generation.

	Without CERs	With CERs
NPV(KRW)	-7,065,276.255	-5,381,501.622

We calculated NPV with using expected benefits from electricity and CERs sales and costs from construction and operation for small hydroelectric power facility. As the above, NPV of this project is very poor. Like the above, NPV of the boryeong small hydroelectric power project is economically not attractive. The risk factors act as obstacles against investment in small hydroelectric power project.

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 or standardized baseline.

Specify the methodology or standardized baseline that establish automatic additionality for the proposed project activity (including the version number and the specific paragraph, if applicable).	N/A
Describe how the proposed project activity meets the criteria for automatic additionality in the relevant methodology or standardized baselines.	N/A

B.6. Emission reductions

B.6.1. Explanation of methodological choices

>>
This project is generating electricity by boryeong small hydroelectric power project and connecting to grid instead of using fossil fuel for abating greenhouse gas (GHG) emissions.
The category applicable to the methodology AMS I.D comprises the below.
1. This category comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass.
2. If the unit added has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15MW for a small-scale CDM project activity applies only to the renewable component. If the unit added co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15MW.
3. Combined heat and power (co-generation) systems are eligible.
4. 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 15MW and should be physically distinct from the existing units.
5. Project activities that seek to retrofit or modify an existing facility for renewable energy generation are included in this category. To qualify as a small scale project, the total output of the modified or retrofitted unit shall not exceed the limit of 15MW.
This project is satisfied with the above condition like the below.
1. This project is small hydroelectric power project. All capacity, 7.5MW including boryeong small hydroelectric power project are less than the applicable condition for small scale, which is 15MW.
2. The capacity of this project is 7.5MW. This project does not comprise any other fossil fuel.
3. This project is not Combined heat and power (co-generation) systems, but electricity generation facility.
4. This project is not the addition of renewable energy generation units, but it is the construction of new renewable energy generation.
5. This Project is not retrofit or modifies an existing facility for renewable energy generation.
This project is applicable to the methodology AMS I.D like the above.

B.6.2. Data and parameters fixed ex ante

Data / Parameter	**Total net electricity generation**
Unit	MWh
Description	electricity Generation data for all plants per year
Source of data	KEPCO, Statistics of Electric Power in 2004, 2005, 2006
Value(s) applied	-
Choice of data or Measurement methods and procedures	The amounts of total net electricity generation using in calculating emission factor is from numerical values of Statistics of Electric Power published by KEPCO in 2004, 2005, 2006.
Purpose of data	Calculation of baseline emission
Additional comment	

Data / Parameter	Fuel consumption data
Unit	ton or kℓ
Description	Fuel consumption data for all plants per year
Source of data	KEPCO, Statistics of Electric Power in 2004, 2005, 2006
Value(s) applied	-
Choice of data or Measurement methods and procedures	The amounts of Fuel consumption using in calculating emission factor is from numerical values of Statistics of Electric Power published by KEPCO in 2004, 2005, 2006.
Purpose of data	Calculation of baseline emission
Additional comment	

Data / Parameter	Caloric value of fuel
Unit	kcal/kg or kcal/ℓ
Description	Caloric value of fuel for all fuels
Source of data	KEPCO, Statistics of Electric Power in 2004, 2005, 2006
Value(s) applied	-
Choice of data or Measurement methods and procedures	The Caloric value of fuel using in calculating emission factor is from numerical values of Statistics of Electric Power in 2004, 2005, 2006 published by KEPCO.
Purpose of data	Calculation of baseline emission
Additional comment	

Data / Parameter	Carbon Emission Factors
Unit	$kgCO_2/TJ$
Description	Carbon Emission Factors for all fuels
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	-

Choice of data or Measurement methods and procedures	values of '2006 IPCC Guidelines for National Greenhouse Gas Inventories' Volume2 Table 2.2
Purpose of data	Calculation of baseline emission
Additional comment	

Data / Parameter	Carbon Oxidation Factors
Unit	%
Description	Carbon Oxidation Factors for all fuels
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	-
Choice of data or Measurement methods and procedures	The Carbon Oxidation Factors using in calculating emission factor is the values of '2006 IPCC Guidelines for National Greenhouse Gas Inventories' Volume2 Table 1.4
Purpose of data	Calculation of baseline emission
Additional comment	

B.6.3. Ex ante calculation of emission reductions

>>

This project is generating electricity by small hydroelectric power plant and connecting to grid instead of using fossil fuel for abating greenhouse gas (GHG) emissions. The amount of GHG emissions are calculated according to the methodology AMS I.D

Baseline emissions

Baseline emissions of this project are calculated by multiplying the amount of this project electricity generation by the electricity Carbon Emission Factor which is calculated through the methodology

$BE_{electricity,y} = EG_{,y} \times EF_{electricity,y}$

$BE_{electricity,y}$: the amount of Baseline emissions in year y (tCO_2)

EG_y : the amount of Total net electricity generation in year y (MWh)

$EF_{electricity,y}$: the Baseline Electricity CO_2 Emissions Factor in year y (tCO_2/MWh)

The Electricity Emissions Factor is calculated by KEPCO, Statistics of Electric Power in 2004, 2005, 2006. The detail about Baseline Electricity CO_2 Emissions Factor will be described in Annex 3

• The amount of total net electricity generation by small hydroelectric power project.

- Unit 1 - 6: 18,491MWh
- Unit 7 , 8: 6,459MWh

• Baseline emissions

Annual electricity generation * Emission Factor = 24,950MWh * 0.5497tCO_2/MWh = 13,715 tCO_2

Project emissions

Because of there is no emission through small hydroelectric power project activity, amount of the emission is 0.

Leakage

This is not applicable as the renewable energy technology used is not equipment transferred from another activity. There for, as per the Simplified Procedures for SSC Project Activities no leakage calculation is required. The amount of Leakage is 0.

Emission Reductions

• Baseline emissions – Project emissions – Leakage = 13,715 - 0 - 0 = 13,715 tCO_2

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

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
Year 1	13,715	0	0	13,715
Year 2	13,715	0	0	13,715
Year 3	13,715	0	0	13,715
Yea 4	13,715	0	0	13,715
Yea 5	13,715	0	0	13,715
Yea 6	13,715	0	0	13,715
Yea 7	13,715	0	0	13,715
Yea 8	13,715	0	0	13,715
Yea 9	13,715	0	0	13,715
Yea 10	13,715	0	0	13,715
Total	137,150	0	0	137,150
Total number of crediting years	10 years			
Annual average over the crediting period	13,715	0	0	13,715

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	Total net electricity generation
Unit	MWh
Description	Net electricity Generation by small hydroelectric power project
Source of data	KOMIPO
Value(s) applied	-
Measurement methods and procedures	Net electricity generation by KOMIPO boryeong small hydroelectric power Plant is measured automatically by established meter continuously
Monitoring frequency	continually
QA/QC procedures	Electricity meter belongs to KOMIPO. The meter was set up transparently in accordance with 'Law regarding measurement' and 'Act on operation of electricity market' and sealed after affirmation of KEPCO. Additionally, The meter will be calibrated according to KEPCO's procedure
Purpose of data	Calculation of baseline emission
Additional comment	

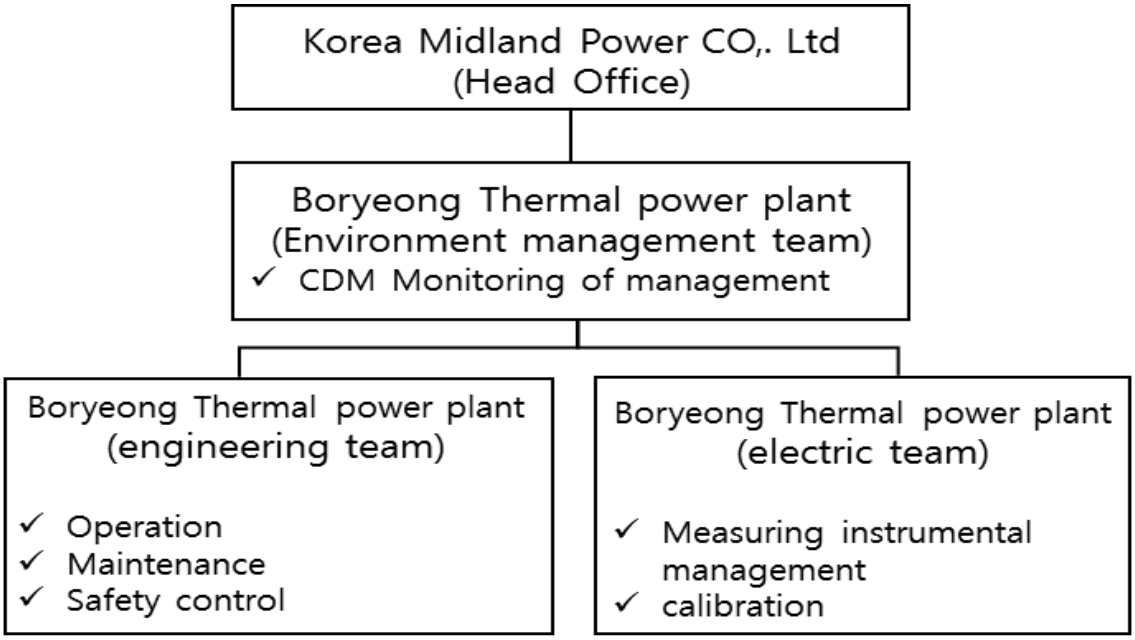
B.7.2. Sampling plan

>>
N/A

B.7.3. Other elements of monitoring plan

>>
KOMIPO have acquired ISO 14001 in 2004. Currently KOMIPO have established a systematic environmental management system.
KOMIPO Boryeong small hydroelectric power plant is prepared to adopt a new management system including various factors for project monitoring and quality control procedures. Therefore there will be no difficulties in performing monitoring and QA/QC procedures. Monitoring plans for this CDM project will be coordinated with environmental management system.

The management and operational structure for monitoring
The remote operating and monitoring system of the small hydroelectric power Plant makes possible to audit and measure the data by sending to the main computer in MCR (main control room) electric characteristics such as power generation, voltage, electric current and frequency of small hydroelectric power generation.
The managing and operating system for monitoring is like below.



Training
To maintain Boryeong small hydroelectric power plant KOMIPO has education programs which contain skill of repairing and operating small hydroelectric power plant system. The main purpose of the education is to acquire new design skills of small hydroelectric power plant for operating high quality plant. Also, generation operators are bred to skilled workers which can operate the system efficiently and prevent accidents through practical business and developing ability of affairs.

Data collection and storage
Data collection and storage method
The amount of electricity supplied to the grid is measured automatically by the meter. The measured electricity amount is collected and stored continuously also these are managed data as reports. The data is saved on PC which monitoring small hydroelectric power management system. Electricity is supplied to

the grid directly. The supplied amount is confirmed by KEPCO through the meter.

Data modification method
The collected data is compared with those of KEPCO. If the two data compared are different, the operational condition of electricity meters and other equipments will be cheeked and be certified by the final decision-maker and KEPCO.

Procedure for maintence of monitoring facility

· Established meter(Watt-hour meter for electricity exported to the grid) will receive calibration once every year from certified organization

· Established meter(Watt-hour meter for electricity imported from the grid)will receive calibration once in 7 years (The watt-hour meter for electricity imported from the grid is not within the control of project participants and calibration frequency of the watt-hour meter in national standard is once in 7 years.)

Procedure of emergency

KOMIPO establishes 『procedure for emergent management』 to rapidly cope with facility obstacles, fire, and spreading accidence of grid connection.

The correct procedure

KOMIPO establishes procedure of correction and prevention related to quality, environment, safety and management system for preventing inconsistence. The application is applied to generate facilities related to performance of management system, inconsistence related to process and activity, important problems and removing inconsistence.

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

>>
Date of completion of the application of the methodology : 18/08/2008
Responsible person / entity : Jaesik, Kim / Korea midland Power Co., Ltd.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>
01/02/2007

C.1.2. Expected operational lifetime of project activity

>>
30 years

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>
Fixed

C.2.2. Start date of crediting period

>>
01/08/2009

C.2.3. Length of crediting period

10 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
The Republic of Korea does not require an EIA (Environmental Impact Assessment) for boryeong small hydroelectric power project whose facility is 7.5. This project has obtained permission by the Ministry of Commerce, Industry and Energy. According to the Act on Assessment of Impacts of Works on Environment, Traffic, Disasters, etc., the Republic of Korea does not require an EIA (Environmental Impact Assessment) for the project activity. In addition, because this project does not emit any air pollutants and GHGs unlike other fossil fuel power generations, this project is sure to be the project which helps to improve its environment.
The 1 hydroelectric power projects did not undertake the EIA. However, in the case of 2 hydroelectric power, the EIA was performed in addition to the introduction of the new facility.EIA results contain new equipments of the project do not emit any pollutants and do not transform any matters into pollutants

D.2. Environmental impact assessment

>>
No significant negative environmental impact is expected from this project activity.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>
The stakeholders of this project are the government, local resident, workers and so on. The KOMIPO informs about the CDM and collects opinions of the stakeholder through the KOMIPO website on September (2007). Additionally, the KOMIPO received opinions from the authorities from Chuncheongnam-do and Boryeong City who are related with this project. Besides, the KOMIPO received opionions during the process of getting a pemmission for hydroelectric power from Chungcheongnam-do city.

Figure 3. Provision space for stakeholder comment collection on KOMIPO website

E.2. Summary of comments received

>>

The stakeholders give some questions about the CDM, the estimation of the reduction of the GHG and the environmental impact of this project. The KOMIPO gives answers for every question. The opinions of the stakeholders are also about the environmental impact of this project. The comments received from KOMIPO websites are questions about CDM business such as effects on ocean & surrounding environment and how to calculate CO_2 reduction. To sum up the comments from related department of Chuncheong-do they recommend the compliances of the land development plan, regulation on its usage & regulation on ocean & marine.

E.3. Report on consideration of comments received

>>

The opinions of the stakeholders are positive because they agree that clean technology is applied for the hydropower to reduce the GHG and the air pollutants and contribute the sustainability. The KOMIPO promised that they will treat the waste if there is dismantle waste and the compliance related regulation commented by the Chungcheongnam-do and Boryeong City.

SECTION F. Approval and authorization

>>

No. 2008 - 9

Approval of CDM Project

Korea Midland Power Co., LTD.
Chief Executive Officer (Mr. Jang-Sup Chung)
167 Samseong-dong, Gangnam-gu, Seoul, Korea

In respect of **"Korea Midland Power Co., LTD. (KOMIPO) Boryeong Small Hydroelectric Power Plant Project"**, in which the above-mentioned entity participates, the Government of the Republic of Korea hereby confirms the followings in accordance with the approval decision of the CDM review committee;

i) The Government of Republic of Korea has ratified the Kyoto Protocol in November 2002.

ii) This is approval of voluntary participation in the proposed CDM project activity.

iii) This project contributes to Sustainable Development in Korea.

June 20, 2008

Ministry of Knowledge Economy	Ministry of Land, Transport and Maritime Affairs
Lee, Youn - Ho	Chung, Jong - Hwan

THE REPUBLIC OF KOREA

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 Midland Power Co., Ltd
Street/P.O. Box	160, Boryeongbuk-ro
Building	
City	Boryeong-si
State/Region	Chungcheongnam-do
Postcode	
Country	Republic of Korea
Telephone	+82
Fax	
E-mail	wotlr@komipo.co.kr
Website	https://www.komipo.co.kr/main/main.asp
Contact person	
Title	
Salutation	
Last name	Kim
Middle name	
First name	Jaesik
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Appendix 2. Affirmation regarding public funding

This project will not receive any public funding

Appendix 3. Applicability of methodology and standardized baseline

Mentioned in the concerned section of the PDD

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

BASELINE INFORMATION

According to "tool to calculate the emission factor for an electricity system", operational margin and build margin can be calculated as below:

The baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2equ/kWh) calculated in a transparent and conservative manner as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in "tool to calculate the emission factor for an electricity system". Any of the four procedures to calculate the operating margin can be chosen, but the restrictions to use the Simple OM and the Average OM calculations must be considered.

1. Operational Margin emission factor

According to "tool to calculate the emission factor for an electricity system", dispatch data analysis should be the first methodological choice for OM emission factor. But, in Korea, dispatch data of the grid is not available. Thus this dispatch data analysis is not selected as a emission factor. Here, Simple OM method is selected for calculating emission factor. As indicated in "tool to calculate the emission factor for an electricity system", the Simple OM method can only be used where low-cost/must run resources5 constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term normal for hydroelectricity production.

The ratio must run/low cost resources constitute of total grid

	2002	2003	2004	2005	2006
Total net generation(MWh)	292,746,000	308,225,887	326,879,672	348,187,780	365,368,969
Net generation of must run/low cost resources	124,379,580	136,622,857	135,253,646	149,934,596	153,236,680
Anthracite generation(MWh)	5,991,495	6,236,623	5,130,890	5,117,963	5,466,561
Hydro generation(MWh)	5,266,907	6,830,016	5,802,167	5,135,032	5,144,992
Nuclear generation(MWh)	113,070,088	123,280,502	123,970,409	139,286,513	142,114,439
Renewable energy generation (MWh)	51,090	275,716	350,180	395,088	510,689
The ratio must run/low cost resources constitute of total grid(%)	42.49%	44.33%	41.38%	43.06%	41.94%

As above, in average of the five most recent years, low-cost/must run resources constitute less than 50% of total grid generation in Korea. Thus Simple OM is appropriate method for OM emission factor.

2. Build Margin emission factor

According to "tool to calculate the emission factor for an electricity system", Build Margin emission factor $EF_{BM,y}$ can be calculated ex-ante based on the most recent information available on plants already built for sample group m at the time of PDD submission. The sample group m consists of either the five power plants that have been built most recently, or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation.

	The power plant capacity additions in the electricity system that comprise 20% of the system generation	Capacity of five power plants that have been built most recently
Net generation(MWh)	74,056,854	22,522

In calculating the BM, emission factor of the power plant capacity additions in the electricity system that comprise 20% of the system generation is selected because the power plant capacity additions in the electricity system that comprise 20% of the system generation is larger than plant capacity five power plants that have been built most recently.

Key Parameter and data sources

No.	Key parameter	Data Source
1	Generation data for all plants for the year 2004-2006	KEPCO 2005, Statistics of Electric Power in 2004 KEPCO 2006, Statistics of Electric Power in 2005 KEPCO 2007, Statistics of Electric Power in 2006
2	fuel consumption data	KEPCO 2005, Statistics of Electric Power in 2004 KEPCO 2006, Statistics of Electric Power in 2005 KEPCO 2007, Statistics of Electric Power in 2006
3	Calorific value of fuel	KEPCO 2005, Statistics of Electric Power in 2004 KEPCO 2006, Statistics of Electric Power in 2005 KEPCO 2007, Statistics of Electric Power in 2006
4	Oxidation Factors	IPCC, Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories
5	Generation facility of Korea	KPX 2007, Statistics of Electricity Generation facility.

The below are results from calculation OM and BM using the statistics.

Operation Margin 2004

No	Plants	Type	Net generation	Coal Consumption	Heavy oil Consumption	Diesel oil consumption	LNG consumption	Coal caloric value	Heavy oil caloric value	diesel oil caloric value	LNG caloric value	CO_2 Emission	Emission factor
			MWh	ton	kilo liter	kilo liter	ton	Kcal/kg	kcal/l	Kcal/l	kcal/kg	tCO_2	tCO_2/MWh
1	Honam #1	bituminous	1,855,554	885,758	606	300	0	5,218	9,323	8,406	0	1,832,763	0.9877
2	Honam #2	bituminous	1,625,399	783,300	1,714	335	0	5,159	9,326	8,408	0	1,605,942	0.9880
3	Samchonpo #1	bituminous	3,974,202	1,624,500	0	1,674	0	5,251	0	8,561	0	3,381,758	0.8509
4	Samchonpo #2	bituminous	3,839,080	1,564,986	0	744	0	5,961	0	8,560	0	3,695,885	0.9627
5	Samchonpo #3	bituminous	3,652,769	1,467,177	0	814	0	6,204	0	8,556	0	3,605,936	0.9872
6	Samchonpo #4	bituminous	3,811,371	1,538,768	0	785	0	6,182	0	8,554	0	3,768,392	0.9887
7	Samchonpo #5	bituminous	4,147,957	1,707,777	0	230	0	4,588	0	8,550	0	3,102,672	0.7480
8	Samchonpo #6	bituminous	4,185,213	1,734,977	0	652	0	4,534	0	8,550	0	3,116,651	0.7447
9	youngheung #1	bituminous	2,986,382	1,114,254	0	27,916	0	5,597	0	8,481	0	2,542,926	0.8515
10	youngheung #2	bituminous	1,172,450	459,217	0	18,314	0	5,559	0	8,284	0	1,057,898	0.9023
11	Boryeong #1	bituminous	4,014,109	1,599,557	0	311	0	5,628	0	8,332	0	3,565,125	0.8881
12	Boryeong #2	bituminous	3,915,285	1,555,055	0	616	0	5,626	0	8,465	0	3,465,604	0.8851
13	Boryeong #3	bituminous	3,746,265	1,427,263	0	574	0	5,646	0	8,312	0	3,192,076	0.8521
14	Boryeong #4	bituminous	4,097,489	1,560,014	0	179	0	5,648	0	8,312	0	3,488,991	0.8515
15	Boryeong #5	bituminous	3,660,240	1,397,343	0	422	0	5,634	0	8,312	0	3,118,491	0.8520
16	Boryeong #6	bituminous	4,093,207	1,559,785	0	350	0	5,640	0	8,312	0	3,484,226	0.8512
17	Taean #1	bituminous	3,780,097	1,438,094	0	999	0	5,681	0	8,327	0	3,237,403	0.8564
18	Taean #2	bituminous	3,975,123	1,509,379	0	310	0	5,678	0	8,264	0	3,394,262	0.8539
19	Taean #3	bituminous	3,732,363	1,415,585	0	390	0	5,676	0	8,554	0	3,182,564	0.8527
20	Taean #4	bituminous	4,048,258	1,539,502	0	254	0	5,669	0	8,285	0	3,456,053	0.8537
21	Taean #5	bituminous	4,091,406	1,547,217	0	329	0	5,696	0	8,466	0	3,490,458	0.8531
22	Taean #6	bituminous	4,056,835	1,531,751	0	230	0	5,696	0	8,364	0	3,455,309	0.8517
23	Hadong #1	bituminous	3,688,313	1,389,739	0	533	0	5,730	0	8,552	0	3,154,651	0.8553
24	Hadong #2	bituminous	4,028,529	1,515,681	0	145	0	5,724	0	8,526	0	3,435,385	0.8528
25	Hadong #3	bituminous	3,997,064	1,501,027	0	670	0	5,744	0	8,534	0	3,415,421	0.8545
26	Hadong #4	bituminous	3,724,757	1,397,482	0	737	0	5,792	0	8,543	0	3,206,927	0.8610
27	Hadong #5	bituminous	4,013,845	1,501,672	0	318	0	5,683	0	8,534	0	3,379,806	0.8420
28	Hadong #6	bituminous	3,685,698	1,379,396	0	689	0	5,638	0	8,534	0	3,081,264	0.8360
29	Dangjin #1	bituminous	3,986,406	1,502,885	0	294	0	5,710	0	8,436	0	3,398,857	0.8526

30	Dangjin #2	bituminous	4,038,457	1,523,605	0	211	0	5,700	0	8,445	0	3,439,185	0.8516
31	Dangjin #3	bituminous	3,711,787	1,404,465	0	605	0	5,677	0	8,452	0	3,158,651	0.8510
32	Dangjin #4	bituminous	3,801,495	1,434,844	0	528	0	5,668	0	8,453	0	3,221,341	0.8474
33	Ulsan #1	heavy oil	271,544	0	73,408	114	0	0	9,398	8,560	0	223,806	0.8242
34	Ulsan #2	heavy oil	244,246	0	65,316	82	0	0	9,406	8,560	0	199,244	0.8158
35	Ulsan #3	heavy oil	268,231	0	71,305	554	0	0	9,401	8,560	0	218,637	0.8151
36	Ulsan #4	heavy oil	1,759,376	0	420,739	1,238	0	0	9,473	8,664	0	1,294,567	0.7358
37	Ulsan #5	heavy oil	2,141,162	0	513,497	931	0	0	9,465	8,664	0	1,576,992	0.7365
38	Ulsan #6	heavy oil	2,196,344	0	527,083	1,603	0	0	9,461	8,664	0	1,619,806	0.7375
39	Youngnam #1	heavy oil	973,872	0	347,107	837	0	0	7,060	8,422	0	796,114	0.8175
40	Youngnam #2	heavy oil	665,973	0	248,049	274	0	0	7,295	8,432	0	586,928	0.8813
41	Yosu #1	heavy oil	723,968	0	181,712	571	0	0	9,510	8,478	0	561,353	0.7754
42	Yosu #2	heavy oil	1,304,109	0	316,523	436	0	0	9,509	8,508	0	976,158	0.7485
43	Pyongtaek #1	heavy oil	850,533	0	204,664	247	2,095	0	9,383	8,471	11,628	628,495	0.7389
44	Pyongtaek #2	heavy oil	880,646	0	209,664	232	2,515	0	9,385	8,494	11,616	644,925	0.7323
45	Pyongtaek #3	heavy oil	751,633	0	179,921	240	3,791	0	9,407	8,462	11,619	559,271	0.7441
46	Pyongtaek #4	heavy oil	800,854	0	192,294	225	3,217	0	9,408	8,469	11,660	595,462	0.7435
47	Namjeju #1	heavy oil	50,294	0	16,510	6	0	0	9,405	8,866	0	50,320	1.0005
48	Namjeju #2	heavy oil	48,714	0	16,040	13	0	0	9,406	8,404	0	48,910	1.0040
49	Jeju #1	heavy oil	44,659	0	15,306	7	0	0	9,402	8,513	0	46,639	1.0443
50	Jeju #2	heavy oil	486,401	0	118,473	73	0	0	9,416	8,489	0	361,596	0.7434
51	Jeju #3	heavy oil	509,330	0	124,160	41	0	0	9,423	8,482	0	379,127	0.7444
52	Seoul #4	LNG	90,322	0	0	1	22,409	0	0	8,617	11,710	61,618	0.6822
53	Seoul #5	LNG	480,919	0	0	3	117,908	0	0	8,617	11,713	324,278	0.6743
54	Incheon #1	LNG	47,491	0	0	0	10,523	0	0	0	11,734	28,994	0.6105
55	Incheon #2	LNG	49,144	0	0	0	11,094	0	0	0	11,735	30,569	0.6220
56	Incheon #3	LNG	19,018	0	0	149	4,235	0	0	8,503	11,734	12,062	0.6342
57	Namjeju D/P	Interanal Combusion	274,089	0	57,808	80	0	0	9,406	8,424	0	176,357	0.6434
58	Jeju G/T	Interanal Combusion	3,016	0	0	2,232	0	0	0	8,501	0	5,884	1.9511
59	Pyongtaek C/C	combined cycle	596,001	0	0	21	98,846	0	0	8,320	11,730	272,297	0.4569
60	Ilsan C/C	combined cycle	3,281,407	0	0	0	593,548	0	0	0	11,715	1,632,749	0.4976
61	Bundang C/C	combined cycle	3,650,122	0	0	0	653,880	0	0	0	11,723	1,799,956	0.4931
62	Ulsan C/C	combined cycle	2,329,524	0	0	0	347,076	0	0	0	11,628	947,632	0.4068
63	Seoincheon C/C	combined cycle	8,353,619	0	0	88	1,209,806	0	0	8,750	11,709	3,326,419	0.3982
64	Shinincheon C/C	combined cycle	11,596,955	0	0	0	1,587,638	0	0	0	11,715	4,367,321	0.3766

Appendix 5. Further background information on monitoring plan

Please refer to section B.7

Appendix 6. Summary of post registration changes

Monitoring plan

- ✓ Imported meter of calibration periodic was revised to 7years according to national standards (1year->7years)

Correction

- ✓ Specification of turbine and generator were incorrectly stated in Boryeong site. Therefore actual installed specification is reflected in the PDD
- ✓ Revision of the management and operation structure for monitoring