CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• 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>.
03	22 December 2006	• 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.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

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Title: Ryesonggang Hydropower Plant No.4, DPR Korea

Version: 1.0

Date: 13/12/2010

A.2. Description of the small-scale project activity:

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The Ryesonggang Hydropower Plant No.4, DPR Korea (hereinafter referred to as the project) is a reservoir type power plant, which was proposed by Kumchon Electric Power Company (KEPC) and will be built newly in Kumchon County, North Hwanghae Province.

The purpose of this project activity is to generate electricity using water resources of the Ryesong River and supply the same to the Western Power Grid (WPG), DPR Korea which has several thermal power plants emitting a large amount of CO_2 by firing fossil fuels.

The project consists of a dam, powerhouse and outdoor substation. The reservoir is a daily regulating reservoir and the annual operation time is 4 003 h. The installed capacity of the project is 10 MW, which consists of 4 sets of generating facilities with a capacity of 2.5 MW each. The project will generate the electricity energy of 42 031.5 MWh and supply 40 030 MWh to the WPG in a year. The electricity generated at 6.6 kV would be stepped up at the outdoor substation and be transmitted to 66 kV Namchon substation, which is connected to the WPG and located at a distance of 10 km from the dam /1/. The total GHG emission reductions are estimated to be 26 639 tCO_2e annually.

The project is expected to be put into operation on 13 April 2012 and replace part of thermal power in WPG with clean and renewable hydro power.

Electricity generation from water resources in rivers and streams is in compliance with the energy development strategy of DPR Korea /10, 11, 12, 13/.

The project contributes to the sustainable development of the local society and the host country, in the following aspects:

- Reducing the fossil fuel consumption, promoting the use of renewable energy and the diversification of the energy structure in DPR Korea compared to a business-as-usual scenario.
- Reducing the emission of the other pollutants resulting from the power generation industry in DPR Korea, compared to a business-as-usual scenario.
- Alleviating the power shortage in local areas, stimulating local economic development.
- Preventing the deforestation of hills, loss of fauna and flora from extensive exploitation for cooking and heating and land loss from seasonal floods.
- Creating several hundreds of local employment opportunities during the construction period and several tens of local employment opportunities during the operation period.

In conclusion, the project activity strongly contributes to the sustainable development in DPR Korea.

A.3. Project participants:

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Name of Party involved (*) ((host) indicates a host party)	Private and/or public entity (ies) Project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Democratic People's Republic of Korea (host)	Kumchon Electric Power Company	No
Czech Republic	Topič Energo s.r.o.	No

Detailed contact information for project participants is available in Annex 1.

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

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A.4.1.1. Host Party (ies):

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Democratic People's Republic of Korea

A.4.1.2. Region/State/Province etc.:

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North Hwanghae Province

A.4.1.3. City/Town/Community etc:

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Kumchon County/Paekyang-ri

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity:

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The project is located at Ryesong River which runs through Kumchon county. The geographical coordinates of the project site are 126°31′42″ longitude E and 38°18′02″ latitude N. The dam is located in Paekyang-ri, which is approximately 148 km south eastward from Sariwon City, North Hwanghae Province and 208 km from the centre of Pyongyang, DPR Korea. The project site can be accessed through Pyongyang-Gaesong expressway. The nearest railway station is the Kumchon Railway Station. To visualize the exact location of the project, refer to the map in Figure 1 and Figure 2.

Figure 1. The map showing the location of Kumchon county

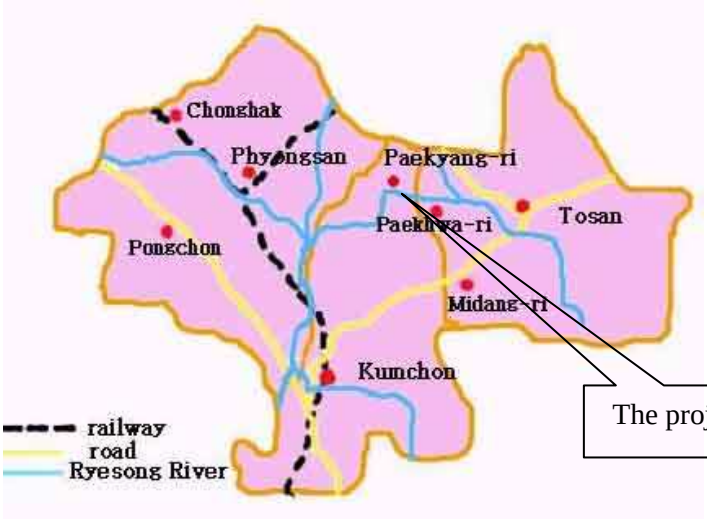

Figure 2. The map showing the location of project

A.4.2. Type and category (ies) and technology/measure of the small-scale project activity:

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1. Type and category (ies) of the small-scale project activity

According to Appendix B to *Simplified Modalities and Procedures for Small-scale CDM Project Activities*, the type and category of the project are defined as follows:

Type I: Renewable energy projects

Category I.D.: Renewable Energy Generation for a Grid

Sub-category: Hydro

Reference: AMS-I.D. version 16, EB 54

The project activity utilizes renewable hydro energy for electricity generation and exports the generated electricity to the regional grid system. Accordingly, the applicable methodology for the project activity shall be AMS-I.D. which includes small hydro electric power generation for a grid.

2. Application of environmentally safe and sound technology

The project activity does not involve any greenhouse gas emissions or burning of any fossil fuels during the process of power generation. The technology employed for the project activity is the current best available practice in small hydro power sector in DPR Korea. Hence, the technology applied for the project activity is environmentally safe and sound.

3. Technologies applied on the small-scale project activity /1/

The project is to build a reservoir type power plant with a total installed capacity of 10 MW (2.5 MW×4) Based on the Feasibility Study, the main components of the project are described as follows:

- Rock filled-dam and concrete gravity dam which are maximally 14.4 m in height and, 443.65 m in length at the top.
- The powerhouse installed with four turbine-generator units (2.5 MW×4)
- An outdoor substation with a main transformer and one set of 66 kV transmission line connected to 66 kV Namchon substation.

The reservoir is a daily regulating type. The powerhouse is in the dam. The lengths of rocks filled-dam and concrete dam are 151 m and 292.65 m, respectively. The distance from the outdoor substation to Namchon substation is 10 km.

Table 1. Main parameters of the main equipment

Item	Unit	Values
Turbines		
Type		370-vertical 275
Quantity	set	4
Diameter	m	2.75
Rated speed	rpm	150
Rated power	MW	2.72
Designed water head	m	8
Rated intake flow	m^3/s	39.6
Manufacturer		Daean Heavy Machine Complex
Generators		
Type		Synchronization-verticality-length 2.5 MW/48-6.6 kV
Quantity	set	4
Frequency	Hz	60
Rated power	MW	2.5
Manufacturer		Songchongang Ectricity Machine Factory

Figure 3. Generating scheme of the project

4. Technology transfer

The main equipment including turbines and generators are locally manufactured in the host country. The proposed project activity does not apply any technology transferred from outside the country. Daean Heavy Machine Complex and Songchongang Electricity Machine Factory will be responsible for producing the equipment /6, 7/. These companies are well known as one of the specially producing base of machines and electric equipment in DPR Korea.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

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The first crediting period of the project activity is 7 years, which is from 13 April 2012 to 12 April 2019. During the first crediting period, the estimated total emission reductions are calculated at 186 473 tCO_2e. The annual and total emission reductions are explained in the following table 2:

Table 2. Estimation of emission reductions during crediting period

Years	Annual estimation of emission reductions in (tCO2e)
13/04/2012-31/12/2012	18 269
2013	26 639
2014	26 639
2015	26 639
2016	26 639
2017	26 639
2018	26 639
01/01/2019-12/04/2019	8 370
Total estimated reductions (tonnes of CO_2e)	**186 473**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**26 639**

A.4.4. Public funding of the small-scale project activity:

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No public funding from parties included in Annex I of UNFCCC is available to the project activity.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

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According to the Appendix C of *Simplified Modalities and Procedures for Small-scale CDM Pproject Aactivities*, the project is not a debundled component of a larger project activity because there is no registered small-scale CDM project activity or an application to register another small-scale CDM activity:

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

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

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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 16, EB54) and "*Tool to calculate the emission factor for an electricity system* (version 02.1.0, EB 60)". For more information regarding the methodology, refer to the link:

http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html.

http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html.

B.2 Justification of the choice of the project category:

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The methodology "*AMS-I.D. Grid connected renewable electricity generation*" (version 16) is applicable to this small-scale CDM project activity because:

- The project activity is using hydropower, which is one of the several renewable energy projects that are eligible to use this methodology.
- The methodology applies to renewable energy generation units that supply electricity to an electricity grid, which is the case for Ryesonggang Hydropower Plant No.4.
- The capacity of the scheme is 10 MW, which is within the limit of 15 MW stipulated for the chosen (small-scale) methodology and this capacity will not change throughout the crediting period.
- The proposed project is not combined heat and power (co-generation) system.

Demonstration for being with in the limits of SSC throughout the crediting period

The feasibility study for this project demonstrates that the project and the project activity will remain under the limits of SSC throughout the crediting period. According to the study, the design discharge has been found out to be 176 m^3/s and gross head available estimated at 7.5 m /1/. Based on the head available and discharge, the optimum capacity of the power project has been determined as 10 MW. Keeping the above considerations in view, and also the maximum electricity generation capacity limited by the design of the plant and machinery and the license issued by the state authorities, there is no

possibility of exceeding the limits of small-scale CDM project activity throughout the crediting period.

B.3. Description of the project boundary:

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In accordance with AMS-I.D. the project boundary encompasses the physical, geographical site of the renewable generation source.

The project boundary is therefore the physical boundary, which includes the dam, outdoor substation, powerhouse and the transmission system till the evacuation point. The power generated from the project would be metered and accurately quantified. The electricity would be exported to WPG. Accordingly, WPG of DPR Korea is also included in the project boundary for the purpose of baseline calculations,

Table 3. The GHG source and type in project boundary

Source		Gas	Included/Excluded	Justification/ Explanation
Baseline	Electricity production in WPG	CO_2	Included	Main emission sources.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
Project Activity	gang Hydro Power Plant No.4	CO_2	Excluded	The project does not lead to CO_2 emission.
		CH_4	included	Main emission source
		N_2O	Excluded	The project does not lead to CO_2 emission.

B.4. Description of baseline and its development:

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The baseline of the project activity will be decided as per the methodology AMS-I.D. (Version 16, EB 54)

In accordance with AMS-I.D. if the project activity is the installation of a new grid-connected renewable power plant/unit, the baseline scenario is the electricity delivered to the grid by the project activity that otherwise would have been generated by the operation of grid-connected power plants and by the addition of new generation sources.

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

The emission factor can be calculated according to method 12(a) selected from the methodology AMS-I.D. (version 16, EB 54) 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. The boundary of the proposed project is WPG, so the boundary when calculating the OM emission factor and BM emission factor are set with in WPG.

In the absence of the project, electricity will be continued to be generated by the existing power plants in WPG.

The key parameters used to determine the baseline emissions are furnished below.

Table 4. Data used to determine baseline emissions

Parameter	Source
Amount of fossil fuel consumed	Central Bureau of Statistics
Net calorific value of fuel consumed	2006 IPCC Guidelines
Net electricity delivered to the grid by the project activity	Feasibility Study Report
Emission factor of fuel consumed	2006 IPCC Guidelines
Emission factor of WPG	Calculation based on the data from Central Bureau of Statistics

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

The project is a small scale project activity. As such, the provisions of Attachment A to Appendix B of S*implified Modalities and Procedures for Small-scale CDM Project Activities* will apply to the project. The '*indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories*' require the project proponents to show that the project activity would not have occurred anyway due to *at least* one of the following barriers:

(a) Investment barrier

(b) Technological barrier

(c) Barrier due to prevailing practices / common practice

(d) Other barriers

The barriers specified in Attachment A to Appendix B are:

a) Investment barrier: A financially more viable alternative to the project activity would have led to higher emissions.

b) Technological barrier: A less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions.

c) Barrier due to prevailing practice: Prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions.

d) Other barriers: Without the project activity, for another specific reason identified by the project participants, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

The main barrier existing in the project is investment barrier.

1. CDM consideration

KEPC is an enterprise that is engaged in the electricity generation and supply in Kumchon county. The company has already surveyed water resources of Ryesong River with the aim of generating electricity a few years ago. According to the survey, the hydropower plant to be built on the Ryesong River was not attractive for a local company in terms of finance. The "*Recommendation Letter of DNA*" (3 February 2009) and the commencement of the CDM project activity in South Hamgyong Province encouraged the company to seriously consider the additional input from CDM application. KEPC requested the feasibility study to the Central Electric Power Design Institute and it was completed on 9 May 2010. However, the Feasibility Study Report (FSR) revealed the project IRR was only 3.97%, well below the national

benchmark 5% /3/, which was not attractive in terms of economy. KEPC contacted the CDM development team (under the State Academy of Science (SAoS)) to visit the site and to study the possibility of applying CDM to the project. After the site visit by CDM experts, they were convinced that the project was eligible for a CDM and that additional revenue from CDM would boost the IRR up to 7.96%, which is higher than the national benchmark. With updated calculation of IRR at hand, the project owner contacted DNA and GBCIO (authorized CDM implementation body) to seriously apply the project as a CDM one. The Ministry of State Construction Control authorized the construction on condition of CDM application and local bank also agreed to give the loan on condition of CDM application. Therefore it is clear that the project owner has fully considered the revenues from CDM when making the decision to proceed with the project activity. Table 5 shows the main time schedule for the proposed project. For the implementation of the project, GBCIO, CDM experts from SAoS and environment experts visited the project site and estimated the CDM possibility of the project.

Table 5. The main time schedule for the proposed project

Milestones	Date
Feasibility Study Report	19/05/2010
Visit report by CDM developing team	06/07/2010
EIA report	10/06/2010
Meeting of the People's Committee of Kumchon County	20/07/2010
Approval of Ministry of State Construction Control	06/09/2010
PDD development contract	14/09/2010
Construction contract	21/10/2010
Loan contract	29/09/2010
Start of project construction	07/10/2010
Turbine purchase contract	12/10/2010
Generator purchase contract	21/10/2010
Electricity purchase contract	21/10/2010

2. Investment barrier

Investment barrier is the main barrier the project may face. Without the revenue from CDM, the project has no chance of implementation.

The purpose of this part is to determine whether the project is economically attractive or not through an appropriate analysis method.

(1) Determination of appropriate analysis method

Although it is not applicable for a small scale project activity, the "*Tool for the Demonstration and Assessment of Additionality* (version 05.2) stipulates that the project developer should identify the financial/ economic indicator, such as IRR, most suitable for the project type and decision context.

According to the "*Tool for the Demonstration and Assessment of Additionality* (version 05.2)", three options can be applied to conduct the investment analysis. They are: the simple cost analysis (Option I), the investment comparison analysis (Option II) and the benchmark analysis (Option III).

Since this project will generate financial/economic benefits other than CDM-related income, through the sale of generated electricity, Option I (Simple cost analysis) is not applicable.

The investment comparison analysis (Option II) is also not applicable for the proposed project because investment comparison analysis method is only applicable to projects whose alternatives are similar investment projects. Therefore Option II is not appropriate.

Then the benchmark analysis (Option III) should be used to identify whether the financial indicators, Financial Internal Return Rate (IRR) in this project are better than relevant benchmark value.

(2) Selection and Validation of Appropriate Benchmarks

EB 41, Annex 45, "*Guidance on the Assessment of Investment Analysis*", section 11 requires,

"In cases where a benchmark approach is used, the applied benchmark shall be appropriate to the type of IRR calculated. Local commercial lending rates or weighted average costs of capital are appropriate benchmarks for a project IRR. Required/expected returns on equity are appropriate benchmarks for equity IRR. Benchmarks supplied by relevant national authorities are also appropriate if the DOE can validate that they are applicable to the project activity and the type of IRR calculation presented." Also section 12 requires: "In the cases of projects which could be developed by an entity other than the project participant, the benchmark should be based on publicly available data sources which can be clearly validated by the DOE. Such data sources may include local lending and borrowing rates, equity indices, or benchmarks determined by relevant national authorities."

According to "*Guideline for Determination of Main Parameters of Hydropower Plants*" (Ministry of State Construction Control, 2006 /3/), it defines not to implement the project when the IRR of proposed hydropower project is less than 5%. Therefore, the threshold can be used as a benchmark.

The following criteria prove it well justifies the conditions above.

- This benchmark is used in the construction of hydropower plants in DPR Korea.
- This benchmark is publicly available data source and can be clearly validated by the DOE.
- This benchmark is widely used in decision making for hydropower projects among the project owners.

3. Calculation and comparison

Based on FSR of the project, the basic parameters for calculation of financial indicators are shown in table 6.

Table 6. Basic parameters for calculation of financial indicators of the Project

Parameters	Value	Source
Installed capacity (MW)	10	Feasibility study report
Net electricity supplied to WPG (MWh)	40 030	Feasibility study report
Total investment (10 000 KPW)	87 200	Feasibility study report
Annual loan rate (%)	3.6	Loan contract
The price of electricity to be sold to WPG (KPW/kWh)	1.98	Guideline for determination of main parameters of hydro power plants
Rate of depreciation of equipment (%)	5	Feasibility study report
Rate of depreciation of structure (%)	2	Feasibility study report
Rate of income tax (%)	30	Guideline for determination of main parameters of hydro power plants
Project lifetime (year)	23	Feasibility study report

Calculation of the total investment on the IRR without the sale revenue of CER based on the data given in table 6, IRR is lower than the benchmark 5% as 3.97%. Therefore, the project is unattractive and requires the additionality.

With the revenue from CER sale, the IRR of the project on the total investment is 7.96% and exceeds the benchmark 5%. In this case, the project is attractive, which means that the revenue from CDM is able to

help the project to overcome the investment barrier.

Sensitivity analysis

This step is to confirm whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions.

EB 41, Annex 45, "*Guidance on the Assessment of Investment Analysis*", section 16 requires,

"Only variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation (all parameters varied need not necessarily be subjected to both negative and positive variations of the same magnitude), and the results of this variation should be presented in the PDD and be reproducible in the associated spreadsheets."

The following four parameters are selected as the critical sensitivity indicators to check the financial attractiveness of the project:

- Annual operational cost;
- Electricity supplied to the grid;
- Total investment; and
- Electricity price.

Variations of ±10% (according to FSR) have been considered in the critical assumptions. Table 7 summarizes the results of the sensitivity analysis, while figure 4 provides a graphic depiction.

Table 7. Result of sensitivity analysis

	-10%	-5%	0%	5%	10%
Electricity supplied to the grid	3.20	3.59	3.97	4.35	4.72
Total investment	4.78	4.36	3.97	3.62	3.30
Annual operation cost	4.07	4.02	3.97	3.92	3.86
Electricity price	3.20	3.59	3.97	4.35	4.72

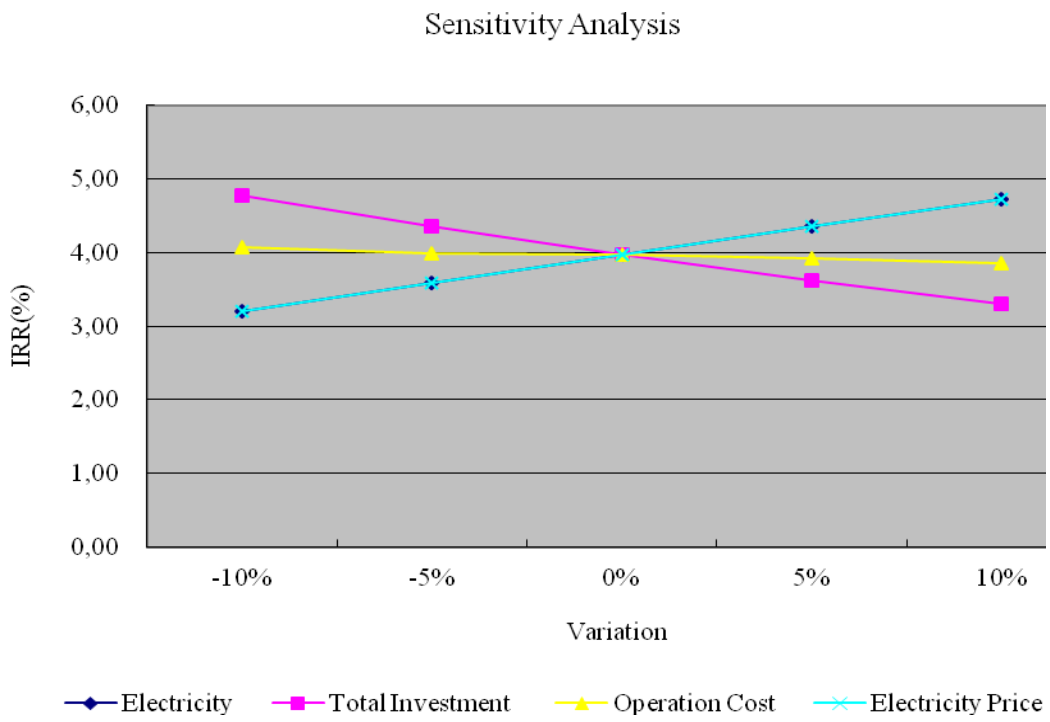

Figure 4. The IRR Sensitivity Analysis with the changes of Total Investment, Annual Operation Cost, Electricity Price or Electricity supplied to the grid

As shown above in the table 7 and figure 4, with four variations of ±10% been considered, the conclusion is that even with reasonable changes in the critical assumptions, the IRR remains lower than the benchmark of 5%. Therefore, the conclusion that the project is additional is robust.

- **Total investment**

In general, when the total investment increases, the project IRR decreases.

If the total investment increases from -10% to +10%, the project IRR would decrease from 4.78% to 3.30%. As a result, although the total investment changes in the range of ±10%, the project IRR would not reach the benchmark 5%. Only when the total investment decreases by 12.44%, the IRR will reach the benchmark. Ryesonggang Hydropower Construction Company is responsible for construction of Ryesonggang Hydropower Plant No.4. The obstacle faced the company during the engineering works.

The FSR predicted the bedrock under the project site, but there was no bedrock at the predicted depth and site. Thus, the design of the plant was subjected to modification. This made the increase of the initial investment. Such an unexpected obstacle seems to occur due to various unexpected causes in the future. In this situation, total investment will not decrease.

This shows that it is difficult to improve the project IRR by reducing the total investment.

- **Electricity supplied to the grid**

When the electricity supplied to the grid increases, the project IRR will also increase.

If the electricity supplied to the grid is increased by 10%, the project IRR would also increase from 3.20% to 4.72%. This is still lower than the 5% benchmark. Meanwhile, it was projected that only when the

annual net electricity supplied to the grid increases by more than 13.89%, the IRR will reach the national benchmark. The electricity output estimated in FSR is the expected value based on the hydro meteorological data for the past 30 years in the designated region. This value, however it may change, will not exceed the limit of 5%, when reviewing the experiences of the other plants so far.

From this, it is clear that it is impossible to improve the IRR by controlling the electricity supplied to the grid.

- **Electricity price**

When the electricity price increases, the project IRR increases. According to the decision of the State Price Assessment Commission of DPR Korea, the manufacturer's electricity price is 1.98 KPW/kWh in DPR Korea. If the electricity price increases by 13.79%, the IRR will surely reach the benchmark. In DPR Korea, the price of electricity is a unified price and is enacted by the government.

By the way, the government has not changed the electricity price for the households and industry so far. Even if the government changes the electricity price during the operation of project, it will not increase up to 13.79%. Therefore, there will not be such case that the project IRR will improve with the increase of electricity price.

This shows that it is impossible to improve the project IRR by increasing the electricity price.

- **Operation cost**

When the operation cost decreases, the project IRR increases.

Even with the decrease in the annual operation & maintenance cost by 10%, the IRR has very little change. But operation cost such as the number of workers and living expenses may increase gradually. Therefore, the project IRR can not increase by adjusting the annual operation cost.

The results of sensitivity analysis confirm that the project faces financial barriers without the CDM revenue.

Conclusion

It is therefore concluded that without CDM, the project faces several barriers, which would prevent the construction and implementation of the specific project activity. CDM helps to overcome these barriers. If the project is not implemented, electricity will be supplied by WPG, which partly depends on thermal power as its energy source. Thermal power has GHG emissions associated with it.

The specific project activity will not be implemented without registering it as a CDM project and will not reduce GHG emissions below the baseline. Therefore, the specific project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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In order to calculate the baseline, project and leakage emissions and hence emission reductions, methodology AMS-I.D. (version 16, EB 54) is used in conjunction with the "*Tool to calculate the emission factor for an electricity system* (Version 02)". Below is a description of how the three types of emission (baseline, project and leakage) are calculated, along with the key assumptions and rationale for methodological choices.

Baseline emissions

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

$$BE_y = EG_{BL,y} \cdot EF_{CO_2,grid,y} \quad (1)$$

Where:

BE_y	Baseline emissions in year *y* (tCO_2)
$EG_{BL,y}$	Quantity of net electricity supplied to the grid as a result of implementation of the CDM project activity in year *y* (MWh)
$EF_{CO2,grid,y}$	Emission factor of the grid in year y (tCO_2/MWh)

The emission factor can be calculated in a transparent and conservative manner as follows:

(a) CM, consisting of the combination of OM and 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 tCO_2/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Calculations shall be based on data from an official source (where available) and made publicly available.

Option (a) is used for the proposed project.

According to "*Tool to calculate the emission factor for an electricity system* (Version 02)", project participants shall apply the following seven steps to calculate the emission factor.

STEP 1. Identify the relevant electricity systems.

STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional).

STEP 3. Select a method to determine OM.

STEP 4. Calculate OM emission factor according to the selected method.

STEP 5. Identify the group of power units to be included in BM.

STEP 6. Calculate BM emission factor.

STEP 7. Calculate CM emissions factor.

Step 1: Identify the relevant electricity systems

For 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 (e.g. the renewable power plant location or the consumers where electricity is being saved) 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. Power plants within the connected electricity system can be dispatched without significant transmission constraints but transmission to the project electricity system has significant transmission constraint.

If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used. If this information is not available, project participants should define the project electricity system and any connected electricity system, and justify

and document their assumptions in the CDM-PDD. The following criteria can be used to determine the existence of significant transmission constraints.

- In case of electricity systems with spot markets for electricity: there are differences in electricity prices (without transmission and distribution costs) of more than 5 percent between the systems during 60 percent or more of the hours of the year;
- The transmission line is operated at 90% or more of its rated capacity during 90% percent or more of the hours of the year.

Where the application of these criteria does not result in a clear grid boundary, participants must use a regional grid definition in the case of large countries with layered dispatch systems (e.g. provincial/regional/national). A provincial grid definition may indeed in many cases be too narrow given significant electricity trade among provinces that might be affected, directly or indirectly, by a CDM project activity. In other countries, the national (or other largest) grid definition should be used by default. Participants must document the geographical extent of the project electricity system transparently and identify all grid power plants/units connected to the system.

For the purpose of determining BM emission factor, the spatial extent is limited to the project electricity system, except where recent or likely future additions to transmission capacity enable significant increases in imported electricity. In such cases, the transmission capacity may be considered a build margin source.

For the purpose of determining OM emission factor, use one of the following options to determine the CO_2 emission factor(s) for net electricity imports from a connected electricity system within the same host country (ies):

(a) 0 tCO_2/MWh; or

(b) The weighted average OM emission rate of the exporting grid, or

(c) The simple OM emission rate of the exporting grid, or

(d) The simple adjusted OM emission rate of the exporting grid.

In the present case, project electricity system is the project activity and the connected electricity system is WPG.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

Project participants may choose between the following two options to calculate OM and BM 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 was chosen.

Step 3: Select a method to determine OM

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

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

The dispatch data analysis OM emission factor is determined based on the grid power units that are

actually dispatched at the margin during each hour where the project is displacing grid electricity. This approach is not applicable to historical data and, thus, requires annual monitoring of the dispatch data analysis OM emission factor. Thus, the application of method (c) is impossible for the project.

Similarly, the data of annual load duration curve required by method (b) also can not be obtained publicly. Therefore, method (b) is also not applicable here.

The method (d) is applicable only when the generations by low-cost/must-run resources constitute more than 50% of the generation of total grid. Low-cost/must-run plants are hydro power plants in DPR Korea. As shown in table 8, the electricity generation from hydro power plants constitutes less than 50% of total generation during the 2005-2009. Therefore, the method (d) is not applicable to calculate the $EF_{OM,y}$.

The simple OM method (a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydro electricity production. Therefore, the method (a) is applicable here.

Table 8. Electricity generation of low-cost/must-run resources in DPR Korea between 2005-2009

Years	2005	2006	2007	2008	2009
Electricity generation of low-cost/must-run resources	46.87	41.76	44.02	41.02	42.69

Data source: Central Bureau of Statistics, 2010

http://10.76.1.11

Step 4: Calculate OM emission factor according to the selected method

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

The simple OM may be calculated:

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.

Option B can only be used if:

(a) The necessary data for Option A is not available; and

(b) Only nuclear and renewable power generation are considered as low-cost/must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and

(c) Off-grid power plants are not included in the calculation (i.e., if Option I has been chosen in Step 2).

For the calculation of OM emission factor of the proposed project, option B can be used.

Under this option, the simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost/must-run power plants/units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_y} \quad (2)$$

Where:

$EF_{grid,OMsimple,y}$ = Simple OM emission factor in year y (tCO_2/MWh)

$FC_{i,y}$	= Amount of fossil fuel type *i* consumed in the project electricity system 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_2/GJ)
EG_y	= Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year *y* (MWh)
I	= All fossil fuel types combusted in power sources in the project electricity system in year *y*
Y	= The relevant year as per the data vintage chosen in Step 3

For this approach (simple OM) to calculate OM, the subscript *m* refers to the power plants/units delivering electricity to the grid, not including low-cost/must-run power plants/units, and including electricity imports to the grid. Electricity imports should be treated as one power plant *m*.

Step 5: Identify the group of power units to be included in BM

The sample group of power units *m* used to calculate BM consists of either:

(a) The set of five power units that have been built most recently; or

(b) The set of power 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 the set of power units that comprises the larger annual generation.

As a general guidance, a power unit is considered to have been built at the date when it started to supply electricity to the grid.

Power plant registered as CDM project activities should be excluded from the sample group m. However, if the group of power units, not registered as CDM project activity, identified for estimating BM emission factor includes power unit(s) that is (are) built more than 10 years ago then:

(i) Exclude power unit(s) that is (are) built more than 10 years ago from the group; and

(ii) Include grid connected power projects registered as CDM project activities, which are dispatched by dispatching authority to the electricity system.

Capacity additions from retrofits of power plants should not be included in the calculation of BM emission factor.

In the case of the WPG, all the thermal power plants are excluded from the sample group of power units *m* used to calculate BM, because they are built more than 10 years ago.

Step 6: Calculate BM emission factor

The BM emission factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (3)$$

Where:

$EF_{grid,BM,y}$	= BM emission factor in year *y* (tCO_2/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_2/MWh)

m = Power units included in BM

y = Most recent historical year for which power generation data is available

CO_2 emission factor of power plants $FE_{EL,m,y}$ is considered as zero, because the plants included in BM are hydropower plants.

Step 7: Calculate CM emissions factor

The CM emissions factor is calculated as follows:

$$EF_{grid,\ CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad (4)$$

Where:

$EF_{grid,\ BM,y}$ = BM emission factor in year *y* (tCO_2/MWh)

$EF_{grid,OM,y}$ = OM emission factor in year *y* (tCO_2/MWh)

w_{OM} = Weighting of OM emissions factor (%) (w_{OM} = 0.5)

w_{BM} = Weighting of BM emissions factor (%) (w_{BM} = 0.5).

From the formula (1) and (4), the baseline emissions can be calculated.

Project emissions

For most renewable energy project activities, PE_y = 0. However, for the following categories of project activities, project emissions have to be considered following the procedure described in the most recent version of ACM0002 (version 12.1, EB 58).

- Emissions related to the operation of geothermal power plants (e.g. Non-condensable gases, electricity/fossil fuel consumption)
- Emissions from water reservoirs of hydro power plants

For the proposed project, emissions from water reservoir of hydropower plant have to be considered.

According to the ACM0002 (version 12.1, EB 58), some project activities may involve project emissions that can be significant. These emissions shall be accounted for as project emissions by using the following equation.

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \quad (5)$$

Where:

PE_y = Project emissions in year *y* (tCO_2e/yr)

$PE_{FF,y}$ = Project emissions from fossil fuel consumption in year *y* (tCO_2/yr)

$PE_{GP,y}$ = Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2e/yr)

$PE_{HP,y}$ = Project emissions from water reservoirs of hydro power plants in year *y* (tCO_2e/yr)

For the proposed project:

$$PE_{FF,y} = 0,\ PE_{GP,y} = 0 \quad (6)$$

If the power density (PD) of the project activity is greater than 4W/m^2 and less than or equal to 10 W/m^2:

$$PE_{HP,y} = EF_{Res} \cdot TEG_y \ / 1\ 000 \quad (7)$$

Where:

$PE_{HP,y}$	= Project emissions from water reservoirs (tCO_2e/yr)
EF_{Res}	= Default emission factor for emissions from reservoirs of hydro power plants in year y ($kgCO_2e/MWh$)
TEG_y	= Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y (MWh)

Formula (7) should be applied for the proposed project, because PD of the project activity is 6.7 W/m^2.

According to this methodology, the PD of the project activity is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \quad (8)$$

Where:

PD	= PD of the project activity (W/m^2)\
Cap_{PJ}	= Installed capacity of the hydro power plant after the implementation of the project activity (W)
Cap_{BJ}	= Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero
A_{PJ}	= Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2)
A_{BL}	= Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero

For the proposed project, $Cap_{BJ} = 0$ and $A_{BL} = 0$, because the power plant and reservoir is new.

So PD of the proposed project is calculated as follows:

$$PD = Cap_{PJ} / A_{PJ} \quad (9)$$

Leakage emissions

If the energy generating equipment is transferred from another activity, leakage is to be considered.

For the proposed project, leakage is zero, because there is no transfer of energy generating equipment.

$$LE_y = 0 \quad (10)$$

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (11)$$

Where:

ER_y	= Emission reductions in year y (tCO_2e/y)
BE_y	= Baseline emissions in year y (tCO_2/y)
PE_y	= Project emissions in year y (tCO_2e/y)
LE_y	= Leakage emissions in year y (tCO_2e/y)

For the proposed project, emission reductions are as follows;

$$BE_y = EG_y \cdot EF_{grid,CM,y} - PE_y \quad (12)$$

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	$NCV_{i,y}$
Data unit:	**TJ/Gg**
Description:	Net calorific value (energy content) per mass or volume unit of a fuel *i*
Source of data used:	IPCC default values
Value applied:	Refer to Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data is collected from the IPCC
Any comment:	

Data / Parameter:	$FC_{i,y}$
Data unit:	**Gg**
Description:	The amount of fuel *i* consumed in WPG in year *y*
Source of data used:	Central Bureau of Statistics
Value applied:	Refer to Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data in CDM Website of DPR Korea
Any comment:	To calculate OM emission factor.

Data / Parameter:	EG_y
Data unit:	**MWh**
Description:	Net electricity generation produced and delivered by all units connected in WPG in year y
Source of data used:	Central Bureau of Statistics
Value applied:	Refer to Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data in CDM Website of DPR Korea
Any comment:	To calculate OM

Data / Parameter:	$EF_{CO2,i}$
Data unit:	**tCO_2/TJ**
Description:	The emission factor of fuel *i* in a mass or volume unit
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories

Value applied:	-
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC Default Value
Any comment:	To calculate OM and BM

B.6.3 Ex-ante calculation of emission reductions:

>>

The baseline emission factor is shown in the table 9

Table 9. Calculation of CM in WPG (tCO_2e/MWh)

OM	BM	CM
1.52	0	0.76

Because the net electricity supplied from the project to WPG is 42 800 MWh, the project emission reductions are calculated as follows:

Baseline emissions

$$BE_y = EG_y \cdot EF_{grid,\,CM,y} = 40\,030 \cdot 0.76 = 30\,422.8\ tCO_2e \quad (13)$$

Leakage emissions

As mentioned in the B.6.1

$$LE_y = 0 \quad (14)$$

Project emissions

$$PE_{HP,y} = 3\,782.8\ tCO_2e \quad (15)$$

Emission reductions

Since a leakage is zero, CER estimated by the project in a year can find from following:

$$BE_y = EG_y \cdot EF_{grid,\,CM,y} - PE_{HP,y} = 26\,639\ tCO_2e \quad (16)$$

B.6.4 Summary of the ex-ante estimation of emission reductions:

>>

Table 10 shows the emission reductions of the project during the first crediting period.

Table 10. Estimate of emission reductions of the project during the first crediting period

Year	Estimation of project activity emissions (tCO_2e)	Estimation of baseline emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of overall emission reductions (tCO_2e)
13/04/2012-31/12/2012	3 026	21 295	0	18 269
2013	3 782	30 422	0	26 639
2014	3 782	30 422	0	26 639
2015	3 782	30 422	0	26 639
2016	3 782	30 422	0	26 639
2017	3 782	30 422	0	26 639

2018	3 782	30 422	0	26 639
01/01/2019-12/04/2019	756	9 126	0	8 370
Total emission reductions (tCO_2e)	**26 474**	**212 9593**	**0**	**186 473**
Credible period (year)		**7**		
Annual average during the credible period (tCO_2e)		**26 639**		

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	EF_{CO2y}
Data unit:	**tCO_2e/kWh**
Description:	CO_2 emission factor of the grid electricity in year y
Source of data to be used:	CM emission factor of WPG in year y calculated using the "*Tool to calculate the emission factor for an electricity system*" (Version 02.1.0)
Value of data	**0.76**
Description of measurement methods and procedures to be applied:	Calculated as per "*Tool to calculate the emission factor for an electricity system*" (Version 02.1.0)
QA/QC procedures to be applied:	-
Any comment:	Refer to B.7.2. Description of the monitoring plan

Data / Parameter:	TEG_y
Data unit:	**MWh/y**
Description:	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y
Source of data to be used:	Measured by watt-hour meters in project activity site
Value of data	**42 031.5**
Description of measurement methods and procedures to be applied:	Measured continuously and recorded on a monthly basis
QA/QC procedures to be applied:	Measurements are undertaken using watt-hour meters. Calibration should be undertaken as prescribed by Quality Supervision Bureau, DPR Korea.
Any comment:	Refer to B.7.2. Description of the monitoring plan

Data / Parameter:	Cap_{PJ}
Data unit:	**MW**
Description:	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data to be used:	Project site

Value of data	**10**
Description of measurement methods and procedures to be applied:	Determine the installed capacity based on recognized standards
QA/QC procedures to be applied:	-
Any comment:	Refer to B.7.2. Description of the monitoring plan

Data / Parameter:	A_{PJ}
Data unit:	**km^2**
Description:	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full
Source of data to be used:	Measured by meters in project activity site
Value of data	**1.5**
Description of measurement methods and procedures to be applied:	Measured from topographical surveys and maps
QA/QC procedures to be applied:	-
Any comment:	Refer to B.7.2. Description of the monitoring plan

Data / Parameter:	$EG_{facility,y}$
Data unit:	**MWh**
Description:	The net electricity delivered by the project
Source of data to be used:	Measured by meters
Value of data	**40 030**
Description of measurement methods and procedures to be applied:	Measured continuously and recorded on a monthly basis
QA/QC procedures to be applied:	The meters will be periodically checked according to the relevant national electric industry standards and regulations; Power supplied to the grid and double checked according to electricity sales receipts.
Any comment:	Refer to B.7.2. Description of the monitoring plan

B.7.2 Description of the monitoring plan:

>>

In this PDD, emission factor of the project is determined ex-ante. Therefore the net electricity generation supplied to the grid by the project is defined as the key data to be monitored. The monitoring plan is drafted to focus in monitoring of this data.

1. Monitoring organization

Prior to the starting of the crediting period, the monitoring team will be organized. Clear roles and responsibilities will be assigned to all staff involved in the CDM project and a single CDM manager will be nominated. The CDM Manager will have the overall responsibility for the monitoring system on this project.

The CDM management structure of the project is shown in figure 5.

Figure 5. CDM management structure of the project

Responsibility of CDM manager:

- CDM management and resolution of the existing problem
- Supervision of project operation and financial issues

Responsibilities of Monitoring and Recording Team under the CDM manager:

- Monitoring and management of the electricity export to and import from the grid daily
- Data collection monthly
- Collecting all the sale and purchase receipts or invoices
- Calibration of meters
- Daily confirmation of monitored data with the Monitoring and Recording Team under the Grid Company

Responsibility of Repair and Maintenance Team 1;

- Repair and maintenance of generating facility No.1 and No.2
- Calibration and replacement of monitoring instruments

Responsibility of Repair and Maintenance Team2:

- Repair and maintenance of generating facility No.3 and No.4

2. Monitoring equipment and its installation

Integrated watt meters and electronic recorders will be installed at two places; first one will be located at the powerhouse of the project and second one at the 66 kV Namchon substation. This equipment will measure and record the delivered or received electricity.

3. Calibration

The project owner and the grid company will sign an agreement to develop a set of quality control procedures regarding the measurement and calibration so as to maintain the accuracy of measurement.

All equipment will be calibrated by the Bureau of Quality Supervision DPR Korea commissioned jointly by the project owner and the grid company every six months.

After calibration, the meters should be sealed by the project owner and Grid Company, each part should not unseal or change the meters when the other one is absent. If the recording difference between the meters of the project owner and Grid Company is lager than the allowable tolerance, the meters will be repaired or replaced by other calibrated meters.

4. Data Management

Data will be archived at the end of each month using the electronic spreadsheet described. The electronic files will be stored on both hard disk and CD-ROM. In addition, a hard copy printout will be archived.

Physical documentation will be collected and stored by the project owner, together with the monitoring plan. In order to facilitate the auditor's reference, monitoring results will be indexed. All data records will be kept for a period of 2 years following the end of the crediting period.

5. Monitoring Report

The project owner will keep the sales receipts, and compile a monitoring report for DOE's verification at the end of the year. The monitoring report includes the monitoring and review report of the net electricity supplied by the project to the grid, the calculation of emission reduction and record of calibration and maintenance.

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

>>

Date of completion: 10/12/2010

Name of person determining the baseline and monitoring methodology:

1. Mr. Hun Kim, Institute of Thermal Engineering, SAoS

Address: Moranbong district, Pyongyang, DPR Korea

E-mail Add: pptayang@star-co.net.kp,

Tel: 850-2-3818111/ext-8544

FAX: 850-2-3814410/2100

2. Mr. Ulsong Kim, Project Officer, SAoS,

Address: Moranbong district, Pyongyang, DPR Korea

E-mail Add: pptayang@star-co.net.kp

Tel: 850-2-3818111/ext-8544

FAX: 850-2-3814410/2100

(Not a project participant)

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>
21 October 2010

C.1.2. Expected operational lifetime of the project activity:

>>
The expected operational lifetime of the project activity is 23 years, including the construction periods.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>
13/04/2012 (or earliest date after registration)

C.2.1.2. Length of the first crediting period:

>>
7 years

C.2.2. Fixed crediting period:

>>
Not applicable

C.2.2.1. Starting date:

>>
Not applicable

C.2.2.2. Length:

>>
Not applicable

SECTION D. Environmental impacts

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D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

>>
According to the "*Law of DPR Korea on Environmental Impact Assessment*", Environmental Impact Assessment (EIA) must be made for all projects to be built with the Approval of the Ministry of State Construction Control (Province/City, County) /2/.

The EIA report was prepared by the Environment & Development Centre (EDC) under the project owner's assignment and was approved by the Environmental Protection Bureau of North Hwanghae Province on 6 July 2010. According to the EIA, environmental impacts caused by the project are analyzed as follows:

Water environment

During the construction phase, the main sources of water pollution are household waste water and waste water from construction site. After the control measures were taken to meet the "*Wastewater Discharge Standard*" for environment protection, the water quality of the main stream of Ryesong River will not be affected. With the completion of the construction, water pollution sources will disappear.

Air pollution

There are houses for workers constructing hydro power plant near the project site. But the impact by air pollution can be ignored due to small source of air pollution.

Noise by the construction

Several rolling stocks and construction machines are working in the construction site of the dam. They cause noises. But the noises are temporary.

Solid wastes

During the construction phase, the solid wastes mainly come from the construction waste slag and builder's garbage. The construction waste slag had been stacked in dumping sites, and builder's garbage had been disposed of and no pollution was caused.

Submerged land

The project submerged 20.3 hectare of farmland. 95 dwelling houses were relocated due to the project. The project helped these people to resettle in newly-built villages in a new area. The project has little effect on the production and the standard of living of the original residents and settlers. With the completion of the reservoir, irrigation condition of the reservoir region is improved, and the productivity of farmland nearby increased.

Ecological environment

The construction of the dam did not cause any damage to ecosystem near reservoir.

There are no rare or endangered animal spreads in the reservoir basin.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

Both the environmental authority and the project owner considered that the proposed project activity will not bring any significant negative impacts on the environment and concluded that the project activity is in compliance with the requirements of laws and regulations on environment protection.

SECTION E. Stakeholders' comments

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E.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

The People's Committee of Kumchon County (PCKC) was responsible to receive the comments from the local stakeholders.

Announcement

The chairman of PCKC convened the meeting of the managers of the agencies/enterprises in the county on 21 September 2010 and announced the future plan to build hydropower plants in 2010. He also asked for the supportive opinion of the participants to name the power plant as Ryesonggang Hydropower Plant No.4 after the name of the Ryesong River which flows through the county.

In the meeting, the president of KEPC introduced the location and the scale of the project, and the

difficulties facing the project in terms of time and finance. He explained about the CDM and its possible contribution to the project in overcoming the financial barriers. He further informed the meeting its discussion with SAoS and GBCIO in applying the project as a CDM project. The project owner (KEPC) assured that the residents living in the affected area will be moved to better houses in a new location to be built by the project owner before the operation of the plant. And the project owner explained the social and economic benefits on Kumchon county through the implementation of the project. The local line radio informed the speaking of the chairman of PCKC and the project owner (KEPC) on the construction of Ryesonggang Hydropower Plant No.4 to the residents in the county several times. Especially, officers in PCKC called upon the residents in future submerged area to explain the reason for their resettlement from the existing dwelling houses and compensation plan by the project owner in detail.

Reception of the Comments

There is a department for appeals and complaints in PCKC to deal with the comments from local stakeholders. Several officers are ready to receive the comments from the local stakeholders all the time. The comments are received in writing and solved in a week. Anyone could put his comment in the department. Comments from local stakeholders will be kept in storage during the construction. For the residents in submerged area, PCKC distributed questionnaires to receive their comments. Their comments were synthesized and analyzed by PCKC on 15 November 2010.

Distributed questionnaires are as follows:

No	Contents	Yes	No	Don't know
1	The project contributes to the sustainable economical development of the country.			
2	The project is suitable to the economic strategy and policy of the government.			
3	There are no rare or endangered animals and plants in the reservoir basin			
4	The dwelling houses are newly built for the residents in the flooded area.			
5	I lead a cultured life due to the construction of hydropower plant.			
6	The project gives the positive influence to my living conditions.			
7	The project improves the traffic conditions in the local areas.			
8	The advanced technologies are disseminated to the local residents due to the construction of the hydropower plant.			
9	The project owner offers the new jobs to the local residents.			
10	The economic exchange is improved between the near counties due to the construction of the hydropower plant.			
11	The project is built by applying the Clean Development Mechanism			
12	I agree the construction of hydropower plant.			
13	The project contributes to the economic development of Kumchon county.			

E.2. Summary of the comments received:

>>

All residents in Kumchon county agreed to the implementation of the project. They understood the severity of deforestation in the region, drought in spring farming season and summer floods which caused traffic cut off and agricultural losses could be lessened through the project. Some residents in the submerged area applied for new permanent jobs to be employed by the end of the completion of the plant.

Other comments were not raised. Survey result by the department for appeals and complaints in PCKC is

as follows.

Table 11. Summary of respondents

Item	Content	Frequency	%
Gender	male	18	85.7
	female	3	14.3
Ages	<30	4	19.0
	30-40	8	38.0
	>40	9	43.0
Education	Middle school	16	76.2
	University	5	23.8
Employment	Governmental officials	3	14.3
	Related employees	4	19.0
	Local residents	14	66.7

E.3. Report on how due account was taken of any comments received:

>>

The comments received show that the local residents have no negative opinion. Meanwhile, the project owner (KEPC) took two measures for the applications of new permanent occupation.

- Project owner will let the residents in the submerged area remove to new dwelling houses before the operation of hydropower plant.
- Project owner will supply electricity for lighting, heating and cooking to new dwelling houses.
- Project owner will lay water lines in all new dwelling houses and supply the family garden
- Project owner selected 15 young and talent residents from the applicants as the workers of the plant.

Project owner planed training of the selected workers from June, 2011 to December, 2011 in other plant under operation.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Kumchon Electric Power Company
Street/P.O.Box:	Kumchon County, North Hwanghae Province, DPR Korea
Building:	
City:	
State/Region:	
Postfix/ZIP:	
Country:	Democratic People's Republic of Korea
Telephone:	850-2-381-5926
FAX:	850-2-381-4654
E-Mail:	gbcio@star-co.net.kp
URL:	
Represented by:	Kumchon Electric Power Company
Title:	Senior Programme Officer
Salutation:	Mr.
Last Name:	Su Hong
Middle Name:	
First Name:	Kim
Department:	Carbon Trade Division
Mobile:	
Direct FAX:	850-2-381-4654
Direct tel:	850-2-381-5926
Personal E-Mail:	gbcio@star-co.net.kp

The Buyer

Organization:	**Topič Energo s.r.o.**
Street/P.O.Box:	Pavelčákova 437/6 779 00 Olomouc,
Building:	
City:	
State/Region:	
Postfix/ZIP:	
Country:	Czech Republic
Telephone:	+420 581 299 055
FAX:	+420 581 76 21 24
E-Mail:	blazek@topic-energo.cz
URL:	http://www.topic-energo.cz
Represented by:	
Title:	Managing Director
Salutation:	Mr.
Last Name:	Blažek
Middle Name:	
First Name:	Miroslav
Department:	
Mobile:	+420 731 688 910
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding from Annex I Parties for the project.

Annex 3

BASELINE INFORMATION

Table 12. Information of electricity generated and fuels consumed by thermal power plants in 2005

Thermal Power Plant	Output (10^3 MWh)	Anthracite Consumption (Gg)	Crude Oil Consumption (Gg)
Pyongyang	1 986	1 384	22.8
DongPyongyang	745	527	7.9
Chongchongang	263	202	2.3
Sunchon	759	555	5.7

Data source: Central bureau of statistics, 2006
http://10.76.1.11

Table 13. Information of electricity generated and fuels consumed by thermal power plants in 2006

Thermal Power Plant	Output (10^3 MWh)	Anthracite Consumption (Gg)	Crude Oil Consumption (Gg)
Pyongyang	1 959	1 387	20.0
DongPyongyang	715	511	7.4
Chongchongang	272	213	3.9
Sunchon	829	608	9.0

Data source: Central bureau of statistics, 2007
http://10.76.1.11

Table 14. Information of electricity generated and fuels consumed by thermal power plants in 2007

Thermal Power Plant	Output (10^3 MWh)	Anthracite Consumption (Gg)	Crude Oil Consumption (Gg)
Pyongyang	1 918	1 360	19.6
DongPyongyang	686	493	5.7
Chongchongang	293	187	4.7
Sunchon	798	594	12.6

Data source: Central bureau of statistics, 2008
http://10.76.1.11

Table 15. Information of electricity generated and fuels consumed by thermal power plants in 2008

Thermal Power Plant	Output (10^3 MWh)	Anthracite Consumption (Gg)	Crude Oil Consumption (Gg)
Pyongyang	1 929	1 375	21.8
DongPyongyang	778	564	6.7
Chongchongang	274	216	5.0
Sunchon	821	619	9.0

Data source: Central bureau of statistics, 2009
http://10.76.1.11

Table 16. Information of electricity generated and fuels consumed by thermal power plants in 2009

Thermal Power Plant	Output (10^3 MWh)	Anthracite Consumption (Gg)	Crude Oil Consumption (Gg)
Pyongyang	1 993	1 427	22.1
DongPyongyang	815	558	7.0

Chongchongang	337	294	6.6
Sunchon	876	663	8.8

Data source: Central bureau of statistics, 2010
http://10.76.1.11

Table 17. Information of fuels consumed for power generation

	Emission factor (tCO_2/TJ)	Net Calorific Value, TJ/Gg
Anthracite	94.6	21.6
Crude oil	71.1	39.8

Data source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories

According to electricity supplied to WPG, the OM of latest three years should be weighted average, so the weighted average OM is:

$$EF_{grid,OMsimple,y} = \frac{\sum_i FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_y} = 1.52\ tCO_2e/MWh \qquad (17)$$

The BM Emission Factor is 0 tCO_2/MWh.

The emission factors of each year and average emission factor in WPG are listed in table 8.

Table 18. Emission factor in WPG

	2007	2008	2009	Average
Emission factor	0.76	0.76	0.76	0.76

Table 19. Plants connected to WPG

Thermal power plants	Hydropower plants
Pyongyang	Daedonggang
DongPyongyang	Namgang
Chongchongang	Supung
Sunchon	

Data source: http://10.76.1.11

Annex 4

MONITORING INFORMATION

NA

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