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

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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: Hamhung Hydropower Plant No.1

Version: 1.0

Date: 01/08/2011

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

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The Hamhung Hydropower Plant No.1, DPR Korea (hereafter referred to as the Project) is a reservoir-type power plant, which is newly built in the downstream of Kumjin River.

The purpose of the project is to supply the electricity from the project to the Eastern Power Grid (EPG) of DPR Korea, which includes several numbers of fossil fuel-fired power plants /1/.

The total installed capacity of the project will be 10 MW, with 2 sets of 4 MW and a set of 2 MW hydropower turbines and associated generators. The project will generate the electricity of 30,880 MWh and supply the electricity of 30,020 MWh to EPG annually. The project activity will include the construction of a diversion dam, a powerhouse, a tunnel, an outdoor substation, a set of power transmission line and resettling of dwelling houses in submerged area /1/.

The project activity will reduce CO_2 emissions of EPG, by displacing part of the electricity from thermal power plants in EPG. If the electricity from renewable water resource is supplied to the EPG by the activity, the annual average emission reductions will be 23,728 tCO_2e during the crediting period.

The project owner will be "Hamhung Electricity Company", which belongs to Hamhung City, South Hamgyong Province and the project will put into operation on 1 January 2013.

It is clear that generation of the electricity by water resources is in compliance with national laws and policies /12, 13, 14, 15, 16/.

The project will bring the positive impacts on local community in the social, economic and environmental aspects:

- Making greater use of renewable hydraulic resources and diversifying sources of electricity generation of the grid.
- Reducing the emissions of greenhouse gas and other pollutants compared to business-as-usual scenario
- Providing local employment opportunities during the project construction and operation period
- Meeting the increase of local electricity demand and improving investment condition of local community

As mentioned above, the proposed project activity contributes to the sustainable development in DPR Korea.

A.3. Project participants:

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Name of Party involved(*)((host)	Private and/or public	Kindly indicate if the Party

indicates a host party)	entity(ies) Project participants(*) (as applicable)	involved wishes to be considered as project participant(Yes/No)
Democratic People's Republic of Korea(host)	Hamhung Electricity Company (HEC)	No
Czech Republic	Topič Energo s.r.o.	No

Detailed contact information is available in Annex 1.

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

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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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South Hamgyong Province

A.4.1.3. City/Town/Community etc:

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Chowon-ri, Jongpyong County

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 in Chowon-ri, Jongpyong County, South Hamgyong Province. The project site can be accessed through Pyongyang-Hamhung expressway and railway. The nearest railway station is Jongpyong Station. The geographical coordinates of the dam is east longitude of 127°15′01″ and north latitude of 39°39′25″. The power house is located at a distance of 270 m from the dam. Figure 1 shows the location of the project.

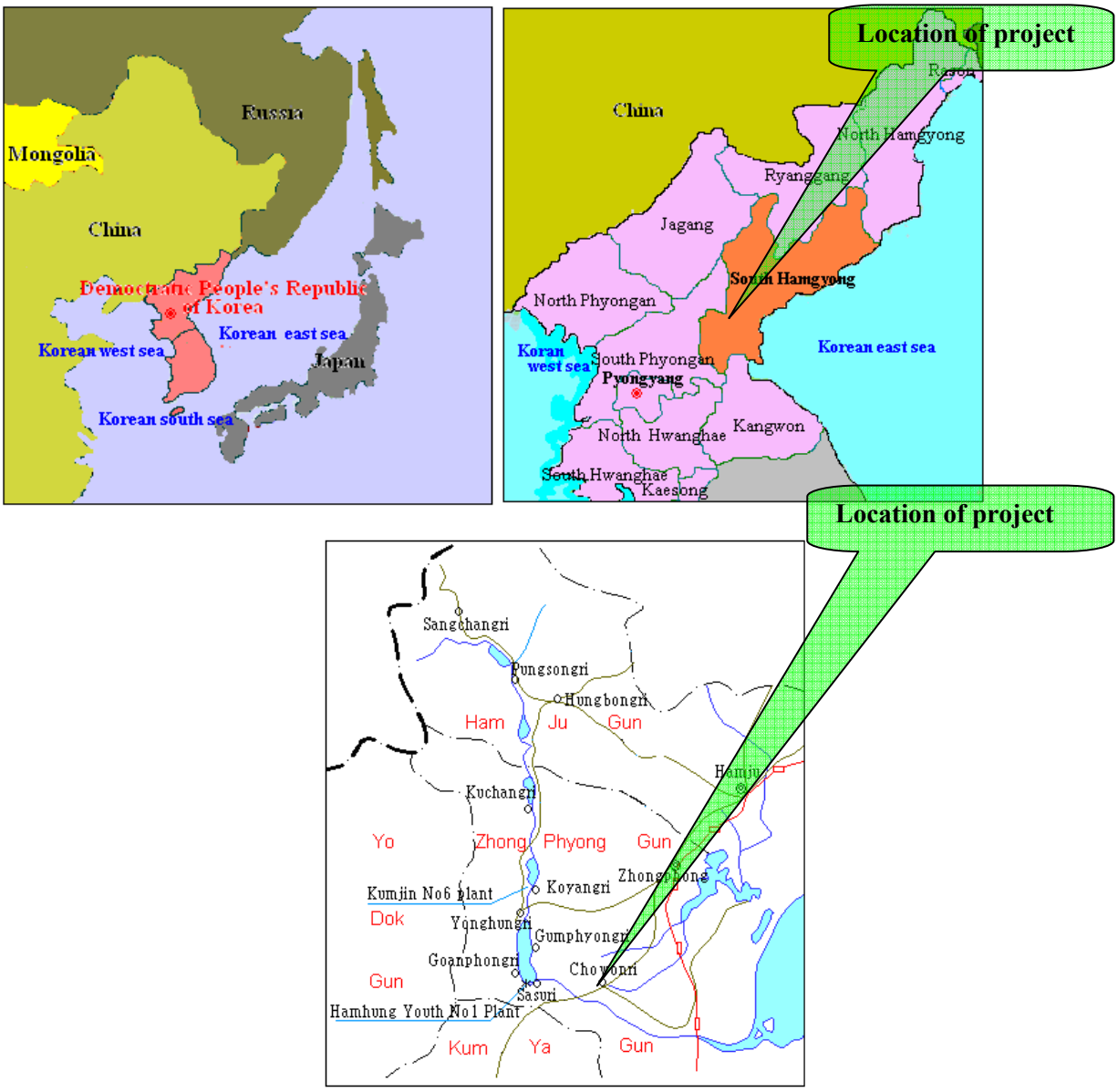

Figure1. Location of the project

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 the categorization of Appendix B of the 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 17, EB 61

The proposed project will produce the electricity by the renewable energy and displace electricity from the EPG that is supplied by several fossil fuel fired generating units. The project activity will install a new power plant at the site where there was no renewable energy power plant operating prior to the implementation of the project plant (Greenfield plant). The project activity results in new reservoir of 2.3 km^2 and the power density is 4.3 W/m^2, which is greater than 4 W/m^2. The capacity of the proposed project will be 10 MW within the threshold capacity of 15 MW. The electricity generated by the project will be transmitted to the EPG through the Jongpyong Substation. Accordingly, the applicable methodology for the project activity shall be AMS.I.D.

2. Technologies applied on the small-scale project activity

The project is a reservoir-type hydropower plant. The project is consisted of a dam, a diversion cave, a frontal pressure pool and a penstock, a powerhouse and an outdoor substation etc. The dam and the cave make the head of 23 m. The length and height of the dam is 450 m and 34.6 m, respectively. The length and diameter of the diversion cave is 270 m and 5.0 m respectively. The plant has two sets of facilities with 4 MW of each power and one set of facilities with 2 MW. Figure 1 shows the layout of the proposed project. The electricity produced in the hydropower plant will be supplied to the Jongpyong Sustation in South Hamgyong Province through the outdoor substation. The Jongpyong Substation is a substation connected to the EPG of DPR Korea.

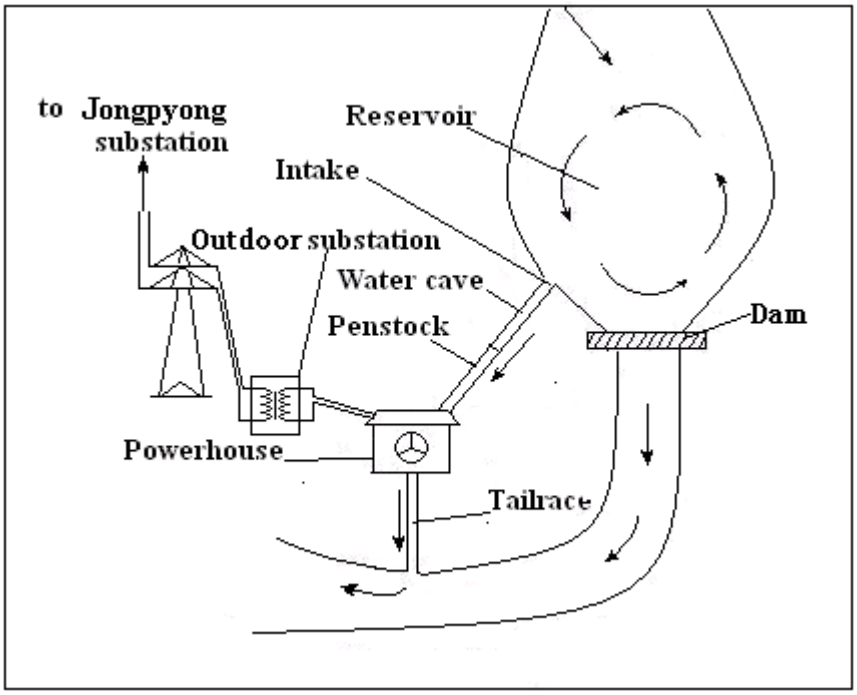

Figure2. The layout of the proposed project

Table 1 shows the key technical parameters of the project.

Table.1 Key technical parameters of the project

Technical parameter	Values
Turbine	
Type	390-H200
Quantity	2 set
Capacity	4,211 kW
Rated rotation speed	300 rpm

Type	390-H140
Quantity	1 set
Capacity	2,105 kW
Rated rotation speed	400 rpm
Manufacturer	Ryongsong Machine Complex (RMC)
Generator	
Type	SVL4,000-6.6
Quantity	2 set
Rated rotation speed	300 rpm
Capacity	4,000 kW
Generation voltage	6.6 kV
Frequency	60 Hz
Type	SVL2,000-6.6
Quantity	1 set
Rated rotation speed	400 rpm
Capacity	2 MW
Generation voltage	6.6 kV
Frequency	60 Hz
Manufacturer	RMC
Power evacuation	
Transmission voltage	66 kV
Substation	66 kV Jongpyong Substation
Dam	
Type of dam	Rock-filled dam
Length	450 m
Height	34.6 m
channel	
Type of channel	Pressure channel
Diameter	5 m
Length	270 m
Length of iron pipe	50 m
Diameter of iron pipe	2.5 m

All persons related with the project operation will be subjected to be trained prior to the operation of the project. In order to operate and maintain the project, regulations related with the project operation and rules for the project equipment maintenance have already been made. The regulations and rules specify how to test and repair the equipment.

3. Application of environmentally sound and safe technology

The technologies applied to the proposed project have been generalized in the world and are environmentally friendly. Characteristics of the hydropower plant and its construction method will not give any negative impacts on the ecosystem. Moreover, it will allow the project to conserve the biodiversity of this particular zone along the river.

4. Technology transfer

The main equipment, such as turbines and generators, are manufactured in the host country. No technology transferred from other countries is involved in this project activity. RMC will be responsible for producing the facilities. This complex is well known as the base of specially producing 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 crediting period of the project activity is 10 years, which is from 1 January 2013 to 31 December 2022. During the crediting period, the total estimated emission reductions are 237,280 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 (tCO_2e)
01/01/2013	23,728
2014	23,728
2015	23,728
2016	23,728
2017	23,728
2018	23,728
2019	23,728
2020	23,728
2021	23,728
2022	23,728
Total estimated reductions (tonnes of CO_2e)	**237,280**
Total number of crediting years	**10**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**23,728**

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 the Simplified Modalities and Procedures for small-scale CDM project activities, the project is not a debundled component of a larger project activity because there is not a 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.

The project participants confirm that there is no registered small-scale CDM project activity or an application to register another small-scale CDM project activity with the same project participants and whose project boundary is not within 1 km of the project boundary of the proposed small-scale activity at

the closest point.

Therefore, according to the Appendix C of the Simplified Modalities and Procedures for Small-scale CDM Project Activities, the project is not a debundled component of a larger project activity.

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 17, EB 61) and "Tool to calculate the emission factor for an electricity system (version 02.2.0, EB 61)". 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 project activity meets all the applicability conditions of the AMS.I.D. (Version 17, EB 61) as described below:

Applicability of AMS.I.D.

The applicability conditions for simplified baseline methodology category AMS.I.D. are:

- The project should be comprised renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass that supply electricity to a national or a regional grid.
- The project should be such project that (a) install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity(Greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s).
- Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology
  - ✓The project activity is implemented in an existing reservoir with no change in the volume of reservoir;
  - ✓The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity is greater than 4 W/m^2;
  - ✓The project activity results in new reservoirs and the power density of the power plant is greater than 4 W/m^2.
- If the new unit has both renewable and non-renewable components (e.g., a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component.
- Combined heat and power (co-generation) systems are not eligible under this category.

For the proposed project:

- The proposed project activity is the hydropower plant project, which supply electricity to EPG.
- Hamhung Hydropower Plant No.1 will be newly built at a site where there was no renewable energy power plant operating prior to the implementation of the project activity.
- The project activity results in new reservoirs and the power density of the power plant will be 4.3 W/m^2, which is greater than 4 W/m^2 and less than 10 W/m^2.
- The installed capacity of the project is 10 MW, which is smaller than 15 MW.
- The proposed project is not combined heat and power (co-generation) system.

  Hence, the project qualifies for the application of methodology AMS.I.D. – Grid connected renewable electricity generation.

Demonstration for being within the limits of SSC throughout the crediting period

The Feasibility Study Report (FSR) for this project demonstrated that the maximum generating capacity of the proposed plant will be 10 MW, which is less than 15MW and generating equipment and structure were designed based on that parameter. Therefore, 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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According to AMS.I.D.(Version 17, EB 61), the project boundary encompasses the physical, geographical site of the renewable generation source.

According to the FSR, electricity generated from the proposed project will be exported to the EPG.

The project boundary will include the physical and geographical site of the proposed project, and all the facilities and power plants in the EPG which related to the electricity to be replaced by the proposed project activity. Therefore, the spatial scope of the project boundary covers the project site and all power plants connected physically into the EPG. Geographically, the EPG is composed of Ryanggang Province, North Hamgyong Province, South Hamgyong Province and Kangwon Province.

Table.3 Emission sources and gases included in the project boundary for the purpose of calculating project emissions and baseline emissions.

Source		Gas	Included/Excluded	Justification/ Explanation
Baseline	Electricity production in the Eastern Power Grid	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	Hamhung Hydropower Plant No.1	CO_2	Excluded	The project does not lead to CO2 emission.
		CH_4	Included	Main emission from reservoir
		N_2O	Excluded	The project does not lead to CO2 emission.

B.4. Description of baseline and its development:

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The government of DPR Korea gives higher priority to the development of the electricity industry than the other sectors in the national economy according to the *"Law on electric power"* adapted on 20

November 1995 /14, 15/.

The government stipulated that the thermal power plants should be constructed in combination with other plants relying on several generation sources while giving priority to the construction of hydropower plants and large scale plants should be constructed simultaneously with small scale plants /16, 17/.

The baseline of the project activity will be decided as per the methodology AMS.I.D. (Version 17, EB61) 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 following baseline scenario options have been identified as realistic and credible alternatives to the project activity:

1. The proposed project activity undertaken without being registered as a CDM project activity
2. Thermal power generation plant with annual equivalent power generation
3. Other renewable sources power generation plant with annual equivalent power generation
4. Annual equivalent electricity supplied by EPG

The baseline scenario options described above are discussed individually considering relevant laws and regulation, as well as investment analysis:

Baseline scenario option 1: the proposed project activity undertaken without being registered as a CDM project activity

The first scenario is in compliance with relevant laws and regulations of DPR Korea, but not a mandatory project. Whether this scenario is a feasible alternative or not, it can be further judged through investment analysis. According to the investment analysis on the proposed project, without CDM revenue the IRR of the project is 3.53%, which is lower than the benchmark 5%. Therefore, the results of the sensitivity analysis confirm that the project faces significant economic and financial barriers without CDM revenue. Meanwhile, the Ministry of State Construction Control (MSCC) is responsible for decision of where the proposed project should be constructed or not in DPR Korea. MSCC do not approve such project that is unattractive economically. Therefore, the proposed project will not be approved by MSCC because of unattractiveness. So, the first scenario is not feasible.

Baseline scenario option 2: thermal power generation plant with annual equivalent power generation.

There is a large difference between thermal power and hydropower in their annual operating hours and the stability of their operation. The installed capacity of an alternative fossil fuel power plant that can provide the equivalent generation may be smaller than 10 MW. And the manufacturing technology of the small coal fire-generating equipment has not been commercialized in DPK Korea and it is difficult for county- level company to construct thermal power plant by its own efforts because of lack of experiences. Moreover, there is no thermal power plant that the installed capacity is smaller than 200 MW in DPR Korea.

Thus it cannot be considered as a feasible alternative.

Baseline scenario option 3: other renewable sources power generation plant with annual equivalent power generation

The electricity generation technologies by wave/tidal, wind, solar and geothermal sources have not been commercialized in DPR Korea and moreover, the project participant confirmed that there is no these renewable resources in the relevant area. Biomass-based power plants with a similar scale to the project

have never been built in DPR Korea. The project participant can not identify the reliable electricity generation technology by biomass resource that ensures the stable operation in DPR Korea.

Thus there are no favorable conditions for the construction of power plants based on other renewable sources. Therefore, this scenario is not a feasible scenario.

Baseline scenario option 4: the annual equivalent electricity supplied by EPG

The baseline scenario option is in compliance with relevant laws and regulations, and without financial barrier and other barriers.

Conclusion:

From the above analysis we can conclude that the fourth scenario is the most feasible scenario. As a result, in the absence of the project, electricity will be continued to be generated by the existing power plants in EPG.

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 17, EB 61) as: 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. The boundary of the proposed project is EPG, so the boundary when calculating the OM emission factor and BM emission factor are set with in EPG.

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

Table.4 Data used to determine baseline emissions

Parameter	Value	Data source
The combined margin emission factor of WPG (tCO_2e/MWh)	0.8833	Calculated based on data from Central Bureau of Statistics /26/
Net electricity supplied to WPG (MWh)	30,020	FSR
Total electricity generated by project (MWh)	30,880	FSR
Power density of the project activity (W/m^2)	4.3	FSR
Default emission factor for emissions from reservoirs of hydropower plants ($kgCO_2e$/MWh)	90	According to "*Approved consolidated baseline and monitoring methodology ACM0002*"

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:

CDM consideration

Since the government of DPR Korea adopted the "*Law of DPR Korea on Medium and Small Scale Plants*" on 11 September 2007, several institutions in South Hamgyong Province began to construct the medium & small scale hydropower plants widely in the local areas and the government encouraged their activities. So, when the project owner intended to construct a new hydropower plant, several hydropower plants had already been on construction along the Kumjin River, and other plants could not be built longer along that river, because the project is unattractive.

The "*recommendation letter of DNA*" (3 February 2009) became the key incentive to the project owner. Project owner attended the CDM-related workshop for implementing CDM projects, being held by General Bureau for Cooperation with International Organizations (GBCIO) on 11-13 July 2009. Project owner realized that he can build the unattractive hydropower plant by application of CDM at the

workshop.

Project owner requested to designate a site for a new hydropower plant and evaluate the potentiality of generation at that site to the Central Electric Power Design Institute (CEPDI), which is responsible to study on the hydropower potentiality of all rivers in South Hamgyong Province. The FSR was presented by CEPDI on 10 February 2010. FSR shows that the project is unattractive at the designated site.

CDM experts of State Academy of Sciences (SAoS) studied the FSR and confirmed CDM eligibility of proposed hydropower plant. Director-General of GBCIO agreed with the project owner that he will cooperate with the project owner in CDM project development, if the project is approved by the People's Committee of Jongpyong County (PCJC). PCJC approved the project on 17 August 2010.

According to prior CDM consideration of the proposed project, the Ministry of State Construction Control (MSCC) approved the project. The project owner made continuous efforts on preceding the project. The project owner submitted the letter of registration request to DNA and made a contract with the constructing company, bank, equipment manufactory, GBCIO and PDD developers, respectively.

The timetable of the project activity is summarized in table 5.

Table.5 The timetable of the proposed project activity

Date	Milestones
03/02/2009	Recommendation Letter of DNA
10/02/2010	Submission of FSR by CEPDI
14/04/2010	Approval of FSR by Ministry of State Construction Control (MSCC)
21/07/2010	Submission of EIA by Environment & Development Centre (EDC)
09/08/2010	Approval of EIA by Bureau of Land and Environmental Protection, South Hamgyong Province
17/08/2010	Meeting of the People's Committee of Jongpyong County (PCJC)
23/08/2010	PDD contract between GBCIO, SAoS and HEC
25/11/2010	Letter of registration request as CDM project
07/12/2010	Approval of project construction of MSCC
06/01/2011	Loan contract between HEC and Provincial Bank of South Hamgyong Province
27/01/2011	Construction contract between HEC and Hamhung Construction Company (HCC)
25/02/2011	Starting of project construction
14/07/2011	Equipment contract between HEC and RMC
21/07/2011	Electricity contract between HEC and Jongpyong Grid Company (JGC)
22/08/2011	LoA by DNA

2. Investment barrier

The provisions of Attachment A to Appendix B of the *simplified 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 participant, 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. Without the revenue from CDM, the Project would never be implemented.

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

(1) Determination of appropriate analysis method

Though not applicable, as it is a small scale project activity, Additionality Tool (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 "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) will be used to identify whether the financial indicators, Financial Internal Return Rate (IRR) in this project is better than relevant benchmark value.

(2) Selection and Validation of Appropriate Benchmarks

EB 61 Report Annex 13, "Guidelines on the Assessment of Investment Analysis" (Version 04), section 12 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 (WACC) 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 13 requires: "In the cases of projects which could be developed by an entity other than the project participant the benchmark should be based on parameters that are standard in the market."

According to the "Guideline for determination of main parameters of hydro power plants" (MSCC, 2006), it stipulated that the project must be not implemented, in cases where the IRR of hydropower project is less than 5%. Therefore, the threshold can be used as benchmark.

- ✓ This benchmark is widely used in assessing their economic attraction in design institutes of hydropower plants.
- ✓ This benchmark is publicly available data sources and can be clearly validated by the DOE.
- ✓ This benchmark is used in making the financial decision by project owners.

3. Calculation and comparison

Based on the 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 EPG (MWh)	30,020	Feasibility study report
Total investment(10,000 KPW)	70,424	Feasibility study report
Annual loan rate (%)	3.6	Guideline for determination of main parameters of hydro power plants
The price of electricity to be sold to EPG (KPW/kWh)	1.98	Guideline for determination of main parameters of hydro power plants
Rate of depreciation of equipments (%)	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

Base on the data given in table 6, calculating the total investment on the IRR without sale revenue of CER, IRR is lower than the benchmark 5% as 3.53%. Therefore, the project is unattractive and requires the additionality.

With the sale revenue of CER, the IRR of project on the total investment is 7.88% and exceeds the benchmark 5%. In this case, the project is attractive, which means, as a result, that the revenue of CDM is able to help the project to overcome the investment barrier.

Sensitivity analysis

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

EB 61 Report Annex 13, "Guidelines on the Assessment of Investment Analysis" (Version 04), section 20 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 M&O cost;
- Feed-in Electricity;
- 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 figure3 provides a graphic depiction.

Table.7 Result of sensitivity analysis

Item	-10%	-5%	0	5%	+10%	IRR equal to 5%
Fixed assets investment	4.12%	3.81%	3.53%	3.27%	3.04%	-21.60%
Annual O&M cost	3.64%	3.58%	3.53%	3.47%	3.41%	-25.30%
Feed-in electricity	2.87%	3.20%	3.53%	3.85%	4.18%	22.60%
Electricity price	2.87%	3.20%	3.53%	3.85%	4.18%	22.60%

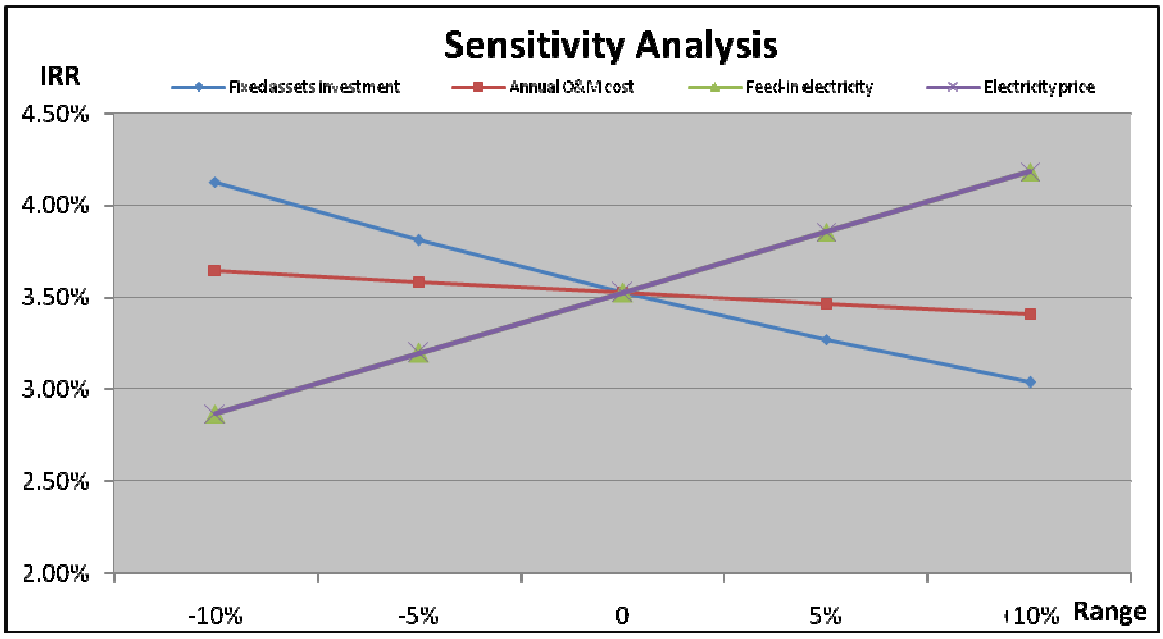

Fig3. The IRR Sensitivity Analysis with the changes of Total Investment, Annual M &O Cost, Feed-in Electricity and Electricity Price

As shown in the table7 and figure 3, with the four Variations of ±10% having been considered, the conclusion is that with reasonable changes in the critical assumptions, the IRR will remain lower than the benchmark rate 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 change from 4.12% to 3.04%. As a result, although the total investment changes in the range of ±10%, the project IRR would not reach the benchmark 5%. If the total investment decreases by 21.60%, the IRR will reach the benchmark.

Total investment is the minimum cost that was calculated by special design institute. By the way, there may be unexpected damages due to engineering mistake and floods in the rainy season and so on. Meanwhile, it is guessed that new technologies and methods will not be proposed to reduce the investment during the construction as for the technological force of project owner enterprise. And due to the lack of practice on the construction of hydro power plants, the investment will increase than the budget. Therefore, according to the previous guess, the investment seems to increase rather than 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 increase, the project IRR also increase.

If the electricity supplied to the grid changes by 10%, the project IRR would change from 2.87% to 4.18%. This is smaller than the 5% of benchmark. Meanwhile, it was calculated that when the annual grid-in electricity increases by more than 22.60%, the IRR reaches the benchmark. The electricity output estimated in FSR is the expected value based on hydro-meteorological data for the past 30 years in the designated region. So the electricity will not be changed so much during the operation period.

From this point, 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 from 2.87% to 4.18%. If the electricity price increases by 22.60%, the project IRR will reach the benchmark.

HEC and HCC stipulated the electricity price as 1.98 KPW/kWh during the operation period in their contract. According to this contract, the electricity price will not be changed during the operation period. Meanwhile, the electricity price is strictly controlled by the government and can not be changed by project participants freely.

As a result, there will not be such case that the project IRR improve with increase of electricity price.

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

- **O&M cost**

When the O&M cost decreases, the project IRR increases.

With a decrease in the annual operation & maintenance cost by 10%, the IRR only rises by 0.2%, which is very little. But, once the plant put into operation, O&M cost will not be changed significantly. Therefore, the project IRR can not increase by adjusting the annual operation cost.

Conclusion

We therefore conclude 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, electrical power will be supplied by the EPG, which partly depends on thermal power as its energy source. The specific project activity will not be implemented without the

registration as a CDM project and will not reduce GHG emissions below the baseline. Therefore, the specific project activity is additional.

B.6. Emission reductions:

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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 17, EB 61) is used in conjunction with the "*Tool to calculate the emission factor for an electricity system* (Version 02.2.0)". 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_2e/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.

Method (a) has been selected for baseline calculations of the proposed project because the data of the year in which project generation occurs is very difficult to acquire. Therefore the emission factor has been calculated using the procedures in the "*Tool to calculate the emission factor for an electricity system*".

According to "*Tool to calculate the emission factor for an electricity system* (Version 02.2.0)", 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. Calculate BM emission factor.

STEP 6. Calculate CM emissions factor.

Step 1: Identify the relevant electricity systems

For determining the electricity emission factors, a project electricity system and a connected electricity system should be defined.

If the DNA of the host country has published a delineation of the project electricity system and the connected electricity systems, these delineations should be used.

Because the DNA of DPR Korea has published a delineation of the project electricity system and connected electricity systems, the electricity generated by the project will be transmitted to the EPG. As for EPG, there is none of electricity transferring from connected electricity system to the project electricity system, so it is not referred to electricity imports.

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 because the off-grid power plant/unit which complies with conditions in the "tool to calculate the emission factor for an electricity system" (version 02.2.0) doesn't exist in the EPG.

Step 3: Select a method to determine OM

According to "tool to calculate the emission factor for an electricity system" (Version 02.2.0), four alternatives could be used to calculate the OM:

(a) Simple OM; or

(b) Simple adjusted OM; or

(c) Dispatch data analysis OM; or

(d) Average OM.

According to this "Methodological Tool", the simplified CM method can only be used if:

- The project activity is located in a Least Developed Country(LDC) or in a country with less than 10 registered projects at the starting date of validation; and
- The data requirements for the application of step 5 cannot be met.

Under the simplified CM, OM emission factor must be calculated using the average OM.

For the proposed project, simplified CM method can be applied because the project is located in DPR Korea with less than 10 registered projects and the data requirements for the application of step 5 cannot be met.

So, to determine OM emission factor, average OM (d) was chosen.

For the average OM, emission factor can be calculated using either ex-ante option or ex post option.

- *Ex ante* option: if the *ex ante* option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is required. For grid power plants, a 3-year generation-weighted average should be used, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation. For off-grid power plants, a single calendar year within the 5 most recent calendar

years prior to the time of submission of the CDM-PDD for validation should be used.

- *Ex post* option: if the *ex post* option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emission factor to be updated annually during monitoring. If the data required to calculate the emission factor for year *y* is usually only available later than six months after the end of year *y*, alternatively the emission factor of the previous year *y-1* may be used. If the data is usually only available 18 months after the end of year *y*, the emission factor of the year proceeding the previous year y-*2* may be used. The same data vintage (*y, y-1or y-2*) should be used throughout all crediting period.

Ex ante option was employed for OM calculation of the proposed project, without requirement to monitor and recalculate the emissions factor during the crediting period.

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

The average OM emission factor is calculated as the average emission rate of all power plants serving the grid, using the methodological guidance of the simple OM, but including in all equations also low-cost/must-run power plants.

The average 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).

To calculate OM of the proposed grid, Option B is applied because:

- The net electricity generation and a CO_2 emission factor of each power unit serving in the proposed grid is not available, and
- The renewable power generation is considered as low-cost/must-run power sources in DPR Korea, and
- Off-grid power plants are not included in the calculation

Under Option B, the average OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, 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:

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

Where:

$EF_{grid,OMaverage,y}$ = Average 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, 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, 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*.

Based on most recent 3years data of the annex 3, the average OM emission factor is 0.883 tCO_2e/MWh.

Step 5: Calculate BM emission factor

Plants in EPG have units that are different in the launched date, generation output and consumption of fuel. The information of each power unit in EPG is very difficult to acquire in DPR Korea. So, the sample group of power units used to calculate BM could not be determined as per the procedure in the methodology. Thus, BM emission factor is zero.

Step 6: Calculate CM emissions factor

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

(a) Weighted average CM: or

(b) Simplified CM

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

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

- The project activity is located in a Least Developed Country (LDC) or in a county with less than 10 registered projects at the starting date of validation; and
- The data requirements for the application of step 5 above cannot be met.

For our project, the simplified CM method (option A) was selected due to:

- The project activity is located in DPR Korea with less than 10 registered projects at the starting date of validation; and
- The data requirements for the application of step 5 above cannot be met.

The CM is calculated using equation (3) below with the following conditions:

- w_{BM}=0 ;
- w_{OM}=1 ;

CM emissions factor is calculated as follows:

$$EF_{grid, CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM} \quad (3)$$

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_{BM} = Weighting of BM emissions factor (%)

From the formula (3), $EF_{grid, CM,y}$ = 0.883 tCO_2/MWh

From the formula (1), BE_y = 30,020×0.883=26,508 tCO_2

Project emissions

According to the ACM0002 (version 12.1, EB 58), the PD of the project activity is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \quad (4)$$

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:

$$PD = Cap_{PJ} / A_{PJ} = 10/2.3 = 4.34\ W/m^2 \quad (5)$$

Because PD of the proposed project is greater than 4 W/m^2 and less than 10 W/m^2, emissions from the reservoir should be considered according to the following formula:

$$PE_{HP,y} = EF_{Res} \cdot TEG_y / 1{,}000 \quad (6)$$

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)

From this formula, project emissions from water reservoirs is 2,779 tCO_2e.

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.

$$LE_y = 0 \quad (7)$$

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (8)$$

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;

$$BE_y = EG_y \cdot EF_{grid,CM,y} = 23\ 728\ tCO_2e \quad (9)$$

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:	Volume 2 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	Refer to Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default values are world-widely used.
Any comment:	IPCC data

Data / Parameter:	$FC_{i,y}$
Data unit:	**Gg**
Description:	The amount of fuel *i* consumed in EPG 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 :	The data from Central Bureau of Statistics is official statistics and publicly accessible and reliable data source.
Any comment:	Official data

Data / Parameter:	EG_y
Data unit:	**MWh**
Description:	Net electricity generation produced and delivered by all units connected in EPG 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 :	The data from Central Bureau of Statistics is official statistics and publicly accessible and reliable data source.
Any comment:	Official data

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:	Volume 2 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	Refer to Annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default values are world-widely used.
Any comment:	IPCC data

B.6.3 Ex-ante calculation of emission reductions:

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The baseline emission factor is shown in the table 8

Table 8. Calculation of CM in EPG (tCO_2e/MWh)

OM	BM	CM
0.883	0	0.883

Because the electricity supplied from the project to the EPG is 30,020 MWh, the project emission reductions are calculated as follows:

Baseline emissions

$BE_y=EG_y*EF_{grid,CM,y}=30,020\times0.883=26,508\ tCO_2e$

Leakage

As mentioned in the B6.1 $LE_y=0$

Project emissions

$PE_{HP,y}=2,779\ tCO_2e$

Emission reductions

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

$ER_y = BE_y - PE_y = 23,728\ tCO_2e$

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

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Table 9 shows the emission reductions of the project during the first crediting period

Table 9. Estimate of emission reductions of the project during the first crediting period

Year	Estimation of	Estimation of	Estimation of	Estimation of

	project activity emissions (tCO_2e)	baseline emissions (tCO_2e)	leakage (tCO_2e)	overall emission reductions (tCO_2e)
01/01/2013	2,779	26,508	0	23,728
2014	2,779	26,508	0	23,728
2015	2,779	26,508	0	23,728
2016	2,779	26,508	0	23,728
2017	2,779	26,508	0	23,728
2018	2,779	26,508	0	23,728
2019	2,779	26,508	0	23,728
2020	2,779	26,508	0	23,728
2021	2,779	26,508	0	23,728
2022	2,779	26,508	0	23,728
Total emission reductions (tCO_2e)	**27,790**	**265,080**	**0**	**237,280**
Credible period (year)		**10**		
Annual average during the credible period (tCO_2e)		**23,728**		

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

B.7.1 Data and parameters monitored:

Data / Parameter:	TEG_y
Data unit:	**MWh/y**
Description:	Total electricity produced by the project activity, including the electricity supplied to EPG and the electricity supplied to internal loads, in year y
Source of data to be used:	FSR (Actual data will be read from meters)
Value of data	**30,880**
Description of measurement methods and procedures to be applied:	Measured continuously, recorded daily and archived on a monthly basis
QA/QC procedures to be applied:	Measurements are undertaken using watt-hour meters. Calibration should be undertaken once a year as prescribed by Quality Supervision Bureau, DPR Korea.
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:	FSR
Value of data	**30,020**
Description of	Measured continuously, recorded daily and archived on a monthly basis

measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	According to national standard, meters will be calibrated once a year. Data measured by meters will be cross checked by electricity sales receipt.
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:	FSR
Value of data	**10**
Description of measurement methods and procedures to be applied:	The capacity of the project will be recorded according to the installed units once a year.
QA/QC procedures to be applied:	The installed capacity will not be changed during the crediting period and will not affect the calculation of emission reductions by the project
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:	FSR
Value of data	**2.3**
Description of measurement methods and procedures to be applied:	The area will be monitored at the end of each year by topographical surveys and maps
QA/QC procedures to be applied:	The power density of the project is 4.3 W/m^2. This is the power density when the reservoir is full. Therefore, the area of the reservoir will not increase anymore and finally, the expected emission reductions by the project will not affect significantly.
Any comment:	

B.7.2 Description of the monitoring plan:

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This monitoring plan is applied to the Hamhung Hydropower Plant No.1 that is developing according to the "*Simplified Modalities and Procedures for Small-scale CDM Project Activities"* in South Hamgyong Province.

The objective of the monitoring plan is to ensure the complete, consistent, clear, and accurate monitoring and calculation of the emissions reductions during the whole crediting period. The project owner is mainly responsible for the implementation of the monitoring plan, and Grid Company will cooperate with the project owner.

1. Monitoring Requirements

- ✓ Real-time monitoring should be taken on gross electricity and net electricity and recording all the electricity should be carried out day by day.
- ✓ Monitoring equipment should be calibrated frequently, according to the regulation of DPR Korea.
- ✓ Net electricity should be identified by Grid Company.

2. Installation of meters and recording of data

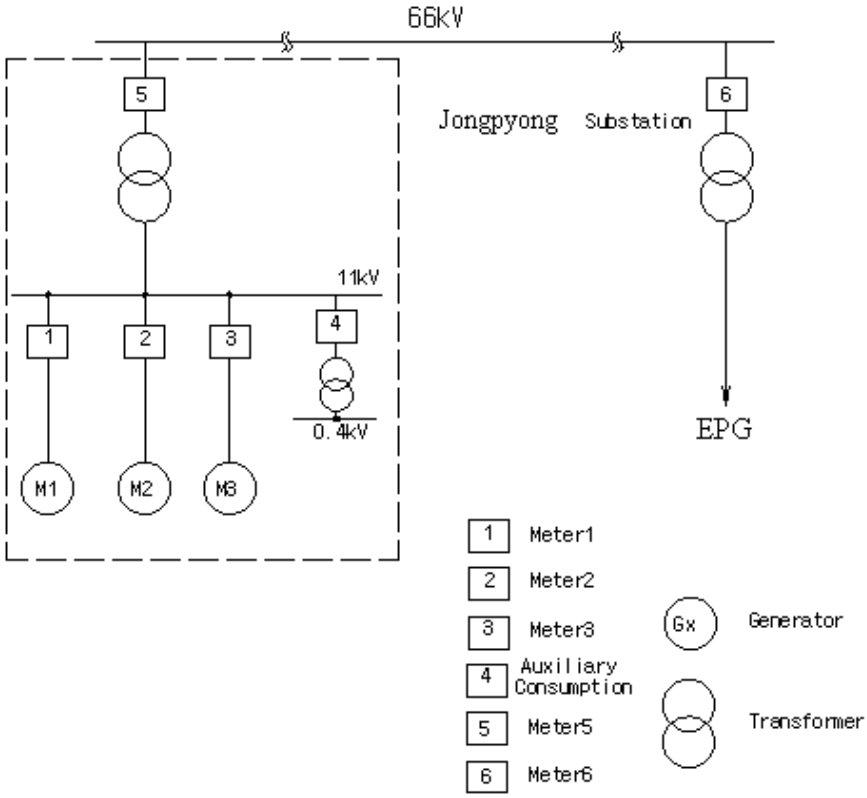

Fig.4. Monitoring system of project

Measuring meters will be installed at two places, in which first one will be located at the powerhouse of the proposed project and the other one at the 66 kV Jongpyong Substation. Fig.4 shows the monitoring system of the proposed project activity.

In fig.4, meter 1, 2 and 3 will measure the electricity generated from the generator 1, 2 and 3 respectively. Meter 4 will measure the electricity consumed by generators and meter 5 will measure the gross electricity except the electricity consumed and meter 6 will measure the net electricity supplied to the grid. And the data to be monitored will be measured at two places respectively. The meters at two places will measure the electricity that is delivered to or received from the Grid respectively. All data are metered and recorded by SCADA with computers. All data collected through the monitoring system will be archived electronically and be kept at least for 2 years after the end of the last crediting period.

3. Monitoring Organization

Monitoring team will be organized for the proposed project and monitoring officers will be appointed in the grid company.

Monitoring team will include 5 people; a team leader, a financial officer and 3 monitoring officers.

The team leader will be appointed by the project owner, who supervises and identifies metering, recording, data collecting and calculating of emission reductions and prepares a monitoring report.

The financial officer is responsible for recording and archiving data, selling the electricity and calculating emission reductions.

Monitoring officers are responsible for metering electricity to be delivered, reading meter's data and collecting data.

Monitoring officers in Grid Company are responsible for metering and recording the net electricity to be transmitted from the proposed plant, archiving the measured data and calculating the emission reductions.

The team leader in the proposed plant and monitoring officers in Grid Company will identify the electricity delivered or received once a month each other.

4. Calibration

According to the electric industry standards or regulations of DPR Korea, the calibration of electric energy meter will be carried out once a year. After verification, meters should be sealed. Both meters shall be jointly inspected and sealed on behalf of the project owner.

All the meters installed should be tested by the qualified supervision organization co-authorized by the project owner and the Grid Company once a year.

5. Data Management

The Integrated Electronic Device (IED) will be installed for the purpose of monitoring the equipment in the plant. IED will measure, record and screen all parameters such as frequency, voltage, electricity output, etc and record any accidents that would occur during the operation period. Monitoring officers will monitor the instrument and generating facilities and control the operation of the plant and take proper steps for the emergency.

Data will be archived at the end of each month using the electronic spreadsheet described. The electronic files will be stored on 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 in his office, 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 2 years after the end of the crediting period.

5. Monitoring Report

In addition, the project owner will keep sales invoices for the power delivered to the grid as a crosscheck. At the end of each crediting year, a monitoring report will be compiled detailing the metering results and evidence (i.e. sales invoices). The monitoring report should include: the monitoring of the electricity supplied to the grid, emission reductions calculation report, repair records and calibration records of the monitoring equipment.

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: 01/08/2011

Name of person determining the baseline and monitoring methodology:

CDM – Executive Board

1. Mr. Chol Ho Ham, Institute of Thermal Engineering, SAoS

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Tel: 850-2-3818111/ext-8544

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(Not a Project Participant)

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

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C.1.1. Starting date of the project activity:

>>

27/01/2011 (The starting date of the project)

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

>>

20 years

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:

>>

Not applicable

C.2.1.2. Length of the first crediting period:

>>

Not applicable

C.2.2. Fixed crediting period:

>>

C.2.2.1. Starting date:

>>

01/01/2013(or earliest date after registration)

C.2.2.2. Length:

>>

10 years

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:

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The project owner had assessed the environmental impact on the project activity as per "Law of DPR Korea on Environmental Impact Assessment". The Environmental Impact Assessment (EIA) report was approved by Bureau of Land and Environment Protection, People's Committee of South Hamgyong Province on 9 August 2010.

The report has described that the environmental impacts by the project activity are insignificant and other projects out of the project boundary are not affected by the proposed project. The report has also described the measure to reduce the environmentally negative impacts and the project will contribute to the social and economic development in the local area.

Synthesizing the result of EIA on the construction and operation of the project is as follows.

Air quality

During the construction period, the air pollution is caused due to the proposed project and there is no pollution that may affect the air quality during the operation period. The main pollutions occurred during the construction period are the suspended dust resulting from digging or filling-up worksites, soil-excavation worksite, rock-fill and aggregate processing ground for the construction of dam and exhaust gas due to the excavation of a great volume of soil, operation of building machinery and transport vehicles.

The air pollution occurred during the construction period is the pollution temporarily occurred. When the relevant measures are taken, the proposed project will not affect the air quality.

Water quality

Waste water caused by the proposed project is mainly discharged during the construction period and little discharged during the operation period.

The main waste water is the mixing wastewater produced in the concrete mixing system, oil-contained wastewater resulted from repairing and maintaining equipment, and domestic sewage caused by employees who are involved in the engineering work, etc. When these measures are taken in accordance with the pollution sources, the project will give no impact on water quality.

Eco-environment

There is no national reserve, nor rare or endangered species of fauna and flora around the project area. It rather provides a favorable condition and environment for the living and breeding of fishes by forming a reservoir. As a result, the project will give little negative impact on eco-environment.

Noise

During the construction of the proposed project it causes noise by the operation of various equipment and the rolling vehicles which are used in the engineering work. In order to reduce the noise caused by the construction of the project, the prolonged operation including the operation at night will be avoided and

the vulnerable areas to the noise (residential area close to the roads, etc) will be marked with boards and the employees who are involved in the engineering work will be worn earflaps and earplugs during the construction period. When the relevant measures are taken during the construction period, the noise impact due to the project will be minimized.

Solid waste

The solid waste due to the proposed project is produced during the construction period. The construction wastes produced during the construction period will be reused in the construction and the residue will be land-filled and recovered by planting trees. The domestic garbage produced by the employees who are involved in the engineering work in the living district will be collected in a certain place and be delivered and disposed in the designated burial ground.

When the relevant measures are taken, it will prevent the pollution due to the solid waste.

Impact on the local economy

Some farmlands and residential areas will be transformed into the reservoir due to the construction of the proposed project. For the flooded lands and dwelling houses, the project owner will be responsible for providing new substitute lands and building new dwelling houses around the project area so that the affected residents will be resettled.

By developing the aqua-culture using the reservoir water, it will contribute to the improvement of the livelihood of residents around the surrounding area and to the local economic development of the residents in this area.

In summary, the project will not have any negative impacts on the environment.

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:

>>

Bureau of Land and Environmental Protection, South Hamgyong Province estimated that the positive impacts by the project are more significant than negative impact in social and environmental aspects, because the project prohibits the damage by flood and water resource is utilized for farming reasonably.

SECTION E. Stakeholders' comments

>>

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

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In order to give the correct understanding to the local residents, the project owner has broadcasted about the project activity through radio. Also, the project owner has allowed the stakeholders to visit the construction site and to suggest the issues related with the project activity.

The comments have been collected from the local residents and stakeholders from 10 August 2010.

The People's Committee of South Hamgyong Province is responsible for collecting the comments from stakeholders.

70 residents have been randomly interviewed, including males and females from age 17 to age 65, from people educated in elementary level to the ones educated in high level, and from the ones living near the project site to the ones of local government offices. The interviewer has considered the extensiveness of the public representatives.

The comments were collected after distributing questionnaires to the residents around the project site and

employees of local government offices.

Major interviewed issues are summarized below:

- Do you know about the project of Humhung hydropower plant No.1?
- What's your attitude towards the construction of the proposed project?
- Do you want to participate in the construction and operation of the proposed project?
- If the proposed project may occupy your farmlands, are you willing to move?
- If the proposed project may flood your house, are you willing to move?
- What do you think are the impacts of the proposed project on the local environment?
- What do you think are the impacts of the proposed project on the local wildlife?
- Do you think the proposed project gives you any benefit?
- What benefit of the proposed project are in the local economy?
- Do you have any other suggestions? What are they?

Table 10 and table 11 show the information on the distribution of questionnaires and the open questions.

Table.10 Stakeholder information

Item	Content	frequency	%
Gender	Male	40	80
	Female	10	20
Ages	<30	10	20
	30-40	20	40
	>40	20	40
Education	Middle school	25	50
	University	25	50
Employment	Governmental officials	15	30
	Related employees	15	30
	Local residents	20	40

Table.11 Information of opening question

Item	content	frequency	%
Gender	male	15	75
	female	5	25
Ages	<30	14	70
	30-40	3	15
	>40	3	15
Education	Middle school	16	80
	University	4	20
Employment	Governmental officials	4	20
	Related employees	6	30
	Local residents	10	50

E.2. Summary of the comments received:

>>

All received comments are as follows.

Table.12 Questionnaires Result

Question No.	Answer			
	Positive impact	**Negative impact**	**No impact**	**Both positive and negative impacts**
1	100%	0	0	0
2	100%	0	0	0
3	100%	0	0	0
4	100%	0	0	0

The survey results shows all stakeholders believe that the proposed CDM project activity will have positive impacts on the local, ecological, environmental, employment and social life. All stakeholders have expressed their supportive opinion to the proposed Project.

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

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The public survey shows that, the local residents are all supportive to the project. Taking into account the comments received from the questionnaires, the project owner took the following measures:

(1) Purification of the wastes accumulated during the construction period and dredging of canal.

(2) Filling up the pits with wastes and construction of embankment.

(3) Recovery of agricultural land used for construction.

(4) Prohibition of lumbering for cooking and heating at near mountains.

(5) The project owner will compensate the used land and implement a resettling plan that improves the living environment of the local residents.

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

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

Annex 3

BASELINE INFORMATION

Table.13 Information of electricity supplied to the grid and fuels consumed by thermal power plants in 2007

Thermal Power Plant	Electricity (10^3 MWh)	Anthracite Consumption(Gg)	Lignite Consumption(Gg)	Crude Oil Consumption(Gg)
Pukchang	9,016	6,401		71.3
Chongjin	252		393	2.0

Data source: Central bureau of statistics, 2008

Table.14 Information of electricity supplied to the grid and fuels consumed by thermal power plants in 2008

Thermal Power Plant	Electricity (10^3 MWh)	Anthracite Consumption(Gg)	Lignite Consumption(Gg)	Crude Oil Consumption(Gg)
Pukchang	9,259	6,676		72.2
Chongjin	288		451	3.1

Data source: Central bureau of statistics, 2009

Table.15 Information of electricity supplied to the grid and fuels consumed by thermal power plants in 2009

Thermal Power Plant	Electricity (10^3 MWh)	Anthracite Consumption(Gg)	Lignite Consumption(Gg)	Crude Oil Consumption(Gg)
Pukchang	9,724	7,060		73.9
Chongjin	302		483	3.2

Data source: Central bureau of statistics, 2010

Table.16 Electricity supplied to the grid by Hydropower plants connected to EPG (10^3MWh)

Year	2007	2008	2009
Sodusu hydro power plant	1,668	1,675	1,601
Anbyon hydropower plant	907	1,007	970
Bujon hydropower plant	1,364	1,655	1,200
Hochon hydropower plant	2,043	2,448	2,374
Tongchon hydropower plant	117	88	104

Data source: Central bureau of statistics

Table.17 Information of fuels consumed for power generation

	Emission factor(tCO_2/TJ)	NCV(TJ/Gg)
Anthracite	94.6	21.6
Lignite	90.9	5.5
Crude oil	71.1	39.8

Data source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Table.18 Emission Factor in the EPG

year	2007	2008	2009	Average
Emission factor	0.878	0.858	0.915	0.8833

Annex 4
MONITORING INFORMATION

No additional information.

REFERENCES

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