CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

SECTION A. General description of project activity

A.1. Title of the project activity:

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Project title: Wonsangunmin Hydropower Plant No.1 (20MW)

Version No: 1.0

Date: 8 August 2011

A.2. Description of the project activity:

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Summary:

The Wonsangunmin Hydropower Plant No. 1 (20MW) (hereafter, the Project) – a run-of-river diversion type hydropower station – is developed by Wonsan Power Construction Complex, a provincial-level company. The purpose of the Project is to utilize the hydrological resources of the Rimjin River to generate zero-emission electricity for the Eastern Power Grid (EPG).

The proposed project activity is located in the upper stream of the Rimjin River at Yohae-ri, Popdong County, Kangwon Province, Democratic People's Republic (DPR) of Korea. The project is a run-of-river diversion type hydropower station with 20 MW (2×10 MW) hydro turbines, operated by Wonsan Power Construction Complex.

The surface area of reservoir at full level is 1.89 km^2, thus power density is 10.6 W/m^2. On the average, the project is expected to produce an average annual power generation of 96 530 MWh and a net electricity supply to the grid is expected to be 91 510 MWh. The power generated by the project will be transferred to the EPG, DPR Korea through the Wonsan substation No.1.

The baseline scenario to the proposed project activity is the situation prior to the implementation of the project activity, that is, the electricity generated by the power plants appertained to the EPG is supplied to local areas.

How the proposed project activity reduces greenhouse gas (GHG) emissions:

As a hydropower project, it will supply clean and reliable power to local areas, displacing thermal power plants in the EPG, DPR Korea and thus reducing the GHG emissions to 67 260 tCO_2e annually.

Contribution of the proposed project activity to sustainable development:

The project is located at Popdong County of Kangwon Province, a mountainous area in the eastern of DPR Korea territory. Due to the severe lack of energy supply to local residents and insufficient fuel resources, nearby forests have been used by local residents for heating and cooking.

As a renewable energy project, the proposed project will bring with positive environmental and economic benefits for local sustainable development. The specified aspects are as follows:

- To be consistent with DPR Korea's national energy development strategy /27, 28, 29/ to improve the local infrastructure facilities and to alleviate power shortage in the local areas;
- To displace some of the electricity generated by fuel-fires power plants in the EPG and to supply zero-emission electricity, and thus to avoid environmental pollution from coal combustion;
- To improve the residents' living standard;
- To create new job opportunities for the local people: approximately 60 permanent jobs will be created during the operational years.

In conclusion, it is clearly in compliance with the development strategy of DPR Korea's government, which contributes to sustainable development of the local community, the host country and the world.

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 Part y involved wishes to be considered as project participant(Yes/No)
Democratic Peoples' Republic of Korea (host)	Wonsan Power Construction Complex (as the project owner)	No
Czech Republic	Topič Energo s.r.o. (as the project buyer)	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

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Democratic Peoples' Republic of Korea

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

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Kangwon Province

A.4.1.3. City/Town/Community etc.:

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Popdong County/Yohae-ri

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

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The proposed project site is 40 kms away from Wonsan City and located in the upstream of the Rimjin River at Yohae-ri, Popdong County, Kangwon Province, DPR of Korea.

The exact geographical location of barrage is E 127°07′ 02″ and N 39°03′20″ respectively. More details about the proposed project can be seen in Fig A.1:

Fig A.1. Map showing the location of project

A.4.2. Category(ies) of project activity:

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Sectoral Scope 1: Energy industries (renewable sources).
The project activity falls under the category of "grid-connected renewable power generation project activities by water sources".

A.4.3. Technology to be employed by the project activity:

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The project is run-of-river diversion type hydropower station and the total installed capacity is 20 MW (2 × 10 MW). The construction of the project is consisted of rock fill dam (non-over flow dam, overflow dam), intake, diversion tunnel, penstock, surge tank, tailrace, powerhouse and step-up substation /2/.

The dam is 63 m in height and 390 m in length. The normal water level and dead water level of the reservoir are 395 m and 372 m, respectively. The total volume of the reservoir is 0.116 km^3, the valid volume 0.099 km^3, the water surface area of the reservoir at full level is 1.89 km^2, and thus the power density is 10.6 W/m^2 /2/.

The diversion tunnel is 16 149 m in length and 3m in diameter. The penstock is 615 m in length and 1.2-2.5 m in diameter. The hydro turbines to be used in the project are two turbines (10.526 MW rated power apiece). The turbines and generators are produced and provided by the Taean Heavy Machinery Complex /2/.

Table A.1 shows the details of the technical data of the hydro turbines and generators.

Table A.1. Key Technical specifications of water turbines and the generators

Turbine		
Parameters Name	**Unit**	**Value**
Type	/	Turbine 683-vertical 161
Installed number	unit	2
Diameter	m	1.61
Rated rotate speed	rpm	514
Rated water head	m	166
Maximum flow quantity	m^3/s	14.8
Rated output	MW	10.526
Efficiency	%	92
Manufacturer	/	Taean Heavy Machinery Complex
Generator		
Type		Synchronization-verticality-length 10 MW

Installed Capacity per set	MW	10
Installed number	unit	2
Frequency	Hz	60
Voltage	kV	6.6
Rated efficiency	%	95
Rated rotate speed	rpm	514
Power Coefficient	Cosψ	0.8
Manufacturer	/	Taean Heavy Machinery Complex

The electricity generated by the project will be transmitted to the Wonsan transformer substation, and then to the EPG, DPR Korea.

There is no technology transfer from abroad because all the employed technology is domestic.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

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The project has chosen the renewable crediting period (3 × 7 years) and the estimation of the emission reductions in the first crediting period (1 April 2012 to 31 March 2019) is presented in Table A.2. Estimated emission reductions throughout the crediting period are 470 820 tCO_2e.

Table A.2. The Estimation of the Emission Reductions in the Crediting Period

Year	Annual estimation of emission reductions in tones of CO_2e
2012	50 445
2013	67 260
2014	67 260
2015	67 260
2016	67 260
2017	67 260
2018	67 260
2019	16 815
Total estimated reductions (tones of CO_2e)	470 820
Total number of crediting years	7
Annual average over the crediting period of estimated reduction(tones of CO_2e)	67 260

A.4.5. Public funding of the project activity:

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

SECTION B. Application of a baseline and monitoring methodology

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

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Methodology used for the proposed project is the approved consolidated baseline and monitoring methodology ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources." (Version 12.10)

The project also refers to "Tool for the demonstration and assessment of additionality" (Version 05.2, EB 39), "Combined tool to identify the baseline scenario and demonstrate additionality" (Version 03.0.0, EB 60) and "Tool to calculate the emission factor for an electricity system" (Version 02.1.0, EB 60).

For more information regarding the methodology, please refer to UNFCCC website at the following link: http://cdm.unfccc.int/methodologies/PAmethodologies /approved.html.

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

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The project applies the consolidated baseline methodology ACM0002 (Version 12.10) to determine the project baseline and calculate GHG emission reductions, and meets all applicability criteria of ACM0002 (Version 12.10) as follows:

1. The Project is a run-of-river diversion type hydropower project; and the electricity generated by the Project will be supplied into the EPG, so it is grid-connected electricity generation project from renewable sources. The installed capacity is 20 MW.
2. The electricity capacity addition is from a new hydropower project with a new reservoir. And the power density is 10.6 W/m^2, which is greater than 10 W/m^2.
3. The project does not involve switching from fossil fuels to renewable energy at the Project site.
4. The geographical and system boundaries for the EPG can be clearly identified and information on the characteristics of the grid is available.

Accordingly, the approved consolidated baseline methodology ACM0002 (Version 12.10) is applicable to the proposed project.

Data and information used in the PDD of the project are mainly sourced from the project Feasibility Study Report (FSR).

B.3. Description of the sources and gases included in the project boundary:

According to the definition of project boundary by ACM0002 (Version 12.10), the project boundary includes the project site (including the reservoir area) and all power plants appertained to the EPG of DPR Korea that is the electricity system where the project is connected to.

Table B.1. Description of How the Sources and Gases are included in the Project Boundary

	Source	Gas	Included/ Excluded	Justification/Explanation
Baseline	Electricity generation by the EPG	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project Activity	Proposed Project	CO_2	No	Minor emission source
		CH_4	Yes	The project is grid-connected electricity generation from a hydropower station with power density of 10.6 W/m^2 (which is greater than 10 W/m^2, there is no need to take in to account CH_4 emissions, according to methodology ACM0002, without CH_4 emission.
		N_2O	No	Minor emission source

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

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"Combined tool to identify the baseline scenario and demonstrate additionality" (Version 03.0.0, EB 60) is applied in this section.

Step 1: Identification of alternative scenarios

This step serves to identify all alternative scenarios to the proposed CDM project activity that can be the baseline scenario through the following Sub-steps:

Step 1a: Define alternative scenarios to the proposed CDM project activity

Since the project activity is the installation of a new grid-connected renewable power plant, the baseline scenario is the following:

Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculation described in the "Tool to calculate the emission factor for an electricity system".

There are 4 credible baseline scenarios;

1) The proposed project activity undertaken without being registered as a CDM project activity;

2) Construction of a fossil fuel-fired power plant with an equivalent amount of installed capacity or annual electricity generation;

3) Construction of a power plant using other sources of renewable energy with equivalent amount of annual electricity generation; and

4) The continuation of the current situation: provision of an equivalent amount of annual electricity generation by the EPG where the Project is connected into.

Sub-step 1b: Consistency with mandatory applicable laws and regulations

Scenario 1: The proposed project activity undertaken without being registered as a CDM project activity

This scenario is in consistency with the current laws and regulations in DPR Korea /27, 28, 29/, but not mandatory. Whether the scenario is applied or not is decided through the investment analysis (section B.5). According to the investment analysis, without the CDM revenue, the total investment IRR of the Project is less than the benchmark level 5%, thus the Project is economically unattractive /2/. This is considered more detail in section B5. Therefore Scenario 1 is not a feasible alternative and it is not the baseline scenario.

Scenario 2: Construction of a fossil fuel-fired power plant with an equivalent amount of installed capacity or annual electricity generation

The installed capacity of the Project is 20 MW. Considering the fossil fuel-fired power plants that can generate the same annual electricity as the alternative scenario for the proposed project, the installed capacity of the fossil fuel-fired power plant would be less than 20 MW. There is no coal output enough to operate thermal power plants in Kangwon Province.

The nearest coal mine from the project site is the Kowon Coal Mine Complex. At present, the annual output of this Coal Mine Complex is very small, thus it is impossible for the mine to supply thermal power plants with coal. And then, in case that coal would be supplied from other coal mines such as the Pukchang Coal Mine Complex in South Pyongan Province, it is also impossible because the Pukchang Coal Mine Complex could not meet the allocated demand of thermal power plants and furthermore impossible because of its limitation in production and costly transportation to the project site. No crude oil and natural gas resource have been undiscovered in DPR Korea /1/. Therefore, the operation of oil or natural gas power plants is of high cost and low stability. Thus the scenario 2 is not feasible and it is not the baseline scenario.

<u>Scenario 3:</u> **Construction of a power plant using other sources of renewable energy with equivalent amount of annual electricity generation;**

The Project site is surrounded by mountainous, so a certain amount of wind resources exist in the project site. And the construction of wind farm that has the equivalent amount of annual electricity generation needs high cost and its technology is not mature in DPR Korea. Therefore, the construction of wind farm is not yet discussed. There exists some possibility to use tidal and wave energy for the project site where is near the seaside (the Korean East Sea), but they are not mature technologically and have high cost in DPR Korea. Therefore, it is also impossible. This is likewise in solar energy field. The power generation technology by solar energy is far from being mature in DPR Korea. The photovoltaic power generation technology is also poor in DPR Korea. It is also impossible to generate electricity from biomass and geothermal resources for the reason that biomass resource is not sufficient and no geothermal resource has been exploited in the project site.

In a word, the electricity generation by renewable resources needs high cost and the technology is not mature in DPR Korea. For the above reasons, the third scenario is therefore not feasible nor is the baseline scenario.

<u>Scenario 4:</u> **The continuation of the current situation: Provision of an equivalent amount of annual power output by the EPG which the project is connected to.**

Scenario 4 is economically viable, and in compliance with current national laws and regulations.

Conclusion:

From above analysis, in the absence of the Project, the most plausible and credible alternative is scenario 4 Provision of an equivalent amount of annual power output by the EPG which the Project is connected into.

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 CDM project activity (assessment and demonstration of additionality):

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The additionality of the project is demonstrated and assessed by using the *"Tool for the Demonstration and Assessment of Additionality" (Version 05.2)* approved by EB. Please see UNFCCC website:

http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf

At the time the project owner received Feasibility Study Report (FSR) from Central Electric Power Design Research Institute, Ministry of Electricity Industry in March, 2009. They found the Project could not overcome the barriers in its low IRR, which can not reach the benchmark IRR.

Meanwhile, the project owner tried to find out a solution to make the Project financially attractive. They could not start the construction of the Project till they heard about CDM from the DNA' notice in February, 2010 /3/. The notice from the DNA mentioned that the implementation of the project with CDM could increase the Project IRR and thus make the project financially feasible.

Subsequently, the project owner started to focus on the UNFCCC and Kyoto Protocol, and collected information about CDM, at the same time they decided not to carry the Project out without CDM support. The project owner held a board meeting to decide the development of the Project as a CDM project. On 13 June 2010, at the board meeting, they have discussed the arrangement for developing Wonsangunmin Hydropower Plant No.1 (20MW) as a CDM project. All the board members considered the IRR of this project is lower than the benchmark IRR, but with the revenue from the CDM, the IRR of the project can increase to a normal level (higher than the benchmark IRR) and guarantee the investor's profit. All the board members agreed to develop the Wonsangunmin project as a CDM project /7/.

The project owner contracted with Kangwon bank for the loan on 29 June 2010 and this date is the Project starting date /9/. At same time, they began to seek for consultant agent. On 21 July 2010, the project owner contracted with General Bureau for Cooperation with International Organization (GBCIO) and State Academy of Sciences (SAoS) to help them applying CDM to Wonsangunmin Hydropower Plant No.1 (20MW)/11/.

From the analysis mentioned above, it is evident that the project owner has considered CDM support carefully before starting the project.

During this period, the GBCIO and SAoS acquired the data and documentation for PDD development, and developed the draft PIN & PDD. In November 2010, the project owner applied the project to the DNA /12/ and after its submission of the application, the project owner singed the Equipment Purchase Contract with Taean Heavy Machinery Complex on 1 December 2010 /13/. On 5 January 2011, the project owner received the Letter of Endorsement from DNA /14/ and with that contracted the Power Purchase Agreement with Power Distribution Station Company in Kangwon Province /15/. In the course of time, the project owner received the Letter of Approval of DNA on 8 April 2011 /16/.

Please find below a detailed timeline of the project implementation in the following table.

Table B.2. The timetable of the project implementation

Date	Key Event
6 March 2009	Feasibility Study Report
3 December 2009	Approval of Land use /4/
15 February 2010	Environmental Impact Assessment Report
3 April 2010	Approval of Environmental Impact Assessment Report
13 June 2010	The project owner decided to apply for CDM
25 June 2010	Construction Approval /8/

29 June 2010	Loan contract with Kangwon Bank
29 June 2010	Starting of construction(the earliest starting date of the project) /10/
21 July 2010	PDD Development Contract with GBCIO and SAoS
15 November 2010	Application of project to the DNA
1 December 2010	Equipment Contract
5 January 2011	Letter of Endorsement
26 February 2011	Power Purchase Agreement
8 April 2011	Letter of Approval

In accordance to the requirement of the ACM0002 Version 12.1.0, the additionality of the proposed project activity is demonstrated and assessed using the latest version of the "Tool for the demonstration and assessment of additionality" (version 05.2) approved by EB, as following steps:

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Define realistic and credible alternatives to the project activity through the following Sub-steps:

Sub-Step 1a. Define alternatives to the project activity

Outcome of Step 1a:

As mentioned in the Section B.4 above, identified realistic and credible alternative scenarios to the project activity include:

1) The proposed project activity undertaken without being registered as a CDM project activity;

2) Construction of a fossil fuel-fired power plant with an equivalent amount of installed capacity or annual electricity generation;

3) Construction of a power plant using other sources of renewable energy with equivalent amount of annual electricity generation; and

4) Provision of an equivalent amount of annual electricity generation by the grid where the project is connected to.

Sub-Step 1b. Consistency with mandatory laws and regulations:

Outcome of Step 1b:

The alternatives 1) ~ 4) are in compliance with all mandatory applicable legislation and regulations in DPR Korea.

Step 2. Investment Analysis

The purpose of Step 2 is to identify that without the revenues from the sale of certified emission reductions (CERs), the Project is economically and financially less attractive than alternative 4. To conduct the investment analysis, the following sub-steps are used:

Sub-Step 2a. Determine appropriate analysis method

The *"Tool for the Demonstration and Assessment of Additionality (Version 05.2)"* recommends three analysis methods which are:

Option I: Simple cost analysis;

Option II: Investment comparison analysis;

Option III: Benchmark analysis;

Since the project will earn revenues not only from the CERs sales but also from electricity sales, the simple cost analysis method is not appropriate. Investment comparison analysis method is only applicable to projects whose alternatives are similar investment projects. However, the most credible alternative of the Project is the provision of equivalent amount of annual electricity output by the EPG, DPR Korea. This alternative is not an investment project, so the investment comparison analysis can't be applied. The benchmark IRR of total investment is available, so the benchmark analysis is chosen.

<u>Conclusion</u>: Option III is only appropriate for the analysis of the additionality of the project activity.

Sub-step 2b. Option III. Apply benchmark analysis

According to the "Guideline for Determination of Main Parameters of Hydropower Plant" issued by the Ministry of State Construction Control in 2006, the benchmark of the financial internal rate of return (after tax) for a hydropower project with the capacity of more than 1 MW is 5%. The calculation and comparison of financial indicators are carried out in sub-step 2c based on this benchmark.

Although the applied IRR benchmark was issued in 2006, which is still the most specific benchmark for this type of project. It was confirmed again in 2010 by the Ministry of State Construction Control that this benchmark is still in effect in 2010. Therefore the 5% benchmark /17/ is representing the common practice of DPR Korea for investment decision processes for hydro projects.

Sub-step 2c. Calculation and comparison of financial indicators (only applicable to options II and III):

1) Key parameters for calculation of financial indicators

The parameters are sourced from the project FSR, which was completed by the Central Electric Power Design Research Institute in March, 2009.

This institute is an authorized and qualified organization responsible for the development of hydropower resources in DPR Korea.

The basic parameters for the calculation of the key financial indices are provided in Table B.3:

Table B.3. The Basic Finance Parameter of the Project

Parameter		Value	Source
Installed capacity (MW)		20	Feasibility Study Report
Annual power supplied to the Grid (MWh)		91 510	Feasibility Study Report
Bus-bar tariff (KPW/kWh)		1.98	Feasibility Study Report
Crediting period (the first crediting period)		7 years	---
Expected CER price (USD/tCER)		10	---
Operation period (years)		20	Feasibility Study Report
Total investment (Million KPW)		2 163	Feasibility Study Report
Interest during construction (Million KPW)		57	Feasibility Study Report
Depreciation rate (%)	construction	2	Feasibility Study Report
	equipment	5	
Income tax (%)		30	Feasibility Study Report

2) Comparison of IRR for the proposed project and the financial benchmark

In accordance with the benchmark analysis (option III), if the financial indicators of the proposed Project such as the Project IRR, are lower than the benchmark, the proposed Project is not considered as financially attractive.

During the feasibility study stage, it was found that the IRR of total investment would not reach the benchmark. The project owner then discovered that potential CERs revenue could help the project to be financially more attractive when the CDM was introduced to the project. The project owner thus considered CERs revenue as an important income source when implementing the project.

Table B.4 shows the Project IRR with and without the revenue of CERs. Without the revenue of CERs, the Project IRR is 3.92% which is lower than the financial benchmark of 5%. So, the project faces obvious financial barriers without CDM revenue.

Table B.4 IRR of the Project

Financial indicators	Without income from CDM	Benchmark	With income from CDM
IRR	3.92%	**5%**	7.58%

Sub-step 2d. Sensitivity analysis (only applicable to options II and III)

We choose the following parameters to conduct sensitivity analysis so to confirm whether the conclusion of low economic attractions still exists when the key hypothesis has changed reasonably:

1. Fixed assets investment
2. Annual O&M cost
3. Feed-in-Tariff excluding VAT
4. Feed-in electricity

In the FSR, sensitivity analysis was conducted to check under variation of ±10%, so variations of ±10% have been considered for these parameters. Table B.5 summarizes the results of the sensitivity analysis, while Figure B.1 provides a graphic depiction.

Table B.5. Results of Sensitivity Analysis

Item	-10%	-5%	0	5%	+10%
Fixed assets investment	4.67%	4.28%	3.92%	3.60%	3.31%
Annual O&M cost	4.02%	3.97%	3.92%	3.87%	3.82%
Feed-in electricity	3.24%	3.58%	3.92%	4.26%	4.60%
electricity tariff	3.24%	3.58%	3.92%	4.26%	4.60%

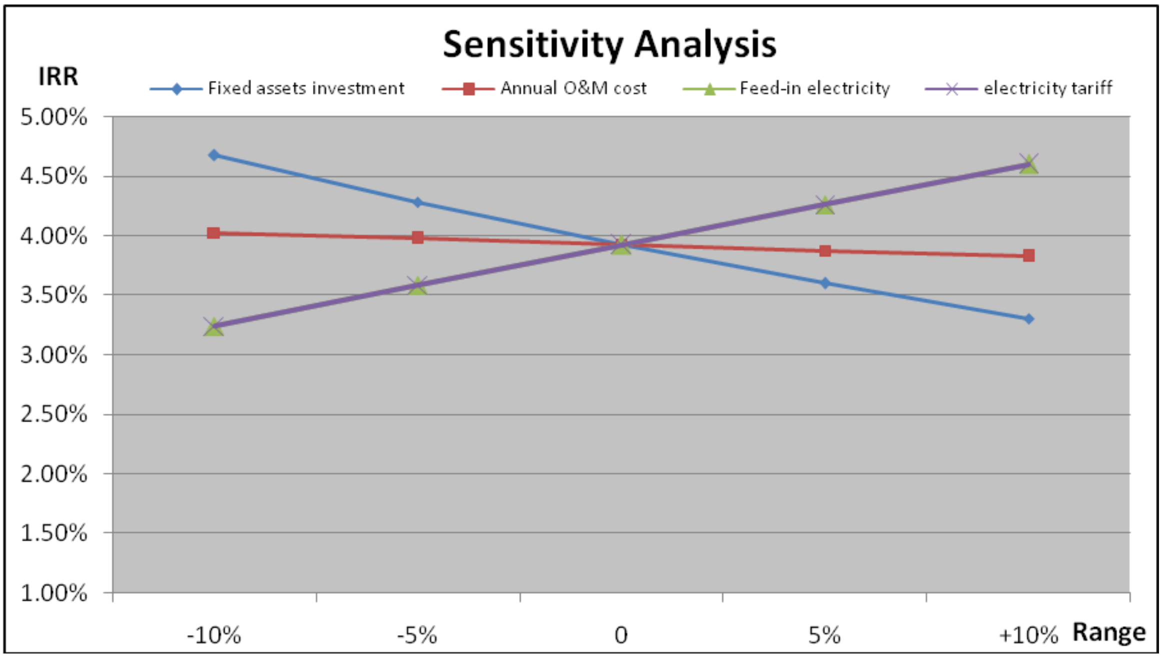

Fig B.1. IRR Sensitivity Analysis

Figure B.1 shows that none of variations can raise the IRR of the proposed project higher than the benchmark of 5%.

When a decrease in fixed assets investment has reached 13.8%, the Project IRR can reach the benchmark. However, the fixed assets investment of the project is larger than the value estimated in the Feasibility Study Report. The project is still under construction, so the actual investment will be higher. Therefore, it is impossible to improve the economic attraction of the project due to the increase in fixed assets investment.

Further, when an increase in electricity supplied to the grid reaches 16.1%, the Project IRR can reach benchmark. The electricity output described in the Feasibility Study Report is the estimated value based on the survey result of the water resource in the project site for 30 years. The hydrometeorology data in the project site was sourced from the Central Hydrometeorology Institution /18/, authoritative hydrometeorology research institution in DPR Korea. Therefore, the electricity output estimated in the Feasibility Study Report could not be changed largely.

When an increase in Feed-in-tariff has reached 16.1%, the Project IRR can reach benchmark. But, according to the decision of the State Price Assessment Committee in August, 2001 /19/, the Feed-in-tariff in DPR Korea is 1.98 KPW/kWh (excluding VAT). The Feed-in-tariff will be not changed unless the State Price Assessment Committee would change the Feed-in-tariff. And the Feed-in-tariff in DPR Korea is getting lower and lower. Considering the current trend in Feed-in-tariff, the Project IRR can not reach the benchmark due to the change in Feed-in-tariff.

As can see in the Table B.5, the sensitivity of the Annual O & M cost is very low. The Annual O & M cost is calculated according to the data from approved FSR. Thus the actual Annual O & M cost will be increased due to the increased salary. In conclusion, considering the increase of employees' payroll and other fixed indexes of Annual O & M cost, the Annual O & M cost used is conservative and credible. Therefore, it is also impossible to adjust Annual O & M cost to raise the IRR significantly.

In the other hand, the whole investment IRR will increase greatly when the project receives the CERs revenue. If the CERs price is taken as 10 USD/tCO_2e into account, the Project IRR reaches 7.58% which is greater than the benchmark, thus the repayment of capital and interest will be raised and the financial situation will be improved. It is obvious that the benefits come from the CDM help the Project owner in releasing the financial pressure that would otherwise obstruct the project activity.

Outcome of Step 2:

The sensitivity analysis shows that without CER revenue, IRR of the project is difficult to reach the benchmark, which supports the conclusion, that the proposed project is unlikely to be financially attractive.

Step 3. Barrier Analysis

As the sensitivity analysis concluded that the proposed CDM project activity is unlikely to be the most financially attractive, step 3 is not applied for this proposed activity.

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity:

In this step, the projects that are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing are analyzed. In this PDD, the Eastern region of DPR Korea is selected for common practice analysis.

Accordingly, all the hydropower plants that have been in operation in Eastern region are analyzed.

As described below, the hydropower projects, economically attractive in DPR Korea, have already been built by the state fund or local fund.

Here, the hydropower stations such as Wonsan Youth No.1 Hydropower station, Wonsan Youth No.2 Hydropower station, Wonsan Youth No.3 Hydropower station, Kumjingang-Kuchang Hydropower Station, Kumjingang-Hungbong Hydropower Station and Anbyon No.2 Hydropower Station whose installed capacities vary from 6 MW to 40 MW are selected for common practice analysis.

Sub-step 4b. Discuss any similar options that are occurring

6 projects are similar with the proposed project.

- **Wonsan Youth No.1 Hydropower Station /**20/

  Wonsan Youth No.1 Hydropower Station with 40 MW installed capacity has been built and operated. The project owner is the People's Committee of Kangwon Province. This project is geographically favourable: it has got high head and much volume of water since the area has got the heaviest precipitation in the country. And it has got easy access to the high road. And, what is more important, it has got long operational hours. Therefore it was then regarded as the most ideal place for construction of hydropower plant. For these reasons, the project was economically feasible and implemented by the local fund.

- **Wonsan Youth No.2 Hydropower Station**

  Wonsan Youth No.2 Hydropower Station with 6 MW installed capacity has been built and operated. The project owner is the People's Committee of Kangwon Province. The project was situated downstream of the Wonsan Youth No.1 Hydropower Station, so it was a down-stage plant. Therefore, the project was economically feasible in that it re-used the water left by the up-stage plant and it had long operational time and low investment.

- **Wonsan Youth No.3 Hydropower Station**

Wonsan Youth No.3 Hydropower Station with 6 MW installed capacity has been built and operated. The project owner is the People's Committee of Kangwon Province. The project was situated downstream of the Wonsan Youth No.2 Hydropower Station, so it was a last-stage plant. Therefore, the project was economically feasible in that it re-used the water left by the up-stage plant and it had long operational time and low investment.

- **Kumjingang-Kuchang Hydropower Station**

This project has been built in Jongpyong County, South Hamgyong Province and its installed capacity is 6 MW. Building materials, especially sand and rock, were available at the riverside. The transportation was much easier than any other project. Therefore, the initial investment was comparatively low and it had long operational time. The project was implemented by local fund.

- **Kumjingang-Hungbong Hydropower Station**

The installed capacity of Kumjingang-Hungbong Hydropower Station is 6 MW. This project is the same case with Kumjingang-Kuchang Hydropower Station in terms of long operational time and low investment.

- **Anbyon No. 2 Hydropower Station**

The owner of Anbyon No.2 Hydropower Station, built and operated in Anbyon County, Kangwon Province, is the People's Committee of Kangwon Province. Its installed capacity is 24 MW and its operational time is much longer than that of the proposed project. And the investment for construction of the project was very low, and thus the project was also feasible financially.

Conclusion:

In general, the project faces investment barrier which would prevent the implementation of the proposed project activity without CDM; CDM helps to overcome these barriers. If the project is not implemented, the power needed will be supplied by the EPG. Hence, the proposed project activity isn't baseline scenario, which is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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According to the consolidated methodology ACM0002 (Version 12.1.0), the following procedures are applied to the proposed project activity to calculate baseline emissions, project emissions, leakage emissions and emission reductions:

1. ***Calculate baseline emissions*** **(**BE_y**)**

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. According to methodology ACM0002, the baseline is the kWh produced by the renewable generating unit multiplied an emission coefficient (measured in kg CO_2/kWh) calculated in a transparent and conservative manner. Here option (a) was chosen to calculate the emission coefficient. The baseline emissions were calculated as follow formula:

$BEy = EG_{PJ,y} \cdot EF_{grid,CM,y}$ （*meth. equation.6*）

Where:

BEy =Baseline emission in year y (tCO_2/yr)

$EG_{PJ,y}$. = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year *y which is* calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh)

Following steps are applied to calculate the baseline emissions:

(1) Calculation of $EG_{PJ..y}$

Because the project activity is the installation of a new grid-connected renewable power plant, then it is regarded as a Greenfield project. Thus option (a) is used, so

$EG_{PJ.y} = EG_{facility.y}$ *(meth.equation 7)*

Where,

$EG_{PJ.y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the Implementation of the CDM project activity in year y (MWh/yr)

$EG_{facility.y}$. = Quantity of net electricity generation supplied by the project plant/unit to the grid in year y (MWh/yr)

(2) Calculation of $EF_{grid,CM,y}$

According to the "Tool to calculate the emission factor for an electricity system" (Version 02.1.0, EB 60), the tool comprises the following steps:

Step1. Identify the relevant electric power system.

Step2. Choose whether to include off-grid power plants in the project electricity system (optional)

Step3. Select a method for calculating the operating margin (OM).

Step4. Calculate the operating margin emission factor (OM) according to the selected method.

Step5. Identify the group of power units to be included in the build margin (BM).

Step6. Calculate the build margin emission factor.

Step7. Calculate the combined margin (CM) emissions factor.

Therefore, the calculation steps of baseline emissions can be described below.

STEP1. Identify the relevant electric power system.

The electricity to be generated from the proposed Project will be delivered to the Eastern Power Grid, DPR Korea. The emission factor of the Eastern Power Grid is calculated following the steps of the methodology.

According to the definition of the EPG by DNA, it covers four provinces (North Hamgyong, South Hamgyong, Ryanggang, Kangwon) /21/. EPG's geographic and system boundaries can be clearly identified.

STEP2. Choose whether to include off-grid power plants in the project electricity system (optional)

Step 2 is omitted since there are no off-grid power plants to be included.

STEP3. Select a method for calculating the operating margin (OM).

"Tool to calculate the emission factor for an electricity system" (Version 02.1.0, EB 60) offers four options for the calculation of the Operating Margin emission factor ($EF_{grid,OM,y}$):

(a) Simple OM, or

(b) Simple adjusted OM, or

(c) Dispatch Data Analysis OM, or

(d) Average OM.

Among the above methodologies, the methodology "Dispatch Data Analysis" should be the first methodological choice. However, the method is not applicable for OM emission factor calculation, because dispatch data, let alone detailed dispatch data, are not available to the public or to the project participants. For the same reason, the simple adjusted OM methodology cannot be used.

The simple OM method (option 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 hydroelectricity production.

From 2005 to 2009, in the composition of gross annual generation power for the EPG, power generated by hydropower resources: 37.4% in 2005, 39.3% in 2006, 39.9% in 2007 , 41.9% in 2008 and 42.4% in 2009 obviously lower than 50%.For this reason, the Simple OM method can be used.

Table B.6 Power Generation of the EPG from 2005 to 2009 /22/

Year	2005	2006	2007	2008	2009
Percent of Hydropower Generation in the EPG (%)	37.4	39.3	39.9	41.9	42.4

Data Source: Central Bureau of Statistics, 2006-2010

STEP4.Calculate the Operating Margin Emission Factor ($EF_{OM,y}$)

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. It 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 is used in this Project.

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:

$$EF_{grid,OMsimple,y} = \frac{\sum_i (FC_{i,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y})}{EG_y} \quad (1)$$

Where:

$EF_{grid,OMsimple,y}$ = Simple operating margin CO_2 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	= Either the three most recent years for which data is available at the time of submission of the PDD to the DOE for validation (ex ante option).

The Simple OM emission factor is calculated ex-ante as a 3-year average (2007-2009):

$EF_{grid,OM,simlpe,y}$ =**1.47 tCO_2/MWh** (details of the calculations are provided in Annex 3)

STEP 5. Identify the group of power units to be included in the build margin (BM).

The purpose of the Step 3 is to identify the cohort of power units to be included in the build margin, and to calculate BM emission factor.

According to “Tool to calculate the emission factor for an electricity system” (Version 02.1.0, EB 60), the sample group of power units used to calculate the build margin 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 recently.

Power plants 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 the build margin 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 the build margin emission factor.

In the EPG of DPR Korea, above requirements to identify the power units for calculation of Build Margin are not met. Therefore, it is impossible to identify the groups for calculation of BM.

STEP6. Calculate the Build Margin emission factor ($EF_{BM,y}$)

According to STEP5,

$EF_{grid,BM,y}$=0 tCO_2/MWh

STEP7. Calculate the combined margin emissions factor

The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM} \qquad (2)$$

Where

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor in year y (tCO_2/MWh)

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh)

$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (tCO_2/MWh)

W_{OM} = Weighting of operating margin emissions factor (%)

W_{BM} = Weighting of build margin emissions factor (%)

The following default values was used for w_{OM} and w_{BM} :

$w_{OM} = 0.5$ and $w_{BM} = 0.5$

$EF_{grid,CM,y} = 0.5*1.47=0.735\ tCO_2/MWh$

2. ***Calculate project emissions***

For most renewable power generation project activities, $PE_y = 0$. However, 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:

$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$ (3)

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)

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

For hydropower project, since it is no fossil fuel consumption and not a geothermal power plant due to the release of non-condensable gases in year *y* (tCO_2e/yr), so $PE_{FF,y}$ and $PE_{GP,y}$ is zero. As for $PE_{HP,y}$, it is justified subject to calculation of Power Density (PD).

According to methodology, hydro power project activities that result in new reservoirs and hydro power project activities that result in the increase of existing reservoirs, project proponents shall account for CH_4 and CO_2 emissions from the reservoir, estimated as follows:

(b) If the power density of the project activity (*PD*) is greater than 10 W/ m^2:

$PE_{HP,y} = 0$

Since for the proposed project, PD is 10.6W/ m^2, which is well above 10 W/ m^2, thus $PE_{HP,y} = 0$

The power density of the project activity is calculated as follows:

$$PD = \frac{CAP_{PJ} - CAP_{BL}}{A_{PJ} - A_{BL}}$$

Where:

PD = Power density of the project activity, in W/m^2

CAP_{PJ} = Installed capacity of the hydro power plant after the implementation of the project activity (W)

CAP_{BL} = 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. Since the power density is calculated as follows:

Power density = Installed capacity/Inundated area = 20 000 000W/1 890 000m^2 = 10.6 W/m^2

3. ***Leakage***

No leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, and transport). These emissions sources are neglected.

4. ***Emission reductions ER_y***

Emission reductions are calculated as follows:

$ER_y = BE_y - PE_y$ (4)

Where:

ER_y = Emission reductions in year *y* (tCO_2e/yr)

BE_y = Baseline emissions in year *y* (tCO_2/yr)

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

Thus

$$ER_y = BE_y \quad (5)$$

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

Data / Parameter:	$FC_{i,y}$
Data unit:	1 000t/yr
Description:	The amount of fuel *i* consumed by the power plants serving to the EPG in year y
Source of data used:	Central Bureau of Statistics (DPRK) - see Reference (30) for details
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official national statistical data
Any comment:	

Data / Parameter:	$EG_{.y}$
Data unit:	10^6 kWh/yr
Description:	Total electricity generation by the power plants serving to the grid in year y
Source of data used:	http://10.76.1.11
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official statistical data
Any comment:	

Data / Parameter:	NCV_i
Data unit:	TJ/Gg
Description:	The net calorific value of fuel *i*
Source of data used:	*2006 IPCC Guidelines for National Greenhouse Gas Inventories*
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value is used because no country specific value is available.
Any comment:	

Data / Parameter:	$EF_{CO2,i}$
Data unit:	tCO_2/TJ
Description:	The CO_2 emission factor per unit of energy of the fuel i
Source of data used:	*2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 2 Energy-Chapter 1*
Value applied:	See Annex 3 for details
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value is used because no country specific value is available.
Any comment:	

Data / Parameter:	w_{OM}; w_{BM}
Data unit:	-
Description:	The default weights of $EF_{OM,y}$ and $EF_{BM,y}$ for hydropower projects
Source of data used:	"Tool to calculate the emission factor for an electricity system" (Version 02.1.0, EB 60)
Value applied:	w_{OM}=0.5; w_{BM}=0.5
Justification of the choice of data or description of measurement methods	The default weights of $EF_{OM,y}$ and $EF_{BM,y}$ for hydropower projects are used as 0.5 respectively which are specified in the "Tool to calculate the emission factor for an electricity system"(Version 02.1.0, EB 60)

and procedures actually applied :	
Any comment:	

Data / Parameter:	$EF_{grid, CM, y}$
Data unit:	tCO_2/MWh
Description:	The Combined Margin Emission Factor of the baseline
Source of data used:	Calculate EF_y according to the above $EF_{OM,y}$ and $EF_{BM,y}$
Value applied:	0.735
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default weights of $EF_{OM,y}$ and $EF_{BM,y}$ for hydropower projects are used as 0.5 respectively which are specified in the "Tool to calculate the emission factor for an electricity system"(Version 02.1.0, EB 60). $EF_y = 0.5 \times EF_{OM,y} + 0.5 \times EF_{BM,y}$
Any comment:	

Data / Parameter:	Cap_{BL}
Data unit:	W
Description:	Installed capacity of the hydropower plant before the implementation of the project activity. For new hydropower plants, this value is zero
Source of data used:	Project site
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to ACM0002 Version 12.1.0
Any comment:	

Data / Parameter:	A_{BL}
Data unit:	m^2
Description:	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 hydropower plants, this value is zero
Source of data used:	Project site

Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	According to ACM0002 Version 12.1.0
Any comment:	

B.6.3. Ex-ante calculation of emission reductions:

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According to section B.6.1 and further details in Annex 3, the combined baseline emission factor of the project is 0.735 tCO_2e/MWh in the crediting period. And the annual electricity delivered to the EPG by the project is 91 510 MWh/yr.

Therefore, BE_y in the first crediting period is to be calculated as follows:

$BE_y = EG_{PJ,y} * EF_{grid,CM,y}$ = 67 260 tCO_2e/yr

Calculation of Project Emission

As a run-of-river hydropower project, there is no sources of artificial emission sources within the project boundary, therefore the project emission is zero, then PE_y=0.

Calculation of the Project Leakage

In accordance to the Methodology ACM0002, there will be no leakage caused by he proposed project activity, therefore L_y=0.

Calculation of the Emission Reduction

The emission reduction $_yER$ by the proposed project activity during a given year y is calculated as follows:

$ER_y = BE_y - PE_y - L_y$ = 67 260 (tCO_2e/yr)-0-0= 67 260 (tCO_2e/yr)

Therefore, in the first crediting period of 7 years, the emission reductions are 470 820 tCO_2e.

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

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The total emission reductions of the project are 470 820 tCO_2e during the first crediting period.

Table B.7 Estimate of Emission Reductions due to the Project

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)
2012	0	50 445	0	50 445

2013	0	67 260	0	67 260
2014	0	67 260	0	67 260
2015	0	67 260	0	67 260
2016	0	67 260	0	67 260
2017	0	67 260	0	67 260
2018	0	67 260	0	67 260
2019	0	16 815	0	16 815
Total(tCO_2e)	0	470 820	0	470 820

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

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B.7.1 Data and parameters monitored:

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Data / Parameter:	$EG_{facilit,y}$
Data unit:	MWh/yr
Description:	Quantity of net electricity generation supplied by the project plant to the grid in year y
Source of data to be used	Project activity site
Value of data applied for the purpose of calculating expected emission reduction in section B.5	91 510
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 standards and regulations.
Any comment:	-

Data / Parameter:	$EF_{grid,CM,y}$
Data unit:	tCO_2/MWh
Description:	Combined Margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system”

Source of data to be used:	As per the “Tool to calculate the emission factor for an electricity system”
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.735
Description of measurement methods and procedures to be applied:	-
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	Cap_{PJ}
Data unit:	MW
Description:	Installed capacity of the hydropower plant after the implementation of the project activity
Source of data to be used:	Project site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	20
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:	-

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:	Project site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1.89
Description of measurement methods and procedures to be applied:	Measured from topographical surveys and maps
QA/QC procedures to be applied:	-
Any comment:	-

B.7.2. Description of the monitoring plan:

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Baseline emission factor of the Project is determined ex ante. Therefore the electricity delivered by the Project to the EPG is defined as the key data to be monitored. The project owner is responsible for the implementation of the monitoring plan in cooperation with the State Academy of Sciences.

1. Monitoring of the Electricity supplied to the EPG by the Project

The electricity supply will be metered by the Project entity by national standard electricity meters. An agreement will be signed between the Project owner and the grid company that defines the metering arrangements and the required quality control procedures to ensure accuracy. According to the Law of DPR Korea on Management of Energy /23/, the electric energy metering equipment will be properly configured and the metering equipment will be checked by both the Project owner and the grid company before the Project is in operation.

Two meters are required, of which, the first meter (backup meter) at the exit of the Project station is employed to measure output electricity, and the second meter (main meter) measures the power supplied to the grid at the entrance of the EPG. Both meters will have the capability to be read remotely through a communication line. Grid-connected electricity generated by the Project will be monitored through main meter. When the main meter has any troubles, the Project owner should employ the data monitored by the backup meter. And the data should be cross-checked against relevant electricity sale receipts and/or records from the grid.

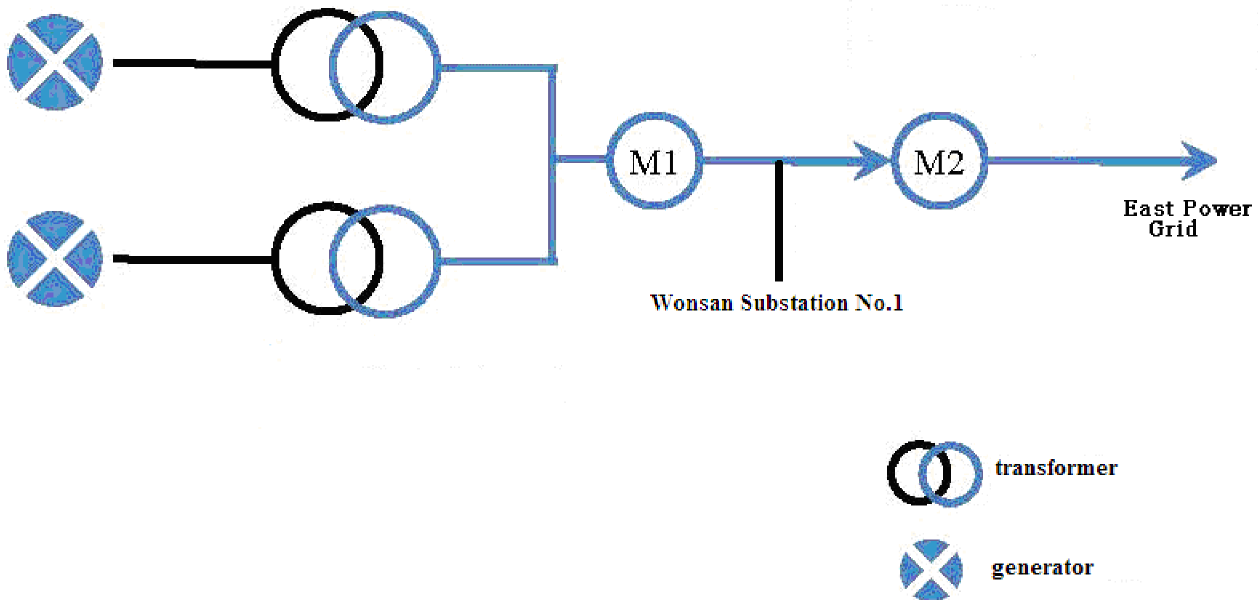

Figure B.2 Location of the meters

The Project owner should ensure that the meter readings be readily available for DOE's verification.

2. Calibration

Calibration of the metering instruments should be implemented according to the national standards /24/. Calibration is carried out and maintained by the project owner and the appointed qualified third party periodically.

The metering equipment shall have sufficient accuracy so that error resulting from such equipment shall not exceed + (-) 0.5% of full-scale rating.

All the meters installed shall be tested by the local grid company within 10 days after:

- Detection of a difference larger than the allowable error in the reading of both meters
- The repair of all or part of meter in operation caused by the failure of one or more parts in accordance with the specifications
- If any errors are detected, the party owning the meter shall repair, recalibrate or replace the meter giving the other party sufficient notice to allow a representative to attend during any corrective activity

Should any previous months reading of the main meter be inaccurate by more than the allowable error, or otherwise functional improperly, the grid-connected electricity generated by the proposed project shall be determined by:

- First, by reading the backup meter to get electricity supplied to the grid (after taking in to account line losses), unless a test by either party reveals it is inaccurate

- If the backup system is not with acceptable limits of accuracy or is otherwise performing improperly, the proposed project owner and the local grid company shall jointly prepare an estimate of the correct reading, and

- If the proposed project owner and the local grid company fail to agree the estimate of the correct reading, then the meter will be referred for arbitration according to agreed procedures.

Calibration will be carried out by local grid company with the records being provided to the proposed project owner, and these records will be maintained by the proposed project owner and the third party designated.

3. Quality Assurance and Quality Control

The quality assurance and quality control procedures for recording, maintaining and archiving data shall be improved as part of this CDM project activity according to EB rules and real practice in terms of the need for verification of the emission reductions on an annual basis according to this PDD.

4. Data Management System

Data will be archived at the end of each month using the electronic spreadsheet. The electronic files will be stored on hard disk and CD-ROM. In addition a hard copy printout will be archived. The project owner will reserve the sale and purchasing invoices, and at the end of each year will prepare a monitoring report for DOE. The monitoring plan includes a monitoring and checking report of electricity supplied to the grid, a calculation report of emission reduction, and maintaining and calibration records of monitoring machines, etc.

In order to facilitate auditor's reference, monitoring results will be indexed. All paper-based information will be stored by project owner. The monitoring reports will be reviewed by the General Manager.

All data records will be kept until 2 years after the end of the crediting period.

5. Reporting

A monitoring officer will be appointed by the project owner, who supervises and verifies metering and recording, collect data, calculate emission reductions and prepare monitoring report.
The monitoring officer will receive support from the State Academy of Sciences, DPR Korea
The specific steps for data collection and reporting are listed below:

- The local grid company reads the main meter and data every month at end of each month.

- The monitoring officer of the project reads the backup meter and records data every month at end of each month, and reports the recorded data to the project owner.

- The local grid company supplies the main meter's readings to the project owner.

- Project owner records the data of net electricity delivered to the grid, based on comparison of the two meter's readings provided by the local grid company and monitoring officer of the project.
- Project owner provides two meter's reading and copies of sales invoices to DOE for verification.

6. Training

The officers relevant to monitoring will attend a training session by the CDM consultants of SAoS. The training session will include the following:

- Basic concept of CDM
- Monitoring plan
- Monitoring procedures
- Method of metering and calibration
- Audit procedures
- Worksheet (excel) containing monitoring data and calculations
- Monitoring report template
- Practical training exercise

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

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The whole study of the Project was completed on 1 November 2010 by Institute of Thermal Engineering, SAoS.

The persons involved in the study are listed as follows:

1. Mr. Mansu Kwak, Senior Researcher, Institute of Thermal Engineering, SAoS, 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, Moranbong district, Pyongyang, DPR Korea,

E-mail Add: pptayang@star-co.net.kp, Tel: 850-2-3818111/ext-8544, FAX: 850-2-3814410/2100

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:

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29 June 2010 (starting date of construction, which is the earliest 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:

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1 April 2012 or the registration date, whichever is the latest

C.2.1.2. Length of the first crediting period:

>>

7 years

C.2.2. Fixed crediting period:

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. Documentation on the analysis of the environmental impacts, including transboundary impacts:

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Based on the Environmental Impact Assessment Law and regulations in DPR Korea /25/, the Environmental Impact Assessment (EIA) must be completed before the development and construction of the proposed project. Thus, the project owner authorized a third party to carry out the EIA report. The EIA report was completed by Environment and Development Centre on 15 February 2010 and has been approved by the Department of Land and Environmental Protection, Kangwon province, on 3 April 2010 /6/.

The main assessment conclusions are provided below:

1. Dust and Air Quality /5/

The air pollution of the project come from excavation and operation of construction machinery and transport vehicles during the construction period.

To reduce flying dust produced during the construction period, the watering on the road and construction site will be carried regularly, and the waste residue produced by the excavation will be piled up in a certain place, where many trees will be planted.

The construction machinery and transport vehicles will be equipped in good condition for removing the exhaust gas and the dust and the air quality will be monitored during the construction period.

2. Waste water

The wastewater produced from the project will mainly come from the manufacturing and life wastewater, but the ingredients of the wastewater are simple. Considering the habitation of the builders spread around, no big negative effects will occurred during construction period.

During the operation period, the wastewater from the repair for hydropower station will contain oil and the wastewater will be treated by an oil collector and oil separation to meet the standard before discharging. The life wastewater from the staffs of the hydropower plant will be processed in a septic tank, and then will be used to irrigate the cultivated land near the tail water channel. Hence the project causes no negative impact on water environment.

3. Ecological environment

The project will cause some negative impacts on local ecological system, but there are no state reserves, habitats and rare or endangered species of plants, fish, and wild animals, and no migrating fishes around the project site. Moreover, a certain amount of water for ecological environment will be kept in the down stream of dam.

Therefore the project will have a little negative impact on the ecological environment.

4. Noise pollution

The noise of the Project is mainly from excavation, public works, blasting and operation of construction machinery and transport vehicles during construction. Consequently, some following measures will be taken to reduce the impacts of noise to a minimum: avoiding working intension of the machines and extending working period, in order to reduce the noise source; arranging the construction schedule seasonably, and forbidding the equipments with high noise and blasting to run in the evening; equipping earplug and ear-muff for workers.

There are no residents and significant habitats near the dam, so if above measures will be taken, periphery environment will not be influenced by the noise in the project site.

5. Impacts on land use and local population

During operation of the project, some area of land will be changed as the reservoir. Therefore the constitution of land use will be changed and some residents and building will be waterlogged.

For the displacement of waterlogged households and building, the project owner will provide compensations for those residents directly affected by the project.

After the Project completion, the land used during the construction period will be immediately restored to farmland and woodland with completion of project.

In summary, if preceding measures will be taken, 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:

>>

According to the results of EIA and the answer from the Department of Land and Environmental Protection, Kangwon Province the impacts on the environment are not significant.

SECTION E. Stakeholders' comments

>>

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

>>

For the CDM stakeholder consultation a one page questionnaire was designed to be easily filled in with the following questions. 52 stakeholders were interviewed by the project developer. The stakeholders include local governmental officials, local residents and related employees. The consultation process /26/ was conducted by Wonsan Power Construction Complex through Popdong County People's Committee on 6 October 2010.

The contents of the questionnaire are as follows:

- Is the Project a positive one or a negative one?
- Will the project bring any benefits to the local residents?
- Do you agree with the construction of the project?
- What do you think about CDM and global warming?
- Do you support building hydropower plants in local area?
- What negative impacts can be made by the Project?
- Do the negative impacts important?
- What can be done to solve those negative impacts?
- Any other opinions?

E.2. Summary of the comments received:

>>

The following is a summary of the key findings:

- The most of the stakeholders have certain knowledge and understandings about hydropower project;
- All of the local residents think that the construction of station will bring benefit to local people;
- All of the residents think that the construction of station will bring small influence on local ecosystem;
- All of the residents support the construction.

Conclusion:

The survey shows that all, local government and residents alike, agree with the construction of the project. The general opinions are: the construction of the station will have a limited influence on the local ecosystem if a series of practical measures are taken. Although some tilled land will be flooded, all of the local residents have obtained corresponding compensation and are very satisfied. Otherwise, the project will supply sufficient electrical power for every day life and manufacturing, substitute electricity for firewood, protect the local environment and accelerate local economic development. Furthermore, it will promote the development of public infrastructures such as, communication, medical facilities and drinking-water sanitation and increase employment opportunities and the local residents'incomes, as well as improve quality of life. The project's impact is more positive than negative. Therefore, the local residents and government support the construction of the station.

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

>>

No negative comments have been received on the Project. Moreover, the local community submitted very positive comments on the effects that the proposed project will improve the local economy and infrastructure.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding from Annex I countries.

Annex 3

BASELINE INFORMATION

Table 1. Data for fuel consumption in thermal power plants in 2007

	Unit	Pukchang	Chongjin
Anthracite	1 000 t	6 401	
Lignite	1 000 t		393
Crude oil	1 000 t	71.3	2.0

Data source: Central Bureau of Statistics 2008, DPR Korea

Table 2. Data for fuel consumption in thermal power plants in 2008

	Unit	Pukchang	Chongjin
Anthracite	1 000 t	6 676	
Lignite	1 000 t		451
Crude oil	1 000 t	72.2	3.1

Data source: Central Bureau of Statistics 2009, DPR Korea

Table 3. Data for fuel consumption in thermal power plants in 2009

	Unit	Pukchang	Chongjin
Anthracite	1 000 t	7 060	
Lignite	1 000 t		483
Crude oil	1 000 t	73.9	3.2

Data source: Central Bureau of Statistics 2010, DPR Korea

Table 4. Electricity output in 2007

	Unit	Electricity supplied to the grid
Chongjin	10^6 kWh	252
Pukchang	10^6 kWh	9 016
Total	10^6 kWh	9 268

Table 5. Electricity output in 2008

	Unit	Electricity supplied to the grid
Chongjin	10^6 kWh	288
Pukchang	10^6 kWh	9 259
Total	10^6 kWh	9 547

Table 6. Electricity output in 2009

	Unit	Electricity supplied to the grid
Chongjin	10^6 kWh	302
Pukchang	10^6 kWh	9 724
Total	10^6 kWh	10 026

Table 7. Data on fuels consumed for electricity generation

	Emission factor(tCO_2/TJ)	NCV(TJ/Gg)

Anthracite	94.6	21.6
Lignite	90.9	5.5
Crude oil	71.1	40.1

Data source: 2006 IPCC Guidelines

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

$$EF_{OM} = \frac{\sum_{i,y} FC_{i,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{\sum_{y} EG_{y}} = 1.47 tCO_2e / MWh$$

The Build Margin Emission Factor is 0 tCO_2/MWh.

The emission factors of each year and average emission factor in the EPG are listed in Table 8.

Table 8. Emission factor in EPG

	2007	2008	2009	average
EF	0. 73	0. 74	0. 74	0. 735

Annex 4

MONITORING INFORMATION

No additional information.

Reference

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/3/ DNA's Letter for CDM consideration, February 2009, National Coordination Committee for Environment

/4/ Licence for Approval of Land Use, No.21, December 2009, Bureau of Forest Management of the People's Committee, Kangwon Province

/5/ Environmental Impact Assessment Report, February 2010, Environment and Development Centre, Ministry of Land and Environment Protection

/6/ Licence for Approval of Environmental Impact Assessment Report, No.ㄷ-1-52, April 2010, Department of Land and Environmental Protection of the People's Committee, Kangwon province

/7/ Minutes for Application of CDM, No.67, June 2010, Wonsan Power Construction Complex

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/11/ PDD Development Contract, July 2010, GBCIO and SAoS

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/29/ Law of DPR Korea on Construction of Middle-Small Scale Plants, 5 August 2008, Law Publishing Company.

/30/ Data for years 2008 – 2010 from Central Bureau of Statistics (DPRK)