Project design document form for CDM project activities

(Version 05.0)

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

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	Sihwa Tidal Power Plant CDM project
Version number of the PDD	Version_ 05.2
Completion date of the PDD	September 4, 2014
Project participant(s)	Korea Water Resources Corporation (K-water[1])
Host Party	Republic of Korea (host)
Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)	Scope : I –Energy industries (renewable-/non-renewable sources) Methodology : ACM0002. – "Consolidated baseline methodology for grid-connected electricity generation from renewable sources.---version 4"
Estimated amount of annual average GHG emission reductions	315,440 tCO_2e

[1] As it can be shown in the MOC submitted on 10 Nov. 2009, Korea Water Resources Corporation has changed its nickname from KOWACO to K-water after registration of the proposed CDM project.

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>>

- **Purpose of the proposed projec**t

By generating electricity using renewable energy source, Korea will be able to reduce GHG emission and increase sustainable development, and increased sea/inner water circulation by this activity will improve the water quality that has been decreased during Sihwa Lake's salt-to-fresh water process[2].

- **Outline of the project Activity**

Sihwa Tidal Power Plant Project will generate electricity by utilizing the sea water when it is coming into Sihwa Lake which is an artificial lake made by the tide embankment.
The plant will be located in Jaggungarisum which is an island in Ansan-city, Gyeonggi Province, Korea. It will be equipped 10 turbine generators (25.4MW) of straight inflow bulb type to produce app. 254MW. This means that it will be expected to generate 552.7 GWh a year, and transmit the electricity of 507.629 GWh to the grid annually. The generated electricity will be transmitted to 'Korea Electric Power Corporation South Sihwa substation' which is 10.5 km's distance from the plant. The substation will be constructed in early 2008.

- **Contribution of the project activity to government policy and sustainable development**

The project supports the Korean government policy as follows;

- Contribute to increase the renewable energy supply ratio by generating electricity with tidal power which Korean government encourages industries to develop.
- Promote, support, and cultivate the use of renewable energy as an alternative energy source.
- Minimize dependence on fossil fuel imports by utilizing tidal power and save the cost by substituting the tidal energy source for the conventional energy source such as fossil fuels.

The project contributes the sustainable development in the following ways.

- Tidal power source, as an alternative energy source, produces many environmental benefits. Compared to other energy sources, generating electricity from tidal power does not emit air pollutants and leave residuals into soil after it is processed.
- As a renewable energy source, tidal power provides future generations with environmentally friendly fuel alternatives that can be used sustainably.
- The project activity does not emit any GHGs, and air pollutants such as Sox, Nox, and dust.
- By the construction of this project with the capacity of 254MW, the air pollution can be decreased annually as follows;

  - CO_2 : 315,440 tons
  - SOx : 589 tons
  - NOx : 446 tons
  - Dust : 31 tons

[2] The construction of the Sihwa tide embankment started in 1987 and finished in 1994. In order to develop reclaimed lands and to provide agricultural water, 12.7 km of tide embankment was constructed which is separating West Sea from Banwol Bay. However, the Korean government decided to turn back Sihwa as seawater lake not as freshwater lake in 2000 because the quality of lake has been dramatically decreased. As well, the plan of the utilization as the source of agricultural water was changed. After that, Korea Water Resources Corporation (K-water) carried out the feasibility study of the construction for the tidal power plant from the year 2002.

As the socio-economic aspect, this project can increase the employment rate in the local area, and establish infrastructure, such as access roads and power lines, and these will benefit the local economy. In addition, the tidal power plant can attract tourists from all over the world as well as from Korea and this will increase the economical benefit in the local areas.

A.2. Location of project activity

A.2.1. Host Party

>>
Republic of Korea

A.2.2. Region/State/Province etc.

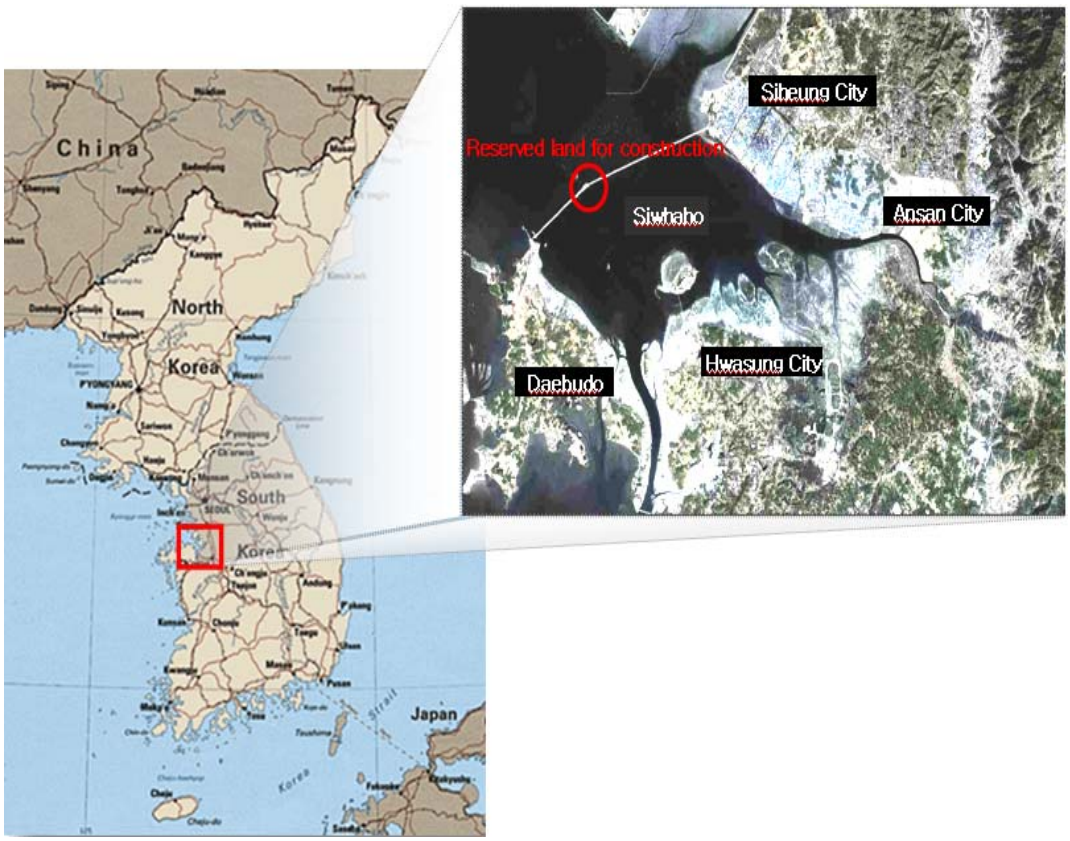
>>
Gyeonggi Province

A.2.3. City/Town/Community etc.

>>
Ansan-city

A.2.4. Physical/Geographical location

>>
Sihwa Tidal Power Plant will be installed and located in Republic of Korea, latitude of 37°18'46"N and longitude of 126°36'36"E as marked on the map, as follows.



<Figure 1.> The location of Sihwa Tidal Power Plant

Sihwa embankment was constructed by Korea Agricultural & Rural Infrastructure Corporation (KARICO), as part of Large-scale Integrated Tideland Reclamation Project in the South-western Coast for six years and a half (June, 1987 ~ January, 1994). Sihwa embankment connects Oido, Siheung-city with Daebudong, Ansan-city. The length of the embankment is 12,676m, and the embankment consists of Sihwa 1-ho, Sihwa 2-ho, Daesun, Buldo, and Tando. Sihwa Lake, surrounded by the Sihwa embankment, has an average year precipitation of 1,189mm, and an average year temperature of app. 12℃, and whose size is 56.5㎢. In addition, the third sea route of Incheon port is located in front of Sihwa Lake from 2.5 kilometer's distance, and LNG harbor is located in the north side of the lake. The characteristic features of the Sihwa Lake in which the Sihwa Tidal Power Plant will be installed are as follows;

- Approx. Higher High water level: app. 4.556m
- Approx. Lowest Low water level: app. - 4.604m
- Mean Range of tide: 5.57m
- Mean See Level: - 0.024m

A.3. Technologies and/or measures

>>

Explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity:

The main objective of the project is to develop, generate, and use this kind of clean electricity which is generated from renewable energy sources without GHGs emissions. Sihwa Tidal Power Plant Project will reduce GHGs emissions by producing electricity with using tidal power source, replacing conventional energy sources such as oils and coals.

Many countries have been developing their industries based on the energy generated by fossil fuel fired power plants which are mainly emitting GHGs that are known to cause the greenhouse effect. The Sihwa Tidal Power Plant will definitely help reduce GHGs emission by replacing fossil fuel power source as the renewable energy source.

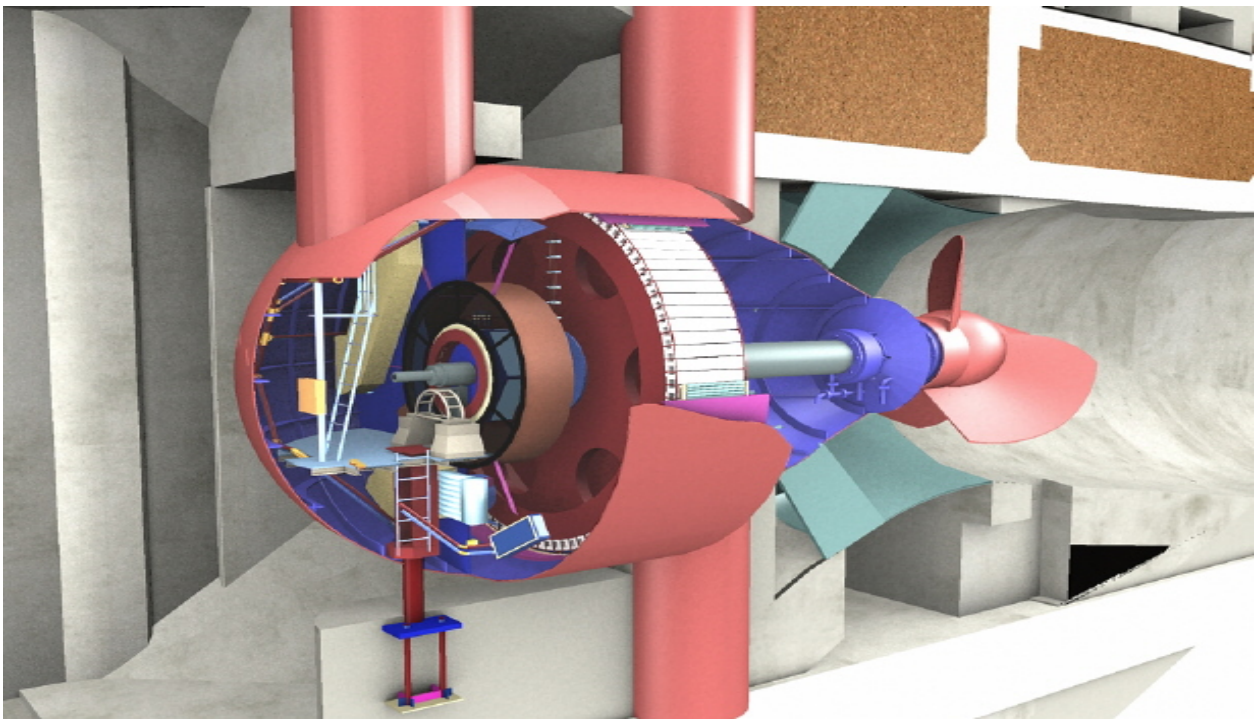
With this project's success, Sihwa tidal power plant will substitute the fossil fuel fired plants, generating 552.7 GWh, so it will bring a CO_2 emission reduction of 315,440 ton per year.

Why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

Korean government has constructed power plants since 1960's in order to supply the essential electricity to factories and homes, but due to the financial and technological reasons, Korean government chose to build fossil fuel fired power plants. These plants have been emitting GHGs while processing fossil fuels to generate electricity, and 58.8% of the total electricity generation comes from fossil fuel fired power plants in Korea (Source: KEPCO 2005). In addition, less than 5% of the electricity is coming out of the alternative energy sources such as hydroelectric power, wind power, or solar power.

By the realization of this project, GHGs emission will be reduced, and it will be the effective driving force to promote the electricity generation industries with using renewable energy sources like tidal power source in Korea.

This project will use non-pumping, one-way-flow, bulb turbine generators which have good energy efficiency, low head drop, and large capacity of 25.4MW. Moreover, these bulb turbine generators have many advantageous features as they are so far widely manufactured, installed, and operated in the world. Ten bulb turbine generators will be installed, and the plant will be able to generate 552.7GWh of electricity per year. These turbine generators, as the core equipment of the electricity generation, will be manufactured by Va Tech Hydro Austria (www.vatech-hydro.com), and this company will transfer advanced technology to K-water for the operation and maintenance.



<Figure 2.> The bulb type Turbine

The general characteristics of the bulb turbine generators manufactured by Va tech are as follows;

- Rated output: 25.4MW
- Maximum output: 25.4MW
- Velocity: 64.29rpm
- Rating: Continuous rating
- Rated head: 5.82m
- Quantity of flow: 482.13m^3/s

Through the development of Sihwa tidal energy, non-oil energy source can be developed and actively coped with the CO_2 reduction measure including Climate Change Convention. As well, from the development of ocean energy, technical, economical feasibility study and basic plan can be established using the Sihwa tide embankment as one of the ways of stable energy supply.

A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
KOREA (host)	Public entity : Korea Water Resources Corporation (K-water(*))	No
Switzerland	Public entity : Korea Water Resources Corporation(K-water)	

* Ecoeye(consulting company) withdrew from project participant on 22nd August 2009 as it can be confirmed in UNFCCC web page.

A.5. Public funding of project activity

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No funding is provided for this project.

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

B.1. Reference of methodology and standardized baseline

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ACM0002. – "Consolidated baseline methodology for grid-connected electricity generation from renewable sources.---version 4"

* We correct the version number of approved methodology according to its version registered on UNFCCC CDM web page as belows.
http://cdm.unfccc.int/Projects/DB/DNV-CUK1143710269.08/view

B.2. Applicability of methodology and standardized baseline

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In this project, the methodology applied to calculate the baseline is "the approved consolidated baseline methodology (ACM0002_version 4)" which can estimate a reduction of GHGs emission from this project activity. ACM0002_version 4 can be applied to the grid connected electricity generated from the tidal power plant – one of the renewable energy sources replacing the fossil fuel fired plant.

This CDM project is to provide electricity through grid-connected electricity generation by using natural tidal power; therefore we use this methodology.

B.3. Project boundary

For the baseline determination, project boundary has been accounted CO_2 emissions from electricity generation in fossil fuel fired power that is displaced due to this project activity.

The spatial extent of the project boundary includes the project site and all the power plants connected physically to the electricity system of Korea Electric Power Corporation (KEPCO).

In the calculation of GHG emissions from the plants included in Project Boundary, the emissions generated during the construction of future power plants, the emissions generated related to electricity transmission and distribution losses, the emissions related to fossil-fuel transportation, mining, water dumping, etc. have not been considered for the baseline.

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	CO_2 emissions from electricity generation in fossil fuel fired power plants connected to the grid	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project scenario	The proposed project	CO_2	No	According to ACM0002 (Version 4.0), project emissions are zero.
		CH_4	No	
		N_2O	No	

B.4. Establishment and description of baseline scenario

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<Table 1> Key information and data used to determine the baseline scenario

Parameter	Value	Source
GEN $_{j, y}$ (MWh) is the electricity delivered to the grid by source *j*.	Refer to Appendix. 4 (Table.2)	Statistics of Electric Power in KOREA (2003, 2004, 2005) (KEPCO)
F $_{i, j, y}$ is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*, *j* refers to the power sources delivering electricity to the grid, not including low-operating cost and must-	Refer to Appendix. 4 (Table.1)	Statistics of Electric Power in KOREA (2003, 2004, 2005) (KEPCO)
Net Calorific Values by Power Plant	Refer to Appendix. 4 (Table.5~7)	Statistics of Electric Power in KOREA (2003, 2004, 2005) (KEPCO)
Fuels Carbon Emission Factor (tC/TJ)	Refer to Appendix. 4 (Table.4)	IPCC 1996 Revised Guidelines
Fraction of Carbon Oxidised (OXID)	Coal : 0.98 Oil and Oil product : 0.99 Gas : 0.995	IPCC 1996 Revised Guidelines
Operating Margin Emissions Factor (in ton CO_2/MWh) 2002~2004	0.7710	Calculated
Build Margin Emissions Factor (in ton CO_2/MWh)	0.4718	Calculated
Baseline Emissions Factor (EFy in ton CO_2/MWh)	0.6214	Calculated

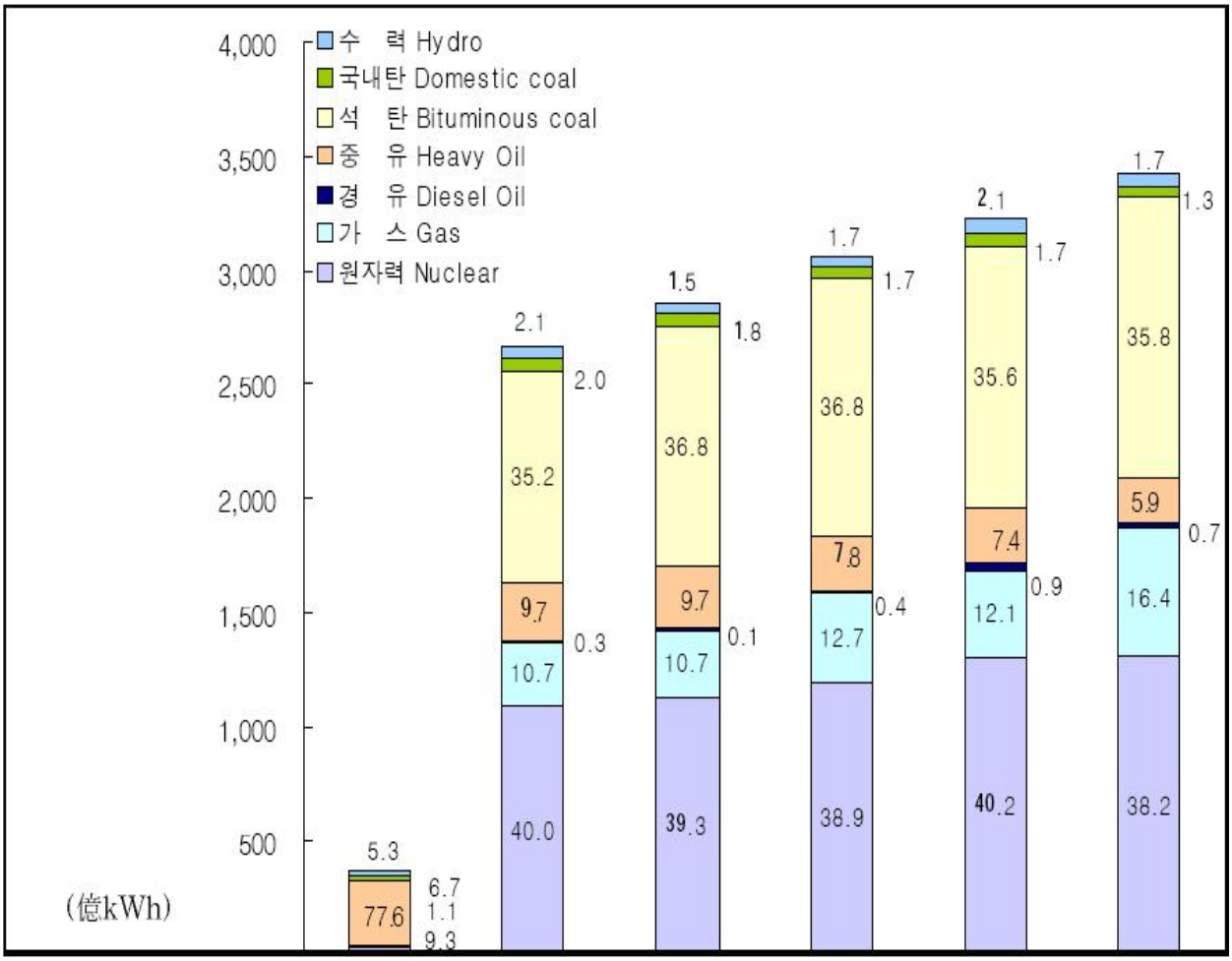
* Research on Korean specific OXID is under way. When the research is completed and therefore the OXID is publicly open, it will be used for calculating baseline factors. Before the Korean specific OXID is published, 0.98 OXID from IPCC is used.

The baseline is calculated according to ACM0002_version 4, in order to estimate the reduction of GHG emission in this project as the following steps.

OM (Operating Margin) and BM (Build Margin) are calculated by using data from existing conventional power plants that are providing electricity to the current electricity grid. With the figures calculated from the first step, the EF $_y$ (Emission Factor) can be calculated as follows.

Step 1. Calculation of the Operating Margin emission factor (OM)

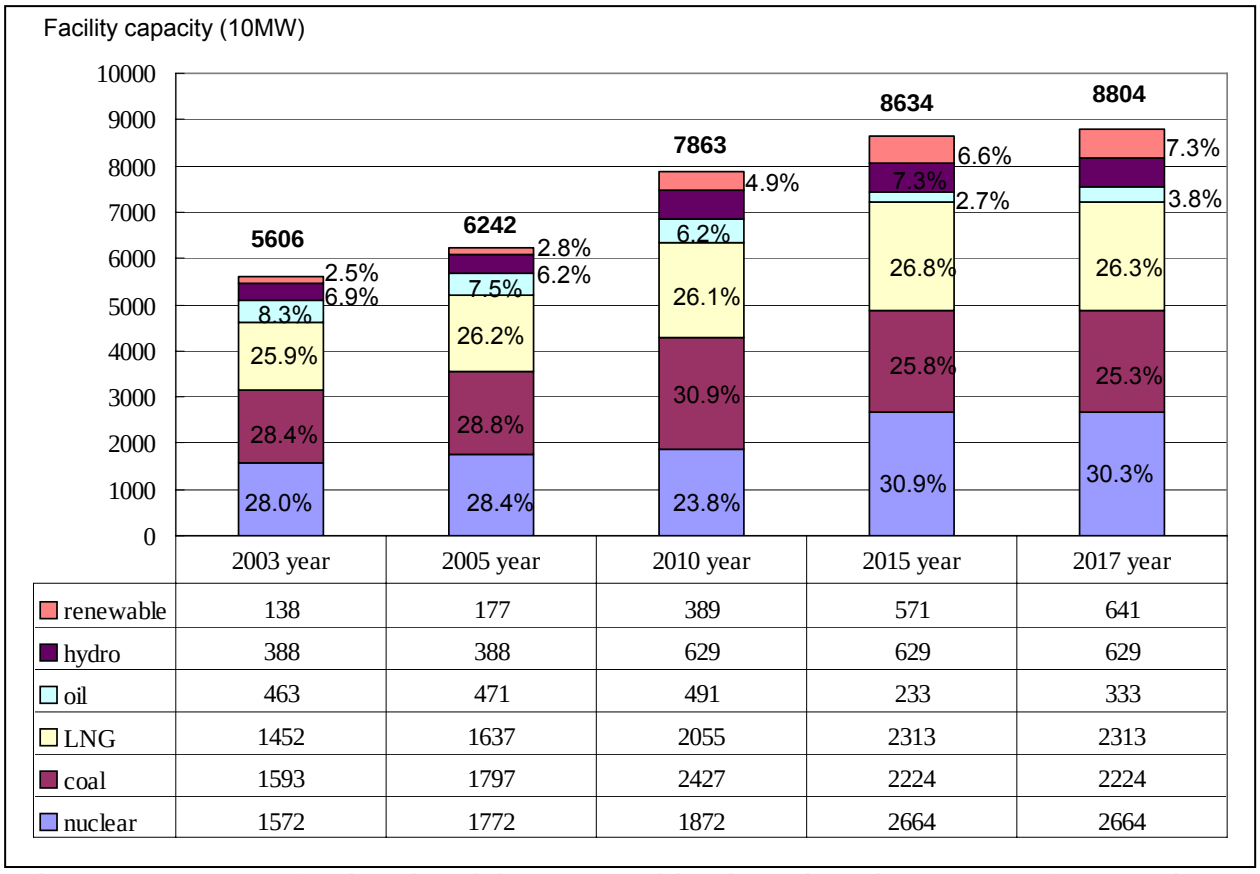
Referring to the ACM0002_version 4, the rate of low cost/must run power generation does not exceed 50% of the total grid (The recent 5 years' low cost/must run power generation from total generation rate was 42.84), and an hourly dispatched data is not available in that region at this point of time. Therefore, option (a) (Simple OM) from the ACM0002_version 4 has been chosen.



(單位 Unit : 百萬kWh million kWh)

區分 Item \ 年度 Year		1980	2000	2001	2002	2003	2004
水 力 Hydro		1,984	5,610	4,151	5,311	6,887	5,744
火 力 Thermal	國內炭Coal(Dom.)	2,481	5,285	5,235	5,144	5,398	4,603
	石 炭Coal(Bitum.)	-	92,253	105,098	112,877	114,878	122,556
	重油 Oil(Heavy)	28,876	25,485	27,770	23,940	23,656	20,099
	輕油 Oil(Diesel)	421	657	386	1,155	2,870	2,433
	가 스 Gas	-	28,146	30,451	38,943	39,091	55,999
原子力 Nuclear		3,477	108,964	112,133	119,103	129,672	130,715
計 Total		37,239	266,400	285,224	306,474	322,452	342,148

<Figure 3> Yearly proportion of the Generation of Electricity based on the Source of Energy (Source: Electricity statistics on Electricity quantity from Korea Electric Power Corporation, 2005)



	2003 year	2005 year	2010 year	2015 year	2017 year
renewable	138	177	389	571	641
hydro	388	388	629	629	629
oil	463	471	491	233	333
LNG	1452	1637	2055	2313	2313
coal	1593	1797	2427	2224	2224
nuclear	1572	1772	1872	2664	2664

<Figure 4> Forecast for the Electricity Composition based on the Source of Energy (Source: the 2nd demand-supply program of electricity from 2004 to 2017, December 2004, MOCIE)

(a) (Simple OM)
Low-operating cost and must run power plants has to be deducted from the data to calculate OM factor. In here, Low-operating cost and must run power plants mean hydro, nuclear, low cost biomass, and geothermal plants.
Besides, in order to conservatively calculate factor, private power generation and community energy service facility[3] are excluded from OM factors.

The OM is calculated as follows, using 3-year average data.

$$EF_{OM,simple,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$

As described ACM0002_version 4, where,

$F_{i,j,y}$ is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*,
j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid,

[3] Community energy Service: Community energy Service is a facility that supplies energy from collectivized energy generating facility such as Steam Supply and Power Generation plant, Heat Only Boiler, and facility for resource recovery to multi-users of household, commercial, and industrial zones. All the generated power is not supplied to the grid, but surplus power supplied in community energy services and private power generation plants, for this reason CO2 emissions per KWh from power supplied to the grid is very high.

$COEF_{i,j,y}$ ($COEF\ i = NCV\ i \cdot EFco_2 i \cdot OXID\ i$) is the CO_2 emission coefficient of fuel *i* (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y*, and
$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j*.

The detailed information used in the calculation is presented in Appendix 4.

Step 2. Calculation of the Build Margin (BM)

According to ACM0002_version 4, there are two options when project participants consider calculating BM, and the participants shall choose one option of them.

Option 1. Participants have to use the most recent data from the sample group that has already been built. Among the sample groups, the participants have to choose one that has a larger annual generation than the other.

- The five power plants that have been built most recently
- The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently

Option 2. After the start point of the project operation, the participants can update data with the most recent data every year. The larger sample group has to be chosen.

- The five power plants that have been built most recently
- The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently

As shown in Figure 3, power generation by coals decrease gradually and therefore BM factors will be updated in accordance with option2.
In this project, among sample groups " top 20% of the system most recently built" has been chosen, and two sample groups are compared as follows;

The annual generation of "the five power plants that have been built most recently" was 1,208.883 GWh (0.37% of the total generation of the grid system), and the annual generation of "the power plants capacity additions in the electricity system that comprise 21.81% of the system generation (in MWh) and that have been built most recently" was 70,405.658 GWh. Therefore, the latter was chosen as a lager figure than the other one.

<Table 2> Sample Plant group (m) for determining Build margin Emission factor

Sample group(m) Classification	"The five power plants that have been built most recently"	"The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently."	Comments
Electricity quantity	1,208.883GWh	70,405.658 GWh	Total generation is 322,767.780 GWh in Korea (based on KEPCO's data of the year 2004)
Proportion (ratio to total generation in Korea)	0.37%	21.81%	
Selected Group		**O**	

The detailed data used in the calculation are presented in Appendix 4.

The calculation of BM_y is as follows;

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

Step 3. Calculation of the baseline emission factor (EF_y)

With the results from step 1 and 2, EF_y has been calculated by using the following formula:

$$EF_y = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y}$$

The emission factors of the OM and BM in Sihwa Tidal Power Plant project have been weighted equally, each 50% because of the uncertainty of the future construction plans for the power plants in Korea. Sections E.4 and E.6 below provide details of the calculation and results.

B.5. Demonstration of additionality

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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:

The additionality of this CDM project is determined by using the tool for the demonstration and assessment of additionality as published in Annex 1, the sixteenth meeting of the executive board (EB-16). The CDM consolidated tool for demonstration of additionality includes the steps as follows;

Step 0. Preliminary screening of projects started after 1 January 2000 and prior to 31 December 2005

The construction for installing a cofferdam started in January, 2005.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations in Korea

Sub-step 1a. Define alternatives to the project activity:

The proposed alternatives are as follows,

Alternative 1. The proposed CDM project activity is the construction of a new tidal power plant that produces electricity connected to KEPCO's electricity system.

Alternative 2[4]. The construction of conventional plants that are connected to the KEPCO's grid system, and base-load plants are chosen among them.

- Alternative 2-1. 1000MW Capacity of base-load standard nuclear power plant
- Alternative 2-2. 1400MW Capacity of base-load next generation nuclear power plant
- Alternative 2-3. 500MW Capacity of base-load bituminous coal power plant
- Alternative 2-4. 800MW Capacity of base-load bituminous coal power plant

Sub-step 1b. Compliance with applicable laws and regulations:

All proposed alternatives comply with the laws and regulatory requirements for electricity generation in KOREA.

Step 2. Investment Analysis

***Sub-step 2a**. Determine appropriate analysis method*

The comparison (*Option* //) demonstrates that the tidal power plant was less financially attractive than any other alternatives.

[4] Sihwa Tidal Power Plant will generate electricity once a day when the inflow of the tides comes in, which means that the plant will not be generating electricity all the time. The available time period to generate electricity is regularly changed little by little everyday with a 14.5 days' cycle. This is different from the regular grid-connected system, but the tidal plant has similar characteristics to the base-load power generation plant in that both plants produce electricity at regular intervals as average rate in a year.

Sub-step 2b. *Option II. Apply investment comparison analysis*

The Sihwa Tidal Power - Net generation cost

The indicators that have been used for the net generation cost are as follows;

<Table 3> Indicators for the net generation cost estimation

Indicator		Figure	Remark
Capacity	**MW**	254	25.4MW × 10
Possible generation (PG)	**GWh/year**	552.7	10 Turbines, 8 floodgates
Utilization rate	**%**	22.814	
Maintenance rate (f1)	**%**	6.28	Based on Lance Dam, France
In plant consumption rate (f2)	**%**	2.00	(Same as above)
Sales of Generated electricity (SG)	**GWh/year**	507.629	SG = PG ·(1-f1) ·(1-f2)
Construction cost per Unit	**Thousand KRW/kW**	1,566.5	Based on Facility Capacity 254MW
Life time of equipment	**Year**	30	Based on existing equipment in other plants
Discount rate	**%**	8	
CRF rate	**%**	8.883	
Corporation Tax Rate	**%**	0.018	
Operation maintenance rate	**%**	2.07	
Fixed rate	**%**	10.971	Based on CRF, Operating rate, Corporation Tax Rate

Source: Report on the plan for Sihwa tidal power plant design by K-water, 2005

The net generation cost was calculated based on Net generation cost formula from KEPCO.

$$\text{Generation Cost (Net)} = \frac{\text{Construction cost per unit (won/}kW\text{) x Fixed rate (\%)}}{\text{8760 x Utilization rate x (1- In plant consumption rate)}} + \frac{\text{Heat consumption rate (}kcal/kWh\text{) x Fuel cost per unit}}{\text{Calorific value (}kcal/kg\text{) x (1- In plant consumption rate)}}$$

The net generation cost of Sihwa Tidal Power Plant was calculated as 87.75 won/KWh.

Sub-step 2c. Calculation and comparison of financial indicators

For the comparison analysis with alternatives, following indicators were used.

<Table 4> Indicators for the comparison analysis

Indicator	Alternative 1	Alternative 2-1	Alternative 2-2	Alternative 2-3	Alternative 2-4
Capacity	254,000 kw	1,000,000 kw	1,400,000 kw	500,000 kw	800,000 kw
Net construction cost per unit (Thousand Korean won/kw)	-	1,498	1,197	1,045	876
Construction term (Month)	54	64	68	44	52
Construction interest (won)		19.96	21.35	13.25	15.88
Total construction cost per unit (Thousand won/kw)	1,567	1,797	1,453	1,183	1,015
Operation maintenance cost (Thousand won/kw, month)		6.66	5.63	4.24	3.43
Life time of facility (year)	30	40	40	30	30
Capital return rate (%)	8.883%	8.386%	8.386%	8.883%	8.883%
Corporate tax rate (%)	0.018%	0.018%	0.018%	0.018%	0.018%
Operation maintenance rate (%)	2.070%	4.447%	4.651%	4.229%	4.055%
Fixed rate (%)	10.971%	12.851%	13.055%	13.130%	12.956%
Fuel purchasing cost (Won/kg, l)				37.157	37.157
Calorific value (kcal/kg,l)				5,780	5,780
Heat consumption rate (Kcal/kwh)		2,315	2,364	2,091	1,377
Calorific value cost per unit (Won/10^6kcal)				6,429	6,429
In plant consumption rate (%)	2.000%	4.700%	4.200%	4.400%	4.200%
Fuel cost (won/kwh)		4.38	4.49	14.06	13.27
R & D (won/kwh)		1.2	1.2		
Utilization rate (%)	22.8%	80.0%	80.0%	80.0%	80.0%

Source: status of power generation facility the year of 2003 by Korea Power Exchange(KPX)

Combined the indicators and the formula above, the each net generation cost was calculated as follows;

<Table 5> Result of net generation cost estimation

Results	Alternative 1	Alternative 2-1	Alternative 2-2	Alternative 2-3	Alternative 2-4
Net generation cost (won/KWh)	**87.75**	34.58	28.25	37.25	28.83

As a result of the comparison analysis, the Alternative 1 shows the highest net generation cost. Therefore the Sihwa Tidal Power Plant was not financially attractive.

Sub-step 2d. Sensitivity analysis

The sensitivity analysis was carried out based on the results of Sub-step 2c, about the highly uncertain indicators.

- Net generation cost change based on fuel purchasing cost per unit 50% increase
- Net generation cost change based on fuel purchasing cost per unit 50% decrease
- Net generation cost change based on discount rate 6%, 7%, 8%
- Net generation cost change based on construction cost per unit 10% increase
- Net generation cost change based on construction cost per unit 10% decrease

The result of sensitivity analysis is as follows;

<Table 6> Result of sensitivity analysis

	Alternative 1	Alternative 2-1	Alternative 2-2	Alternative 2-3	Alternative 2-4
Material cost per unit 50% increase	**87.75**	34.58	28.25	44.28	33.45
Material cost per unit 50% decrease	**87.75**	34.58	28.25	30.21	24.21
Discount rate 6%,	**70.53**	33.24	27.11	36.60	28.20
Discount rate 7%,	**78.81**	33.92	27.69	36.93	28.51
Discount rate 8%,	**87.75**	34.58	28.25	37.25	28.83
Construction cost per unit 10% increase	**96.52**	38.04	31.08	39.56	30.79
Construction cost per unit 10% decrease	**78.97**	31.12	25.43	34.93	26.87

As a result of the sensitivity analysis, the construction of Sihwa tidal power plant was less financially attractive than any other alternatives.

Step 4. Common Practice Analysis

Sub-step 4a. Other activities similar to the Sihwa Tidal Power Plant in KOREA

There is no tidal power plant installed in Korea.

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

There is no relevant data.

Step 5. Impact of CDM registration

The success of the construction and operation of the project will have big impact on Korea environmentally and financially. Environmentally, the project will contribute to decrease GHG emission by 315,440 tonnes of CO_2, as well as some amount of SOx, Nox, and dust. Financially, Sihwa tidal power plant IRR will be increased by 0.79% with the estimated carbon profits.

<Table 7> Result of IRR estimation

	Without revenue from selling of CERs	With revenue from selling of CERs
IRR	1.39%	2.18%

*When IRR is caudated at Table 9, 'Alternative Energy Development Promotion Act amended on March, 2002[5].' is not considered.

By achieving this CDM registration, the incentives will give motivation to these kinds of renewable energy power developments that may not be financially attractive without CDM program. Furthermore, it will influence national energy generation policy so that the reduction of GHGs emission can be extended**.**

B.6. Emission reductions

B.6.1. Explanation of methodological choices

>>

Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

For the baseline determination, project boundary has been accounted CO_2 emissions from electricity generation in fossil fuel fired power that is displaced due to this project activity.

The spatial extent of the project boundary includes the project site and all the power plants connected physically to the electricity system of Korea Electric Power Corporation (KEPCO).

In the calculation of GHG emissions from the plants included in Project Boundary, the emissions generated during the construction of future power plants, the emissions generated related to electricity transmission and distribution losses, the emissions related to fossil-fuel transportation, mining, water dumping, etc. have not been considered for the baseline.

[5] 'Alternative Energy Development Promotion Act amended on March, 2002.' : Alternative Energy Development Promotion Act amended in March, 2002, the Ministry of Commerce, Industry and Energy (MOCIE) of Korean Government issued the Public Notice N0.2003-61 on October 9, 2003 and its amendment No. 2004-104 on October 19, 2004 which compensates the renewable energy electricity generation projects for the difference between the standard price applicable for the electricity generated using the alternative energy and the system marginal price of the grid promote such kinds of electricity generation.

B.6.2. Data and parameters fixed ex ante

>>

Data / Parameter	*Operating Margin Emissions Factor* ($EF_{grid,OM,y}$)
Unit	tCO_2e / MWh
Description	Operating margin CO_2 emission factor for the project electricity system in year y(2002 ~ 2004)
Source of data	Calculated
Value(s) applied	0.7710
Choice of data or Measurement methods and procedures	This value was calculated according to ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" version 4. The applied value was derived from "2002, 2003, 2004 Statistics of Electric Power in Korea (2003, 2004, 2005)" (KEPCO) and "2004 Status of Generation facility (2005)" (KPX).
Purpose of data	Calculation of baseline emissions
Additional comment	The data will be electronically kept during the each crediting period and two years after CERs are issued.

Data / Parameter	*Net Calorific Values* by Power Plant ($NCV_{i,y}$)
Unit	kcal/ mass or volume unit
Description	Net calorific value of fuel *i* : bituminous, heavy oil, diesel oil, LNG / $_y$: year
Source of data	Statistics of Electric Power in KOREA (2003, 2004, 2005) (KEPCO)
Value(s) applied	Refer to Appendix. 4 (Table.5~7)
Choice of data or Measurement methods and procedures	The applied value was derived from "2002, 2003, 2004 Statistics of Electric Power in Korea (2003, 2004, 2005)" (KEPCO)
Purpose of data	Calculation of baseline emissions
Additional comment	The data will be electronically kept during the each crediting period and two years after CERs are issued.

Data / Parameter	*Fuels Carbon Emission Factor (*$EF_{CO2,i,y}$)
Unit	tCO_2 /GJ
Description	CO_2 emission factor of fuel *i* *i* : bituminous, heavy oil, diesel oil, LNG / $_y$: year
Source of data	IPCC 1996 Revised Guidelines
Value(s) applied	Refer to Appendix. 4 (Table.4)
Choice of data or Measurement methods and procedures	IPCC default values at the lower limit of the uncertainty at 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol.2 (Energy) is used.
Purpose of data	Calculation of baseline emissions
Additional comment	The data will be electronically kept during the each crediting period and two years after CERs are issued.

* In connection with Fraction of Carbon Oxidised (OXID) the value of IPCC 1996 Revised Guidelines is used(Coal : 0.98, Oil and Oil product : 0.99, Gas : 0.995). Research on Korean specific OXID is under way. When the research is completed and therefore the OXID is publicly open, it will be used for calculating baseline factors. Before the Korean specific OXID is published, 0.98 OXID from IPCC is used.

B.6.3. Ex ante calculation of emission reductions

>>

Key information and data used to determine the baseline scenario

Parameter	Value	Source
GEN $_{j, y}$ (MWh) is the electricity delivered to the grid by source *j*.	Refer to Appendix. 4 (Table.2)	Statistics of Electric Power in KOREA (2003, 2004, 2005) (KEPCO)
F $_{i, j, y}$ is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*, *j* refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid	Refer to Appendix. 4 (Table.1)	Statistics of Electric Power in KOREA (2003, 2004, 2005) (KEPCO)
Net Calorific Values by Power Plant	Refer to Appendix. 4 (Table.5~7)	Statistics of Electric Power in KOREA (2003, 2004, 2005) (KEPCO)
Fuels Carbon Emission Factor (tC/TJ)	Refer to Appendicx. 4 (Table.4)	IPCC 1996 Revised Guidelines
Fraction of Carbon Oxidised (OXID)	Coal : 0.98 Oil and Oil product : 0.99 Gas : 0.995	IPCC 1996 Revised Guidelines
Operating Margin Emissions Factor (in ton CO_2/MWh) 2002~2004	0.7710	Calculated
Build Margin Emissions Factor (in ton CO_2/MWh)	0.4718	Calculated
Baseline Emissions Factor (EFy in ton CO_2/MWh)	0.6214	Calculated

* Research on Korean specific OXID is under way. When the research is completed and therefore the OXID is publicly open, it will be used for calculating baseline factors. Before the Korean specific OXID is published, 0.98 OXID from IPCC is used.

A. Estimate of GHG emissions by sources:

GHG emissions resulted directly from this project will be zero since this plant will use tidal power source as a renewable energy.

GHG emissions resulted from the construction site or within the construction period will not be included as a project emission.

Therefore, the direct emissions estimated from the project activity will be zero.

B. Estimated leakage:

No leakage is estimated at this point of time.

C. The sum of E.1 and E.2 representing the project activity emissions:

The total sum of emissions from the project activity and the leakage (E1 + E2) will be zero.

D. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

This calculation for estimating the baseline is described as ACM0002_version 4.

The equation for calculating emissions in the baseline (BE_y) is:

$$BE_y = EG_y * EF_y$$

Where:
BE: Baseline emissions (t CO_2e)
EG: Annual electricity supplied by the project to the grid (MWh)
EF: baseline emission factor (tCO_2e / MWh)
y: refers to a given year

The baseline emission factor calculations will be based on the combined margin using the "Simple Operating Margin," option (a) of the ACM0002_version 4.

$$EF_y = w_{OM} * EF\_OM_y + w_{BM} * EF\_BM_y$$

Where:
EF: baseline emission factor (tCO_2e / MWh)
w_{OM}: Operating Margin weight, which is 0.5 by default
EF_OM: Operating Margin emission factor (tCO_2e / MWh)
w_{BM}: Operating Margin weight, which is 0.5 by default
EF_BM: Build Margin emission factor (tCO_2e / MWh)
y: refers to a given year

The emission factor (EF_OM y) of operating margin is calculated using the following equation:

$$EF\_OM_y\ (tCO2e / MWh) = \frac{\sum_{i,j} F_{i,j,y} . COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$

Where:
$F_{i,j,y}$ is the amount of fuel *i* (in GJ) consumed by power source *j* in year y;
j is the set of plants delivering electricity to the grid, not including low-cost or must-run plants and carbon financed plants;
$COEF_{i,j,y}$ is the carbon coefficient of fuel *i* (tCO_2/GJ);
$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j*.

The emission factor (EF_BM y) of Build margin is calculated using the following equation:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} . COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

Where:
$F_{i,m,y}$ is the amount of fuel *i* (in GJ) consumed by power source m in year y;
m is the power plants that comprise 20% of the system generation and that have been built most recently.
$COEFi_{i,m,y}$ is the carbon coefficient of fuel *i* (tCO_2/GJ);
$GEN_{m,y}$ is the electricity (MWh) delivered to the grid by source *m*.

Republic of Korea is located in the southern half of the Korean Peninsula, and the host country does not import/export electricity from/to other countries. The data for the calculation of the OM emission factor and BM emission factor including the total electricity produced is based on the KEPCO's 2002, 2003 and 2004 years' data. See Appendix 4 for more information. According to the above method, the GHGs emission reduction from the project was calculated as 315,440ton. As a result, the baseline emissions of this project activity will be approximately 2,208,080ton CO_2 for the entire 7-year project duration as a crediting period.

E. Difference between C and D representing the emission reductions of the project activity:

The estimated GHG emission from the project activity and the leakage, namely the result of the section E.3, was zero. In addition to this, the result from the section E.4 was 315,440 ton/year as a baseline emission. Therefore, the GHG emission reduction from this CDM project is estimated as 315,440ton/year, and for a whole crediting period (7 years), the estimated GHG emission reduction will be estimated as 2,208,080ton.

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

Estimated emission reductions by project activity

Years	Estimation of project activity emission reductions (tonnes of CO_2 e)	Estimation of baseline emission reductions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of emission reductions (tonnes of CO_2 e)
Year 1 (2010)	315,440	0	0	315,440
Year 2 (2011)	315,440	0	0	315,440
Year 3 (2012)	315,440	0	0	315,440
Year 4 (2013)	315,440	0	0	315,440
Year 5 (2014)	315,440	0	0	315,440
Year 6 (2015)	315,440	0	0	315,440
Year 7 (2016)	315,440	0	0	315,440
Total (tonnes of CO_2 e)	2,208,080	0	0	2,208,080

All the figures above will be updated with the latest available data at the second and the third crediting periods. After above data are estimated figures, these estimated values will be updated and re-calculated with the current available data through the actual monitoring on the project.

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

No emissions from the project activity are identified

Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived:

Data / Parameter	EGy*
Unit	MWh
Description	Net amount of electricity transmitted to the grid excluding electricity consumed in the plant
Source of data	Statistics of Electric Power in KOREA (2003, 2004, 2005) (KEPCO)
Value(s) applied	Refer to the Table 2 of Annex 4
Measurement methods and procedures	- Data will be directly measured, aggregated weekly, monthly and yearly double checked against receipt of sales. *The amount of electricity consumed in the plant and electricity transmission to a grid will be measured by unilateral meter. - The watt-hour meter is installed according to the relevant CDM guidelines and national standards of the "Measures Act" and the "Rules on the Operation of the Electric Utility Market". - The measurement and management of watt-hour meter will be undertaken by experienced staff who belongs to the K-water. - The electricity supplied to the grid will be measured automatically with the installed meter and those measured data will be delivered to the KPX.
Monitoring frequency	hourly measurement and monthly recording
QA/QC procedures	* According to the regulation on the electricity measurement equipment, the equipment must use the main metering equipment that has allowable error of ± 0.2%, and the sub-metering equipment that has allowable error of ± 0.5%. This equipment shall be sealed by the authorised person from the connected substation right after the installation of the equipment. Also, electricity generation will be checked every 5 minutes. - The meters shall be calibrated when they are installed, and re-calibrated every two years after the installation (The meters for electricity imported from the grid shall be calibrated every seven years according to the national law).
Purpose of data	Calculation of baseline emissions
Additional comment	The data will be electronically kept during the each crediting period and two years after CERs are issued.

Data / Parameter	EFy
Unit	tCO_2/MWh
Description	CO_2 emission factor of the Korea grid
Source of data	Calculated
Value(s) applied	0.6214

Measurement methods and procedures	This value was calculated as a weighted sum of the OM and BM emission factor according to ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" version 4.
Monitoring frequency	Yearly
QA/QC procedures	N/A
Purpose of data	Calculation of baseline emissions
Additional comment	The data will be electronically kept during the each crediting period and two years after CERs are issued.

Data / Parameter	$EF_{BM, y}$
Unit	tCO_2/MWh
Description	CO_2 BM emission factor of the Korea grid
Source of data	Calculated
Value(s) applied	0.4718
Measurement methods and procedures	This value was calculated as $[\sum_{i, m} F_{i, m, y} \cdot COEF_{i, m}] / [\sum_{m} GEN_{m, y}]$ over recently built power plants defined in the baseline methodology according to ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" version 4.
Monitoring frequency	Yearly
QA/QC procedures	N/A
Purpose of data	Calculation of baseline emissions
Additional comment	The data will be electronically kept during the each crediting period and two years after CERs are issued.

Data / Parameter	$F_{i, y}$
Unit	Mass or volume
Description	Amount of each fossil fuel consumed by each power source / plant
Source of data	Measured
Value(s) applied	See the Table 1 of Annex 4
Measurement methods and procedures	Simple OM Data will be used of 3 year vintage data at the time of PDD submission and BM Annual data obtained from the KEPCO will be used. The applied value was derived from "2002, 2003, 2004 Statistics of Electric Power in Korea (2003, 2004, 2005)" (KEPCO)
Monitoring frequency	Yearly
QA/QC procedures	N/A
Purpose of data	Calculation of baseline emissions
Additional comment	The data will be electronically kept during the each crediting period and two years after CERs are issued.

Data / Parameter	$COEF_i$
Unit	t CO_2/mass or t CO_2/volume
Description	CO_2 emission coefficient of each fuel type i
Source of data	Calculated
Value(s) applied	See the Table 2 and 3 of Annex 4
Measurement methods and procedures	This value was calculated as $[NCVi \cdot EFco_2i \cdot OXIDi]$ according to ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" version 4 and was derived from "2002, 2003, 2004 Statistics of Electric Power in Korea (2003, 2004, 2005)" (KEPCO)

Monitoring frequency	Yearly
QA/QC procedures	N/A
Purpose of data	Calculation of baseline emissions
Additional comment	The data will be electronically kept during the each crediting period and two years after CERs are issued.

Data / Parameter	NCVi(Local value)
Unit	kcal/ mass or volume unit
Description	Net Caloric coefficient of each fuel type i to calculate $COEF_i$
Source of data	"Statistics of Electric Power in Korea" produced by KEPCO
Value(s) applied	See the Table 5 to 7 of Annex 4
Measurement methods and procedures	This value is derived from "Statistics of Electric Power in Korea" released by KEPCO every year.
Monitoring frequency	Yearly
QA/QC procedures	N/A
Purpose of data	Calculation of baseline emissions
Additional comment	The data will be electronically kept during the each crediting period and two years after CERs are issued.

Data / Parameter	GENy
Unit	MWh/each plant
Description	Electricity generation of each power source / plant
Source of data	"Statistics of Electric Power in Korea" produced by KEPCO
Value(s) applied	See the Table 2 of Annex 4
Measurement methods and procedures	This value is obtained from "Statistics of Electric Power in Korea" produced by KEPCO every year. Simple OM : Data will be used of 3 year vintage data at the time of PDD submission. BM : Annual data will be used.
Monitoring frequency	Yearly
QA/QC procedures	N/A
Purpose of data	Calculation of baseline emissions
Additional comment	The data will be electronically kept during the each crediting period and two years after CERs are issued.

* The power plants to calculate OM factor is identified by using KEPCO's "2002, 2003, 2004 Statistics of Electric Power in Korea (2003, 2004, 2005)" at the time of PDD submission and the power plants to calculate BM factor is yearly identified by using KEPCO's "Statistics of Electric Power in Korea".

Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

$BEy = EFy \times EGy$

Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

Option 2 is not selected, as it is not appropriated to ACM0002_version 4 Baseline methodology for small grid-connected zero-emission renewable electricity generation.

Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

No sources of leakage have been identified

Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

$ER_y = BE_y – PE_y – L_y$

Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

All variables, except one related to off-site transportation, used to calculate project and baseline emissions are directly measured or are publicly available official data. To ensure the quality of the data, in particular those that are measured, the data are double-checked against commercial data. The quality control and quality assurance measures planned for the Project are outlined in the following table.

Data	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1.EGy	Low	QA/QC procedure for this is planned. The electricity output from each bulb turbine to the grid will be monitored and recorded at the on-site control The allowable error of data must be within ± 0.2%. (Except for the main meters for exported electricity, the allowable error of data is within ± 0.5%).
5. $F_{i, y}$	Low	QA/QC procedure for this is planned. The data will be obtained by KEPCO.
6.$COEF_i$	Low	QA/QC procedure for this is planned. Data will be checked against other sources.
Others	Low	QA/QC procedure for this is planned. All the data and grid statistics data will be used, and provided by KEPCO

Quality control (QC) and quality assurance (QA) procedures

1. Monitoring equipment

1-1. Electricity measuring meters shall be set up transparently in accordance with “Law regarding measurement” and “Act on operation of electricity market” and shall be sealed after affirmation of KPX.
1-2. The meters shall be authorized through the due formal certifying process (the valid period for the authorized certification: 7 years.)

1-3. The meters shall be calibrated when they are installed, and re-calibrated every two years after the installation(The meters for electricity imported from the grid shall be calibrated every seven years according to the national law).

2. Monitoring of amount of electricity

2-1. The amount of electricity transmitted to the grid shall be measured automatically by the established meters. The measured variables are simultaneously transferred to K-water central control system.
2-2. The measured amount of electricity shall be collected daily, weekly, and monthly and shall be archived in electronic way.
2-3. The collected variables in article 2-2 shall be compared with those of KPX.
2-4. If the two variables compared in article 2-3 are different, the operation condition of electricity meters and other equipments shall be examined. In case meters are improperly operated equipment, internal investigation and correction procedure shall be followed and be certified by the final decision-maker and KPX.

3. Management of monitoring and electricity safety

3-1. The person in charge of monitoring and electricity safety shall attend the following courses once a year.
- Course on 'Law regarding measurement'
- Course on 'Act on operation of electricity market
- Course on Electricity safety

3-2. In case of absence of the responsible person, the second responsible person shall be selected..
3-3. If the responsibility for monitoring and electricity safety is transferred to another person, one shall be approved by the final decision-maker.

* For detailed QC/QA, refer to QA/QC manual handed into DOE.

B.7.2. Sampling plan

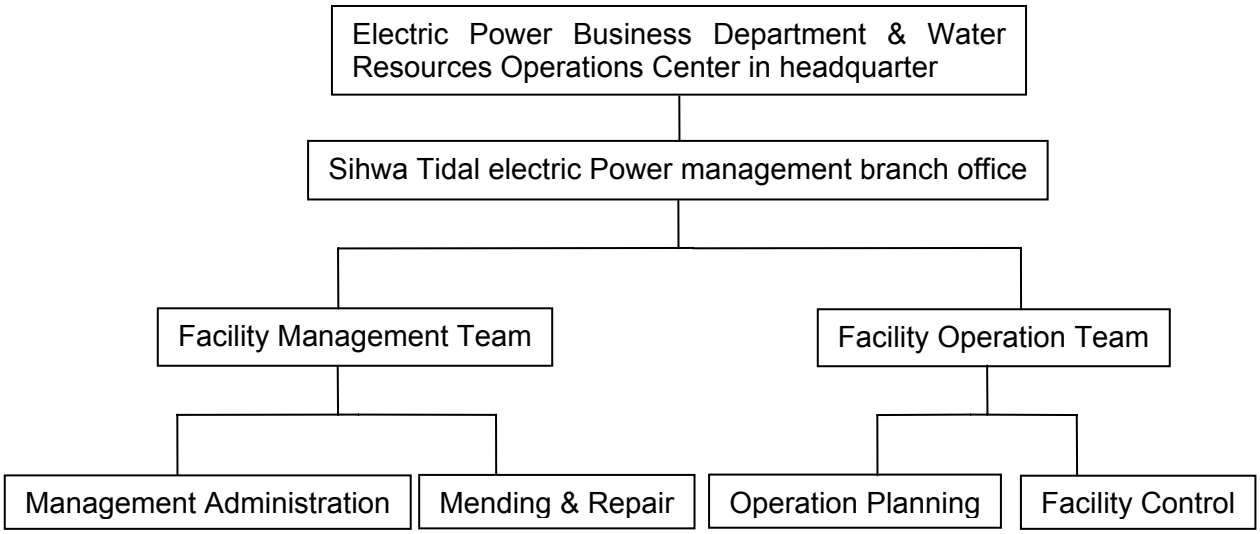
>>
n/a

B.7.3. Other elements of monitoring plan

>>

The operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

This figure describes the operational and management structure (can be changed by company reorganization)



<Figure 5.> Operational and management structure of Sihwa CDM Project

Responsible department and persons for the monitoring are as follows

- Responsible department to measure the input-output electricity and maintain watt hour meters : Sihwa Tidal Electric power management branch office

- Responsible department to collect and record electricity data and to calculate BM emission factor : Electric Power Business Department

- Responsible department to check and correct the transmitted electricity by comparing the data of K-water and KPX :
  Water Resources Operations Center

- Responsible monitoring person for the Project : person in charge to be decided by personnel transfer

- Practical monitoring person : person in charge to be decided by personnel transfer

- Baseline emission factor calculating person : person in charge of CDM affairs in headquarter

B.7.4. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

>>
The detailed baseline information is attached in Appendix 4.
Date of completion of the baseline study in 01/08/2005.
Name of person/entity determining the baseline:
Dr. Jae-soo Jung (civilenvi@ecoeye.com) / Ecoeye Co., Ltd.(consultant*)

* The role of the Consultant is limited only for United Nations Framework Convention on Climate Change (UNFCCC) registration work.

* Ecoeye withdrew from project participant on 22nd August 2009, as it can be confirmed in UNFCCC
web page, and has no right to this CDM project any more.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>
The starting date of the project activity begins in December 31, 2004.

C.1.2. Expected operational lifetime of project activity

>>
The estimated operational lifetime is approximately 30 years.

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>
Renewable crediting period

C.2.2. Start date of crediting period

>>
01/07/2011
* The starting date has been changed according to the request of project participant as it can be confirmed in UNFCCC web page.

C.2.3. Length of crediting period

7 years of period

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
HYUNDAI ENGINEERING CO., LTD. (www.hec.co.kr) executed the feasibility study on the Sihwa Tidal Power Plant from the year 2002 to 2003 in accordance with the Impact Assessment Act regarding environment, traffic, and disaster. The consultative meetings for concerning matters over the construction of Sihwa Tidal Power Plant were held by Ministry of Environment and stakeholders, started on March, 2002 and completed on June, 2004.

Due to the incompatibility between the actual construction plan and the approved construction plan, the Ministry of Environment requested K-water to change or revise the items as the environmental impact assessment. In addition, because it became hard to keep track of all the records about discussions and meetings, the construction plans and consultative meetings were advised to be managed and executed in one unified format. So the consultative meetings reports had to be changed and revised. The schedules of the important events about the EIA are as follows,

- 2002. 5. : Executed Environmental Impact Assessment.
- 2003. 6. : Advised from EIA experts on the Sihwa Tidal Power Plant construction.
- 2003. 10. : Held conferences for the project description and collected opinions from related government departments and environmental NGOs.
- 2003. 11. : Submitted the EIA report on Sihwa Tidal Power Plant construction.
- 2004. 6. : Completed the discussion on the EIA.
- 2005. 3. : Approved and Scheduled for the changed EIA consultative report.

The final EIA consultative report dealt with the issues on the various perspectives such as natural environment, residential environment, and socio-economic environment etc…while the report have the analysis on complicated inter-relationship between environmental impact elements and factors which can be caused by the Sihwa Tidal Power Plant construction.

(The related EIA report was submitted to DOE.)

D.2. Environmental impact assessment

>>
It is possibly expected to take place a landslide effect by the plant construction. Besides, some contaminants which exist in the lake can be diffused to the sea when the plant is operating, and it is expected that certain sediment erosion can be influential in the adjacent area. Therefore the strong measures were established and planned as follows;

1. Landslide reduction plan
   - Install the cofferdam before all the facilities' construction.
   - Install the contamination-stop-filter that can protect the lake and the sea.
   - Install the provisional waterways and grit chamber.

2. Contaminants diffusion (by the operational discharge) reduction plan
   - Gradually increase the electricity generation when the plant starts operating.
   - Control the amount of discharge

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>
The EIA report was submitted in order to collect opinions and suggestions from government agencies concerned such as Ministry of Environment (ME), Ministry of Maritime Affairs & Fisheries (MMAF), Gyeonggi Province, Hwaseong-city, Ansan-city, and Siheung-city. In response to the EIA report, K-water received written opinions from the above government agencies. Also public opinions were reflected especially from citizens, who were living near the Sihwa Lake. To do this, the schedules of the public hearings and the EIA report displays were announced through newspapers and the internet as follows,

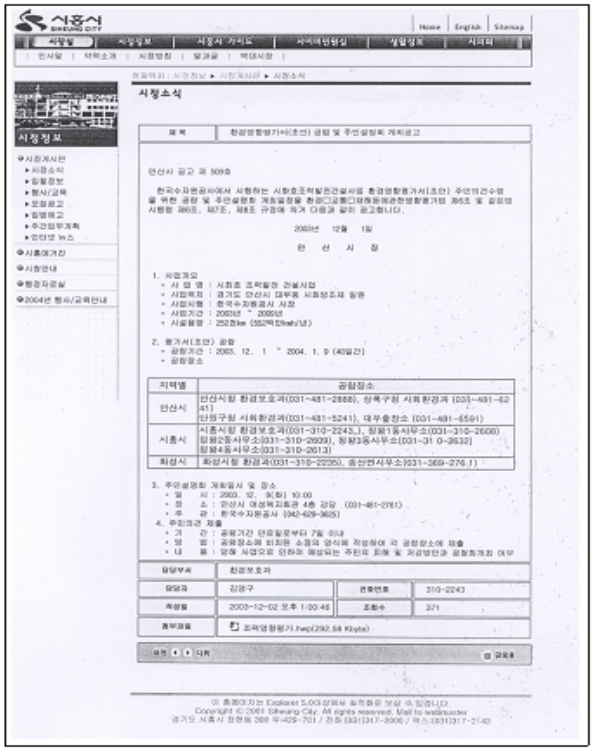
- Announcement dates of the information on the public display and hearing

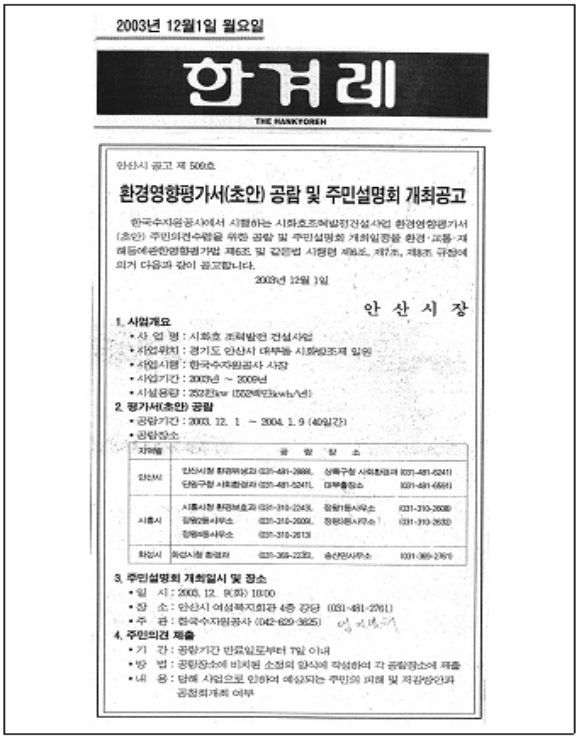
  • Dec. 1, 2003. on the Hankyoreh Shinmun, the Gyeonggi Shinmun (Newspapers)

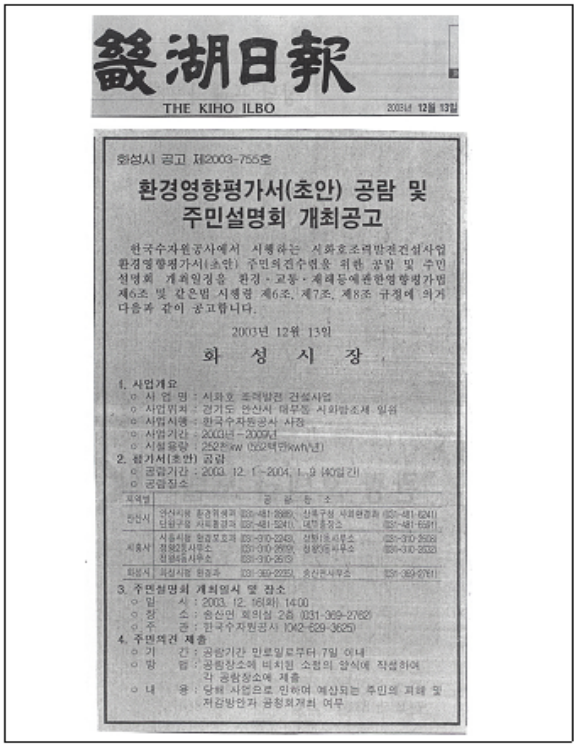
and Ansan City Hall homepage (www.iansan.net)
- Dec. 13, 2003. on the Kihoilbo (Newspaper) and Hwaseong City Hall homepage (www.hscity.net)

- Place for Public displays: 8 places were chosen where residents on that area can easily visit and look at the EIA report.

- Period for Public displays: 2003. 12. 1. ~ 2004. 1. 9.


시흥시
SIHEUNG CITY
Home | English | Sitemap
시청소식
시청정보
환경영향평가서(초안) 공람 및 주민설명회 개최공고
안산시 공고 제 509호
1. 사업개요
• 사 업 명 : 시화호 조력발전 건설사업
• 사업위치 : 경기도 안산시 대부동 시화방조제 일원
• 사업시행 : 한국수자원공사 사장
• 사업기간 : 2003년 ~ 2009년
• 시설용량 : 252천kw (552백만kwh/년)
2. 평가서(초안) 공람
• 공람기간 : 2003. 12. 1 ~ 2004. 1. 9 (40일간)
• 공람장소
지역별 공람장소
안산시 안산시청 환경보호과(031-481-2888), 단원구청 사회환경과(031-481-6241)
시흥시 시흥시청 환경보호과(031-310-2243), 정왕1동사무소(031-310-2608), 정왕2동사무소(031-310-2609), 정왕3동사무소(031-310-2632), 정왕4동사무소(031-310-2613)
화성시 화성시청 환경과(031-369-2235), 송산면사무소(031-369-2761)
3. 주민설명회 개최일시 및 장소
• 일 시 : 2003. 12. 16(화) 14:00
• 장 소 : 송산면 회의실 2층 (031-369-2762)
• 주 관 : 한국수자원공사 (042-629-3625)
4. 주민의견 제출
• 기 간 : 공람기간 만료일로부터 7일 이내
• 방 법 : 공람장소에 비치된 소정의 양식에 작성하여 각 공람장소에 제출
• 내 용 : 당해 사업으로 인하여 예상되는 주민의 피해 및 저감방안과 공청회개최 여부
담당부서 환경보호과
담당자 김영구 전화번호 310-2243
작성일 2003-12-02 오후 1:00:48 조회수 371
첨부파일 조력발전개요.hwp(292.58 Kbyte)


2003년 12월1일 월요일
한겨레
THE HANKYOREH
안산시 공고 제 509호
환경영향평가서(초안) 공람 및 주민설명회 개최공고
한국수자원공사에서 시행하는 시화호조력발전건설사업 환경영향평가서(초안) 주민의견수렴을 위한 공람 및 주민설명회 개최일정을 환경·교통·재해등에관한영향평가법 제6조 및 같은법 시행령 제6조, 제7조, 제8조 규정에 의거 다음과 같이 공고합니다.
2003년 12월 1일
안 산 시 장
1. 사업개요
• 사 업 명 : 시화호 조력발전 건설사업
• 사업위치 : 경기도 안산시 대부동 시화방조제 일원
• 사업시행 : 한국수자원공사 사장
• 사업기간 : 2003년 ~ 2009년
• 시설용량 : 252천kw (552백만kwh/년)
2. 평가서(초안) 공람
• 공람기간 : 2003. 12. 1 ~ 2004. 1. 9 (40일간)
• 공람장소
지역별 공 람 장 소
안산시 안산시청 환경위생과 (031-481-2888), 상록구청 사회환경과 (031-481-6241)
단원구청 사회환경과 (031-481-5241), 대부출장소 (031-481-6591)
시흥시 시흥시청 환경보호과 (031-310-2243), 정왕1동사무소 (031-310-2608)
정왕2동사무소 (031-310-2609), 정왕3동사무소 (031-310-2632)
정왕4동사무소 (031-310-2613)
화성시 화성시청 환경과 (031-369-2235), 송산면사무소 (031-369-2761)
3. 주민설명회 개최일시 및 장소
• 일 시 : 2003. 12. 16(화) 10:00
• 장 소 : 안산시 여성복지회관 4층 강당 (031-481-2761)
• 주 관 : 한국수자원공사 (042-629-3625)
4. 주민의견 제출
• 기 간 : 공람기간 만료일로부터 7일 이내
• 방 법 : 공람장소에 비치된 소정의 양식에 작성하여 각 공람장소에 제출
• 내 용 : 당해 사업으로 인하여 예상되는 주민의 피해 및 저감방안과 공청회개최 여부


錦湖日報
THE KIHO ILBO
2003년 12월 13일
화성시 공고 제2003-755호
환경영향평가서(초안) 공람 및 주민설명회 개최공고
한국수자원공사에서 시행하는 시화호조력발전건설사업 환경영향평가서(초안) 주민의견수렴을 위한 공람 및 주민설명회 개최일정을 환경·교통·재해등에관한영향평가법 제6조 및 같은법 시행령 제6조, 제7조, 제8조 규정에 의거 다음과 같이 공고합니다.
2003년 12월 13일
화 성 시 장
1. 사업개요
○ 사 업 명 : 시화호 조력발전 건설사업
○ 사업위치 : 경기도 안산시 대부동 시화방조제 일원
○ 사업시행 : 한국수자원공사 사장
○ 사업기간 : 2003년 ~ 2009년
○ 시설용량 : 252천kw (552백만kwh/년)
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○ 공람기간 : 2003. 12. 1 ~ 2004. 1. 9 (40일간)
○ 공람장소
지역별 공 람 장 소
안산시 안산시청 환경위생과 (031-481-2888), 단원구청 사회환경과 (031-481-6241)
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정왕2동사무소 (031-310-2609), 정왕3동사무소 (031-310-2632)
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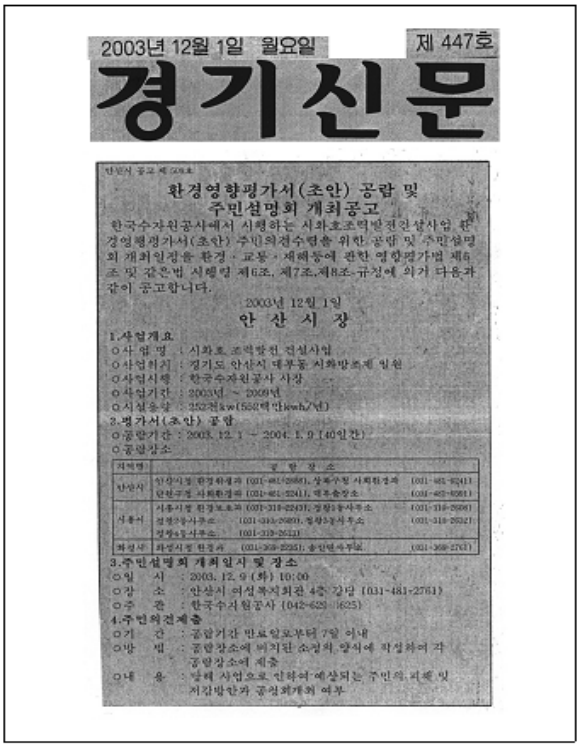
화성시 화성시청 환경과 (031-369-2235), 송산면사무소 (031-369-2761)
3. 주민설명회 개최일시 및 장소
○ 일 시 : 2003. 12. 16(화) 14:00
○ 장 소 : 송산면 회의실 2층 (031-369-2762)
○ 주 관 : 한국수자원공사 (042-629-3625)
4. 주민의견 제출
○ 기 간 : 공람기간 만료일로부터 7일 이내
○ 방 법 : 공람장소에 비치된 소정의 양식에 작성하여 각 공람장소에 제출
○ 내 용 : 당해 사업으로 인하여 예상되는 주민의 피해 및 저감방안과 공청회개최 여부


2003년 12월 1일 월요일
제 447호
경기신문
환경영향평가서(초안) 공람 및 주민설명회 개최공고
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2003년 12월 1일
안 산 시 장
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○사업위치 : 경기도 안산시 대부동 시화방조제 일원
○사업시행 : 한국수자원공사 사장
○사업기간 : 2003년 ~ 2009년
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○공람장소
지역별 공 람 장 소
안산시 안산시청 환경위생과 (031-481-2888), 단원구청 사회환경과 (031-481-6241)
시흥시 시흥시청 환경보호과 (031-310-2243), 정왕1동사무소 (031-310-2608)
정왕2동사무소 (031-310-2609), 정왕3동사무소 (031-310-2632)
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화성시 화성시청 환경과 (031-369-2235), 송산면사무소 (031-369-2761)
3.주민설명회 개최일시 및 장소
○일 시 : 2003. 12. 9 (화) 10:00
○장 소 : 안산시 여성복지회관 4층 강당 (031-481-2761)
○주 관 : 한국수자원공사 (042-629-3625)
4.주민의견제출
○기 간 : 공람기간 만료일로부터 7일 이내
○방 법 : 공람장소에 비치된 소정의 양식에 작성하여 각 공람장소에 제출
○내 용 : 당해 사업으로 인하여 예상되는 주민의 피해 및 저감방안과 공청회개최 여부

The Public hearings to reflect opinions from local residents was held two different times as follows,

1) Date and time: 2003. 12. 9. 10:00AM ~
Place: Ansan Women Center Conference Hall
Target audience: Residents from Ansan-city, Siheung-city, and Hwaseong-city
Objective: To collect opinions from residents and reflect them to the project planning.

<Figure 10.> First Public hearing at the Ansan Women Center

2) Date and time: 2003. 12. 16. 14:00PM ~
Place: Hwaseong-city Songsan-myeon office
Target audience: Hwaseong-city residents
Objective: To collect opinions from residents and reflect them to the project planning.

<Figure 11.> Second Public hearing at the Songsan-myeon office

(Note: The report related to the lists of participants and presenters was submitted to DOE separately.)

E.2. Summary of comments received

>>

The target audience to collect opinions for Sihwa Tidal Power plant was mainly the authorities concerns and the residents near that region, and summary of the comments received is as follows.

<Table 8> Summary of stakeholders' comments

	Opinions & Requests	Suggested by	Remark
1-Q	Present a thorough analysis of how sedimentary environment changes resulting from the turbine generators will affect organisms living on the sea floor (Benthos) during the actual operation.	- ME	- Written opinion
2-Q	Present an estimation of how the plant operation will affect the oceanic lives' movements as they pass through the turbine generators.	- ME	- Written opinion
3-Q	It is expected that the tidal plant may give off pollutants into the neighborhood sea area during its trial running. Suggest strong pollution-control measures.	- ME	- Written opinion
4-Q	Will the discharge facilities to reduce air-pollutants be installed during the power plant operation?	- ME	- Written opinion
5-Q	Suggest an established measurement to treat wastewater in case that it is caused by the plant.	- ME	- Written opinion
6-Q	Provide a study report examining on whether the plant causes noises and vibrations during the operation.	- ME	- Written opinion
7-Q	To conserve scenery around the tideland and to keep pedestrians and visitors from being overawed by the aerial power cable, the idea that the aerial power transmission cables are installed under ground or under water should be considered.	- ME - Gyeonggi Prov. - MMAF - Hwaseong-city residents	- Written opinion
8-Q	A port should be constructed in the future because the construction and operation of the tidal power plant may cause inconveniences in operating vessels.	- MMAF	- Written opinion

9-Q	According to the water quality improvement triggered by the tidal power generation, K-water should take measures to boost the local market economy for contributing to the fishery right restoration and the equal regional development.	- Gyeonggi Prov. - Hwaseong-city - Hwaseong-city residents	- Written opinion
10-Q	The escalation of the sea deposit triggered by the increasing amount of sea water flow into Sihwa Lake may cause the mud flat to contain pollutants, and this would critically contaminate the tideland ecosystem. Therefore, K-water should examine it thoroughly and prepare for it.	- Gyeonggi Prov. - MMAF - Hwaseong-city	- Written opinion
11-Q	It is expected to damage around that area because it is difficult to secure the irrigation water for the neighboring farmland during the dry season, so K-water should take proper measures.	- Gyeonggi Prov. - Hwaseong-city	- Written opinion
12-Q	K-water must consider the concerning issues that could cause bad effects on the local communities and the residents during the construction period, and have to provide ways to minimize them.	- Gyeonggi Prov. - Hwaseong-city residents	- Written opinion - Requested opinion at the public display
13-Q	Is it possible to provide free distribution of the electricity produced from the plant for the residents around the Sihwa Lake? Is there any way to return the profit from the plant operation to residents around that region?	- Hwaseong-city residents	- Public hearing
14-Q	How much would the speed change of a running fluid affect the movement of ships?	- Siheung-city	- Annexed paper
15-Q	A board which consists of residents, farmers, and fishermen should be operated and monitor the project if K-water follows the construction plans and the project activity improves the lake water quality.	- Siheung YMCA	- Public hearing

(Note: The full reports related to the written opinions from the government agencies and the public hearings were separately submitted to DOE.)

E.3. Report on consideration of comments received

>>

The results on how due account during the public hearing period was taken as follows.

<Table 9> Report on how to take due account of stakeholders' comments

	How the accounts were managed	**Remark**
1-A	Carried out the thorough examination of Benthos, and provided a report that expects the sedimentary environment changes based on the examination.	

2-A	Provided the result after examining the possible effects.	
3-A	To minimize undesirable influence on the open sea which would be caused during the trial running of the plant, a plan that the tidal power plant discharges into the open sea step by step was examined, and reflected to the construction plan.	
4-A	It is known that the tidal power plants don't emit the air-pollutants as they generate the electricity using tidal energy source, so there would be no other plans to reduce the air-pollutants.	
5-A	Estimated population when the plant starts operating and reflected measures to be taken and the method of treating wastewater that would occur under the circumstances.	
6-A	Plant facilities such as turbine generators and other systems will be constructed under the ground/water level, so there will be no known influences from noises and vibrations during the operation, and there was no noise effect had been reported in the international practice cases.	
7-A	Transmission lines will be planned to set up under the ground	
8-A	Matters in relation to a port construction should be set up after the port construction plan is completed, and K-water will have a thorough inspection about any inconveniences caused by the plant then.	
9-A	K-water completed the compensation on the fishery right as it will be extinguished by the construction of the plant, and K-water will discuss with relative authorities whether the fishery permit should be given or not after examining the improvement of water quality in Sihwa Lake. In addition, K-water will be in connection with the neighboring tourist attractions to contribute to a local economy's boost by attracting national and international tourists.	
10-A	As a result of a thorough study on the movement of the sea deposit, some degree of soil erosion and suspended solid are expected to occur. Therefore, K-water is planning to remove the sea deposits and reinforce the base of the plant and near the area in order to minimize the influences on tideland ecosystem.	
11-A	Although the plant is commercially operated, the water level of Sihwa Lake will be kept as high as the current water level (EL (-) 1.0m), so it is not expected to have the influences on securing the irrigation water.	
12-A	To minimize undesirable effects which may be caused during the plant construction phase, K-water reflected suggestions and opinions from case studies on practices and experts into the construction plans, and will collect and update the opinions and suggestions from the public and residents continuously.	
13-A	It is difficult to return the profit from the plant operation to residents directly around that area since there are no regulations and programs to support the suggestion, but K-water will discuss with the authorities concerned to make it possible to support the programs by revising the relevant regulations and laws.	

14-A	It is expected that the effect of the velocity of the flow on the movement of ships will be insignificance, but before starting the effluent from the tidal plant, K-water is planning to broadcast an announcement and install mark floats to guide ships and residents around the boundary.	
15-A	Currently 'Sihwa sustainable development conference group' (http://www.sihwa-sd.com) is managed by local residents, experts, and NGOs. They are also planning to monitor matters concerned such as water quality and other environmental, local issues when the plant is constructing and operating.	

(Note: The consultative reports about how due account was taken during public hearings and displays were submitted to DOE separately.)

SECTION F. Approval and authorization

>>

In connection with this project, the K-water is the project participant and parties involved are the Republic of Korea and Switzerland and the LOAs from two DNA are already posted in CDM website.

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

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	KOREA WATER RESOURCES CORPORATION (“K-water”)
Street/P.O. Box	200 Sintanjin-Ro, Daedeok-Gu
Building	K-water
City	Daejeon
State/Region	
Postcode	306-711
Country	The republic of KOREA
Telephone	+82-42-629-2114
Fax	+82-42-629-2999
E-mail	kdj@kwater.or.kr
Website	http://english.kwater.or.kr/
Contact person	Kim Deog-je
Title	Manager
Salutation	Mr.
Last name	Deog-je
Middle name	
First name	Kim
Department	Electric Power Business Dept.
Mobile	
Direct fax	+82-42-629-2999
Direct tel.	+82-42-629-2988
Personal e-mail	kdj@kwater.or.kr

Appendix 2. Affirmation regarding public funding

There is no public funding to constitute a diversion of official assistance, nor to count towards any financial obligation from Parties included in Appendix I.

Appendix 3. Applicability of methodology and standardized baseline

Please refer to the section B.

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

<Table 1> Data on fuel consumption for plants in the Operating Margin

Energy sources	Plant Name		Fuel consumption 2002 (ton)	Fuel consumption 2003 (ton)	Fuel consumption 2004 (ton)
Bituminous	Honam	#1	732,433	633,609	885,758
		#2	782,381	832,014	783,300
	Samchonpo	#1	1,570,717	1,535,849	1,624,500
		#2	1,478,115	1,680,305	1,564,986
		#3	1,546,947	1,634,224	1,467,177
		#4	1,468,736	1,710,195	1,538,768
		#5	1,296,193	1,430,182	1,707,777
		#6	1,492,369	1,436,503	1,734,977
	Boryeong	#1	1,522,646	1,263,072	1,599,557
		#2	1,488,547	1,311,401	1,555,055
		#3	1,240,289	1,478,200	1,427,263
		#4	1,485,354	1,355,767	1,560,014
		#5	1,336,613	1,468,153	1,397,343
		#6	1,488,931	1,343,310	1,559,785
	Taean	#1	1,203,424	1,466,761	1,438,094
		#2	1,342,878	1,333,563	1,509,379
		#3	1,290,663	1,459,118	1,415,585
		#4	1,381,903	1,358,587	1,539,502
		#5	1,375,995	1,243,228	1,547,217
		#5	979,172	1,335,853	1,531,751
	Hadong	#1	1,358,393	1,476,164	1,389,739
		#2	1,458,164	1,377,617	1,515,681
		#3	1,449,498	1,362,366	1,501,027
		#4	1,360,689	1,483,166	1,397,482
		#5	1,434,705	1,375,276	1,501,672
		#6	1,307,355	1,473,500	1,379,396
	Dangjin	#1	1,457,856	1,369,223	1,502,885
		#2	1,426,409	1,360,761	1,523,605
		#3	1,277,914	1,488,422	1,404,465
		#4	1,275,932	1,501,207	1,434,844
	Yonghung	#1			1,114,254
		#2			459,217

Energy sources	Plant Name		Fuel consumption 2002 (kl)	Fuel consumption 2003 (kl)	Fuel consumption 2004 (kl)
Heavy Oil	Honam	#1	3,619	3,528	606
		#2	3,264	641	1,714
	Ulsan	#1	169,437	113,103	73,408
		#2	160,954	104,734	65,316
		#3	174,584	109,039	71,305
		#4	424,713	361,447	420,739
		#5	340,975	484,842	513,497
		#6	407,525	327,005	527,083
	Youngnam	#1	168,139	250,280	347,107
		#2	131,462	223,269	248,049
	Yosu	#1	167,477	173,830	181,712
		#2	226,755	85,905	316,523
	Pyongtaek	#1	361,196	343,765	204,664
		#2	379,819	325,723	209,664
		#3	340,527	329,779	179,921
		#4	302,867	361,331	192,294
	Namjeju	#1	8,449	12,520	16,510
		#2	9,565	12,216	16,040
	Jeju	#1	7,508	10,363	15,306
		#2	123,477	107,856	118,473
		#3	111,071	124,954	124,160
	Incheon	#1	15,908	22,390	
		#2	18,368	22,656	
		#3	12,112	24,998	
		#4	12,286	23,774	
	Namjeju	D/P	55,233	56,401	57,808

Energy sources	Plant Name		Fuel consumption 2002 (kl)	Fuel consumption 2003 (kl)	Fuel consumption 2004 (kl)
Diesel Oil	Honam	#1	564	409	300
		#2	620	366	335
	Samchonpo	#1	994	1,144	1,674
		#2	960	657	744
		#3	734	838	814
		#4	675	299	785
		#5	1,291	2,118	230
		#6	840	1,570	652
	Boryeong	#1	308	968	311
		#2	552	934	616
		#3	372	59	574

		#4	174	307	179
		#5	781	152	422
		#6	113	356	350
	Taean	#1	918	319	999
		#2	401	730	310
		#3	235	193	390
		#4	152	628	254
		#5	1,633	994	329
		#6	6,021	1,011	230
	Hadong	#1	584	390	533
		#2	133	445	145
		#3	125	613	670
		#4	625	302	737
		#5	484	435	318
		#6	316	223	689
	Dangjin	#1	439	926	294
		#2	628	787	211
		#3	868	510	605
		#4	1,041	746	528
	Ulsan	#1	848	484	114
		#2	372	1,061	82
		#3	281	500	554
		#4	676	1,450	1,238
		#5	836	1,740	931
		#6	987	1,525	1,603
	Youngnam	#1	1,109	1,024	837
		#2	279	270	274
	Yosu	#1	436	370	571
		#2	163	86	436
	Pyongtaek	#1	364	167	247
		#2	289	195	232
		#3	460	111	240
		#4	384	123	225
	Namjeju	#1	22	20	6
		#2	21	24	13
	Jeju	#1	15	23	7
		#2	16	65	73
		#3	24	-	41
	Seoul	#4	11		1
		#5	9	4	3
	Incheon	#1	98	6	
		#2	97	6	
		#3	135	247	149
		#4	251	170	
	Pyongtaek C/C		43,827	96,032	21

	Ilsan	C/C	20,350	40,006	
	Bundang	C/C	66	-	
	Ulsan	C/C	20,902	63,295	
	Seoincheon	C/C	17,631	44,792	88
	Shinincheon	C/C	17,219	47,393	
	Boryeong	C/C	13,907	97,106	
	Hallim	C/C	26,967	16,286	28,796
	Anyang	C/C	-	-	
	Bucheon	C/C	-	-	
	K I E Co.	C/C	52,608	103,057	
	L G Bugog	C/C	5,370	67,273	
	Namjeju	D/P	75	84	80
	Busan			1,213	2,687
	Yonghung	#1			27,916
		#2			18,314
	Yulchon	C/C			596
	Jeju	G/T			2,232

Energy sources	**Plant Name**		**Fuel consumption 2002 (ton)**	**Fuel consumption 2003 (ton)**	**Fuel consumption 2004 (ton)**
LNG	Pyongtaek	#1	1,407	2,727	2,095
		#2	1,201	2,402	2,515
		#3	1,385	2,238	3,791
		#4	1,335	2,370	3,217
	Seoul	#4	23,145	32,670	22,409
		#5	175,058	126,211	117,908
	Incheon	#1	39,155	25,930	10,523
		#2	40,762	28,612	11,094
		#3	18,751	34,035	4,235
		#4	19,824	24,093	
	Pyongtaek C/C		99,363	76,012	98,846
	Ilsan	C/C	510,283	530,874	593,548
	Bundang	C/C	604,893	598,396	653,880
	Ulsan	C/C	255,078	189,997	347,076
	Seoincheon	C/C	1,086,293	1,012,670	1,209,806
	Shinincheon	C/C	1,416,960	1,405,724	1,587,638
	Boryeong	C/C	454,503	571,742	988,548
	Hallim	C/C	-		
	Anyang	C/C	338,303	325,207	270,559
	Bucheon	C/C	244,828	266,577	258,596
	K I E Co.	C/C	501,648	381,684	467,583
	L G Bugog	C/C	147,849	121,037	260,653
	Busan	C/C		234,533	1,298,418

Source : Statistics of Electric Power in KOREA (2003, 2004, 2005) (KEPCO)

<Table 2> Electricity generation and CEF Calculation for the Operating Margin in 2002, 2003, 2004

Plant Name		MWh Produced in 2002	MWh Produced in 2003	MWh Produced in 2004	CEF (t CO_2 / MWh) 2002	CEF (t CO_2 / MWh) 2003	CEF (t CO_2 / MWh) 2004
Honam	#1	1,508,303	1,372,873	1,855,554	1.0386	1.0286	1.0191
	#2	1,623,572	1,784,483	1,625,399	1.031	1.0249	1.0193
Samchonpo	#1	4,006,965	3,745,916	3,974,202	0.9047	0.931	0.8779
	#2	3,755,823	4,110,134	3,839,080	0.9056	0.9277	0.9932
	#3	3,976,257	4,051,427	3,652,769	0.8974	0.9183	1.0185
	#4	3,763,370	4,250,404	3,811,371	0.8984	0.9144	1.0201
	#5	3,320,736	3,606,167	4,147,957	0.8767	0.889	0.7716
	#6	3,814,588	3,609,696	4,185,213	0.8757	0.8915	0.7683
Boryeong	#1	3,905,038	3,237,526	4,014,109	0.9154	0.9192	0.9163
	#2	3,824,457	3,380,013	3,915,285	0.9138	0.9155	0.9132
	#3	3,390,363	4,090,927	3,746,265	0.8776	0.877	0.8791
	#4	4,069,374	3,754,883	4,097,489	0.8772	0.8765	0.8785
	#5	3,662,540	4,063,865	3,660,240	0.877	0.877	0.8791
	#6	4,076,351	3,709,092	4,093,207	0.8773	0.8771	0.8783
Taean	#1	3,335,520	3,995,111	3,780,097	0.8827	0.8808	0.8836
	#2	3,735,044	3,651,716	3,975,123	0.8808	0.8781	0.8809
	#3	3,586,755	3,994,351	3,732,363	0.881	0.8773	0.8797
	#4	3,857,072	3,708,360	4,048,258	0.8781	0.8816	0.8808
	#5	3,842,365	3,370,362	4,091,406	0.8828	0.882	0.8802
	#6	2,721,769	3,637,652	4,056,835	0.8912	0.8797	0.8787
Hadong	#1	3,763,669	3,995,331	3,688,313	0.8772	0.8819	0.8824
	#2	4,033,255	3,739,800	4,028,529	0.8787	0.8786	0.8797
	#3	3,995,847	3,694,945	3,997,064	0.8815	0.8798	0.8816
	#4	3,763,399	4,029,035	3,724,757	0.879	0.878	0.8882
	#5	3,976,839	3,733,243	4,013,845	0.8769	0.8793	0.8687
	#6	3,620,142	4,013,010	3,685,698	0.8779	0.8754	0.8626
Dangjin	#1	3,997,354	3,677,169	3,986,406	0.8795	0.8825	0.8797
	#2	3,923,487	3,685,913	4,038,457	0.8779	0.8776	0.8787
	#3	3,514,316	4,034,969	3,711,787	0.8793	0.8778	0.8779
	#4	3,519,919	4,096,642	3,801,495	0.8879	0.884	0.8742
Ulsan	#1	650,428	430,067	271,544	0.8254	0.8346	0.8587
	#2	621,740	404,834	244,246	0.8218	0.8248	0.8498
	#3	667,893	414,630	268,231	0.8229	0.8349	0.8491
	#4	1,778,566	1,507,363	1,759,376	0.7641	0.7654	0.7666
	#5	1,415,550	2,025,171	2,141,162	0.7699	0.7633	0.7673
	#6	1,698,585	1,363,879	2,196,344	0.7683	0.7658	0.7683
Youngnam	#1	664,185	890,011	973,872	0.8102	0.8323	0.8516

	#2	506,254	753,536	665,973	0.8278	0.8601	0.9182
Yosu Ⅱ	#1	686,062	703,557	723,968	0.7856	0.792	0.8078
(Yosu)	#2	878,464	328,981	1,304,109	0.8301	0.8365	0.7798
Pyongtaek	#1	1,535,696	1,465,460	850,533	0.7505	0.7402	0.7702
	#2	1,625,568	1,393,188	880,646	0.7449	0.7435	0.7634
	#3	1,434,408	1,400,056	751,633	0.7579	0.7485	0.7761
	#4	1,282,597	1,539,552	800,854	0.7539	0.7455	0.7753
Namjeju	#1	26,182	38,080	50,294	1.0309	1.04	1.0423
	#2	29,181	36,860	48,714	1.047	1.0488	1.0460
Jeju	#1	22,410	30,288	44,659	1.0771	1.1001	1.0881
	#2	506,993	439,474	486,401	0.7792	0.7829	0.7745
	#3	453,911	513,880	509,330	0.7828	0.7752	0.7755
Seoul	#4	96,233	132,599	90,322	0.7327	0.7492	0.7543
	#5	750,457	503,383	480,919	0.71	0.7618	0.7455
Incheon	#1	263,763	225,023	47,491	0.4525	0.6641	0.6750
	#2	279,809	242,806	49,144	0.4439	0.6527	0.6878
	#3	142,944	267,999	19,018	0.4016	0.6825	0.6999
	#4	150,246	214,153		0.406	0.6942	
Pyongtaek		792,480	863,292	596,001	0.5342	0.5728	0.5052
Ilsan		2,913,131	3,097,425	3,281,407	0.5529	0.557	0.5502
Bundang		3,392,511	3,344,852	3,650,122	0.5435	0.5447	0.5452
Ulsan		1,837,604	1,557,954	2,329,524	0.4542	0.4835	0.4498
Seoincheon		7,381,775	7,012,289	8,353,619	0.4539	0.4566	0.4403
Shinincheon		10,460,040	10,459,986	11,596,955	0.4163	0.4211	0.4164
Boryeong		3,055,340	4,436,234	6,979,928	0.4658	0.4533	0.4310
Busan			1,574,883	9,884,075		0.4544	0.3991
Hallim		97,221	55,044	96,435	0.7629	0.8141	0.8223
Anyang (Other co.)		1,909,128	1,793,725	1,506,070	0.5404	0.5521	0.5468
Bucheon (Other co.)		1,339,949	1,454,854	1,425,073	0.5558	0.5575	0.5518
K I E Co. (Other co.)		3,312,541	2,683,591	2,809,983	0.5053	0.5397	0.5063
LG Bugog (Other co.)		1,091,904	1,221,992	1,894,996	0.4262	0.4539	0.4187
Namjeju(D/P)		262,357	265,063	274,089	0.6724	0.673	0.6703
Yulchon	C/C			36,366			0.6768
Jeju	G/T			3,016			2.0328
Yonghung	#1			2,986,382			0.8787
	#2			1,172,450			0.9313
Total		**163,898,595**	**166,911,029**	**187,513,847**	**0.7794**	**0.7815**	**0.7542**

Source: Statistics of Electric Power in KOREA (2003, 2004, 2005) (KEPCO)

<Table 3> Sample group plants used in the Build Margin calculation and Carbon Emission Factor of the Build Margin

Plant name		Technology	year operation	Fuel	MWh in 2004	% of total output	CEF	Result
Sungnam		small hydro power	2004.12	hydro	14	0.00%	0	0
Maebongsan-wind power		wind power	2004.12	wind power	42	0.00%	0	0
Yongheng	#2	steam	2004.11	bituminous coal	1,172,450	1.67%	0.9313	0.0155
new solar energy		solar power	2004.09	solar	11	0.00%	0	0
Yulchon	C/C	steam	2004.07	LNG	36,366	0.05%	0.6768	0.0003
Yongheng	#1	steam	2004.07	bituminous coal	2,986,382	4.24%	0.8787	0.0373
Ulchin	#5	nuclear power	2004.07	nuclear	4,656,890	6.61%	0	0
Hankyung-wind power		wind power	2004.02	wind power	10,577	0.02%	0	0
Chunsang		small hydro power	2004.01	hydro	54	0.00%	0	0
Cheongju LFG		steam by L.P.G	2004.01	LFG	9,958	0.01%	0	0
WunjeongLFG		steam by L.P.G	2003.12	LFG	13,733	0.02%	0	0
Daegwanryung-wind power		wind power	2003.11	wind power	3,713	0.01%	0	0
Daejon Geumgodong		steam by L.P.G	2003.06	LFG	10,048	0.01%	0	0
Hoicheon ENC		steam by L.P.G	2003.05	LFG	7,169	0.01%	0	0
Busan	C/C	combined cycle power	2003.05	LNG	9,884,075	14.04%	0.3991	0.0560356
Andong		small hydro power	2003.08	hydro	8,250	0.01%	0	0
Muju		small hydro power	2003.04	hydro	695	0.00%	0	0
Seohee- ENC		steam by L.P.G	2003.04	LFG	30,262	0.04%	0	0
Yonggwang	#6	nuclear power	2002.12	nuclear	6,311,544	8.96%	0	0

Gunsan- filling		steam by L.P.G	2002.12	LFG	4,659	0.01%	0	0
Gunsan-wind power		wind power	2002.11	wind power	4,582	0.01%	0	0
Taean	#6	steam	2002.05	bituminous coal	4,056,835	5.76%	0.8787	0.0506
Yonggwang	#5	nuclear power	2002.05	nuclear	5,511,898	7.83%	0	0
Pohang-hodong		steam by L.P.G	2002.05	LFG	12,675	0.02%	0	0
Sangwon ENC		steam by L.P.G	2001.12	LFG	54,381	0.08%	0	0
Sanchong pumping #2		pumping	2001.11	hydro	287,832	0.41%	0	0
Milyang		small hydro power	2001.10	hydro	7,872	0.01%	0	0
Sanchong pumping #1		pumping	2001.09	hydro	290,531	0.41%	0	0
Yongdam		hydro	2001.09	hydro	166,759	0.24%	0	0
Yeongcheon		small hydro power	2001.08	hydro	3,332	0.00%	0	0
Hadong	#6	steam	2001.07	bituminous coal	3,685,698	5.23%	0.8626	0.0452
Dangjin	#4	steam	2001.03	bituminous coal	3,801,495	5.40%	0.8742	0.0472
Pohang-wind power		wind power	2001.02	wind power	576	0.00%	0	0
Taean	#5	steam	2001.01	bituminous coal	4,091,406	5.81%	0.8802	0.0511
Jeju	#3	steam	2000.12	heavy oil	509,330	0.72%	0.7755	0.0056
Dangjin	#3	steam	2000.09	bituminous coal	3,711,787	5.27%	0.8779	0.0463
Hoengseong		small hydro power	2000.08	hydro	5,004	0.01%	0	0
Hadong	#5	steam	2000.07	bituminous coal	4,013,845	5.70%	0.8687	0.0495
L G Bugog	C/C	combined cycle power	2000.07	LNG	1,894,996	2.69%	0.4187	0.0113
Jeju	#2	steam	2000.03	heavy oil	486,401	0.69%	0.7745	0.0054
Dangjin	#2	steam	1999.12	bituminous coal	4,038,457	5.74%	0.8787	0.0504
Ulchin	#4	nuclear power	1999.12	nuclear	8,623,075	12.25%	0	0

Total	70,405,658	100%	BM Factor	0.471834

Source: Statistics of Electric Power in KOREA (2005) (KEPCO), Current status of power generating facility(2005, KPX)

<Table 4> Fuels Carbon Emission Factor (tC/TJ)

Fuel	Carbon Emission Factor (tC/TJ)	Fuel	Carbon Emission Factor (tC/TJ)
Liquid Fossil		**Solid Fossil**	
Primary fuels		*Primary Fuels*	
Crude oil	20	Anthracite	26.8
Orimulsion	22	Coking coal	25.8
Natural gas liquids	17.2	Other bituminous coal	25.8
Secondary fuels/products		sub-bituminous coal	26.2
Gasoline	18.9	Lignite	27.6
Jet kerosene	19.5	Oil shale	29.1
Other Kerosene	19.6	Peat	28.9
Shale oil	20	*Secondary fuels/products*	
Gas/Diesel oil	20.2	BKB & Patent Fuel	25.8
Residual fuel oil	21.1	Coke Oven/Gas Coke	29.5
LPG	17.2	Coke gas oven	13
Ethane	16.8	Blast Furnace gas	66
Naphtha	20	**Gaseous Fossil**	
Bitumen	22	Natural gas (dry)	15.3
Lubricants	20	**Biomass**	
Petroleum coke	27.5	Solid Biomass	29.9
Refinery Feedstocks	20	Liquid Biomass	20
Refinery gas	18.2	Gas Biomass	30.6
Other oil	20		

Source: IPCC Guidelines, 1996a

<Table 5> Net Calorific Values by Power Plant in 2002

Plant Name		Caloric value (by source in 2002)			
		Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L. N. G (kcal/kg)
Honam	#1	5,465	9,896	8,871	-
	#2	5,473	9,922	8,870	-
Samchonpo	#1	5,943	-	9,000	-
	#2	5,925	-	8,999	-
	#3	5,941	-	9,001	-
	#4	5,928	-	9,002	-
	#5	5,781	-	9,000	-
	#6	5,764	-	9,000	-
Boryeong	#1	6,048	-	8,943	-
	#2	6,047	-	8,936	-
	#3	6,180	-	8,749	-
	#4	6,192	-	8,749	-
	#5	6,188	-	8,749	-
	#6	6,188	-	8,749	-
Taean	#1	6,299	-	9,013	-
	#2	6,310	-	9,013	-
	#3	6,307	-	9,013	-
	#4	6,314	-	9,013	-
	#5	6,344	-	9,013	-
	#6	6,340	-	9,013	-
Hadong	#1	6,260	-	9,002	-
	#2	6,262	-	8,975	-
	#3	6,261	-	8,983	-
	#4	6,262	-	8,993	-
	#5	6,261	-	8,983	-
	#6	6,262	-	8,983	-
Dangjin	#1	6,212	-	9,378	-
	#2	6,220	-	8,916	-
	#3	6,226	-	9,627	-
	#4	6,210	-	8,939	-
Ulsan	#1	-	9,838	9,120	-
	#2	-	9,881	9,120	-
	#3	-	9,805	9,120	-
	#4	-	9,967	9,123	-
	#5	-	9,948	9,123	-
	#6	-	9,966	9,123	-
Youngnam	#1	-	9,926	8,971	-
	#2	-	9,924	8,974	-
Yosu	#1	-	10,015	8,979	-
	#2	-	10,024	8,981	-
Pyongtaek	#1	-	9,907	9,095	12,949

	#2	-	9,907	9,102	12,939
	#3	-	9,908	9,101	12,945
	#4	-	9,905	9,081	12,956
Namjeju	#1	-	9,942	8,866	-
	#2	-	9,944	8,865	-
Jeju	#1	-	10,009	9,238	-
	#2	-	9,977	8,928	-
	#3	-	9,975	8,928	-
Seoul	#4	-	-	9,070	13,033
	#5	-	-	9,070	13,025
Incheon	#1	-	-	8,985	13,015
	#2	-	-	8,986	13,013
	#3	-	-	8,993	13,018
	#4	-	-	8,988	13,019
Pyongtaek	C/C	-	-	8,969	13,036
Ilsan	C/C	-	-	8,934	13,040
Bundang	C/C	-	-	8,970	13,044
Ulsan	C/C	-	-	9,049	13,029
Seoincheon	C/C	-	-	9,104	13,006
Shinincheon	C/C	-	-	9,096	13,007
Boryeong	C/C	-	-	9,101	13,034
Hallim	C/C	-	-	8,961	-
Anyang C/C	(Other co.)	-	-	-	13,052
Bucheon C/C	(")	-	-	-	13,018
K I E Co.	(")	-	-	9,081	13,029
L G Bugog	(")	-	-	9,027	13,042
Namjeju	D/P	-	9950	8867	-

Source: Statistics of Electric Power in KOREA (2003) (KEPCO)

<Table 6> Net Calorific Values by Power Plant in 2003

Plant Name		Caloric value (by source in 2003)			
		Coal (kcal/kg)	Heavy oil (kcal/l)	Diesel oil (kcal/l)	L. N. G (kcal/kg)
Honam	#1	5,693	9,859	8,844	-
	#2	5,655	9,901	8,847	-
Samchonpo	#1	5,846	-	9,009	-
	#2	5,844	-	9,011	-
	#3	5,862	-	8,948	-
	#4	5,855	-	8,992	-
	#5	5,766	-	9,000	-
	#6	5,765	-	9,000	-
Boryeong	#1	6,066	-	8,942	-
	#2	6,075	-	8,944	-
	#3	6,254	-	8,749	-
	#4	6,254	-	8,777	-
	#5	6,254	-	8,749	-
	#6	6,239	-	8,749	-
Taean	#1	6,181	-	9,013	-
	#2	6,192	-	9,013	-
	#3	6,188	-	9,013	-
	#4	6,198	-	9,013	-
	#5	6,155	-	9,013	-
	#6	6,167	-	9,013	-
Hadong	#1	6,149	-	8,941	-
	#2	6,144	-	8,984	-
	#3	6,146	-	8,912	-
	#4	6,145	-	8,957	-
	#5	6,148	-	8,871	-
	#6	6,142	-	8,839	-
Dangjin	#1	6,102		8,892	-
	#2	6,121		8,904	-
	#3	6,129		8,889	-
	#4	6,118		8,893	-
Ulsan	#1	-	9,861	9,018	-
	#2	-	9,856	9,047	-
	#3	-	9,862	9,035	-
	#4	-	9,921	9,120	-
	#5	-	9,912	9,120	-
	#6	-	9,921	9,120	-
Youngnam	#1	-	9,196	8,997	-
	#2	-	9,043	8,993	-
Yosu	#1	-	9,979	8,975	-
	#2	-	9,983	8,970	-
Pyongtaek	#1	-	9,838	8,974	-

	#2	-	9,844	8,972	12,955
	#3	-	9,845	8,977	12,929
	#4	-	9,842	8,976	12,950
Namjeju	#1	-	9,852	8,900	-
	#2	-	9,853	8,958	-
Jeju	#1	-	10,009	9,238	-
	#2	-	9,945	8,928	-
	#3	-	9,943	8,928	-
Seoul	#4	-	-	9,070	13,013
	#5	-	-	7,515	13,003
Incheon	#1	-	9,828	7,526	13,018
	#2	-	9,833	8,986	13,018
	#3	-	9,822	8,993	13,017
	#4	-	9,830	8,988	13,015
Pyongtaek	C/C	-	-	8,926	13,026
Ilsan	C/C	-	-	8,966	13,021
Bundang	C/C	-	-	-	13,030
Ulsan	C/C	-	-	9,053	13,007
Seoincheon	C/C	-	-	9,151	12,999
Shinincheon	C/C	-	-	9,150	13,005
Boryeong	C/C	-	-	9,131	13,016
Busan	C/C	-	-	9,242	12,997
Hallim	C/C	-	-	8,964	-
Anyang C/C	(Other co.)	-	-	-	13,033
Bucheon C/C	(")	-	-	-	13,022
K I E Co.	(")	-	-	9,092	13,014
L G Bugog	(")	-	-	9,033	13,018
Namjeju	D/P	-	9,852	8,881	-

Source: Statistics of Electric Power in KOREA (2004) (KEPCO)

<Table 7> Net Calorific Values by Power Plant in 2004

Plant Name		Caloric value (by source in 2004)			
		Coal	Heavy oil	Diesel oil	L. N. G
		(kcal/kg)	(kcal/l)	(kcal/l)	(kcal/kg)
Honam	#1	5,493	9,814	8,848	
	#2	5,430	9,817	8,850	
Samchonpo	#1	5,527		9,012	
	#2	6,275		9,010	
	#3	6,530		9,006	
	#4	6,507		9,004	
	#5	4,829		9,000	
	#6	4,773		9,000	
Yonghung	#1	5,892		8,927	
	#2	5,852		8,720	
Boryeong	#1	5,924		8,770	
	#2	5,922		8,910	
	#3	5,943		8,749	
	#4	5,945		8,749	
	#5	5,931		8,749	
	#6	5,937		8,749	
Taean	#1	5,980		8,765	
	#2	5,977		8,699	
	#3	5,975		9,004	
	#4	5,967		8,721	
	#5	5,996		8,912	
	#6	5,996		8,804	
Hadong	#1	6,032		9,002	
	#2	6,025		8,975	
	#3	6,046		8,983	
	#4	6,097		8,993	
	#5	5,982		8,983	
	#6	5,935		8,983	
Dangjin	#1	6,011		8,880	
	#2	6,000		8,889	
	#3	5,976		8,897	
	#4	5,966		8,898	
Ulsan	#1		9,893	9,010	
	#2		9,901	9,010	
	#3		9,896	9,010	
	#4		9,972	9,120	
	#5		9,963	9,120	
	#6		9,959	9,120	
Youngnam	#1		7,432	8,865	
	#2		7,679	8,876	
Yosu	#1		10,011	8,924	
	#2		10,009	8,956	
Pyongtaek	#1		9,877	8,917	12,920
	#2		9,879	8,941	12,907

	#3		9,902	8,907	12,910
	#4		9,903	8,915	12,956
Namjeju	#1		9,900	9,333	
	#2		9,901	8,846	
Jeju	#1		9,897	8,961	
	#2		9,912	8,936	
	#3		9,919	8,928	
Namjeju	D/P		9,901		
Seoul	#4			9,070	13,011
	#5			9,070	13,014
Incheon	#1				13,038
	#2				13,039
	#3			8,951	13,038
Pyongtaek C/C				8,758	13,033
Ilsan	C/C			-	13,017
Bundang	C/C			-	13,026
Ulsan	C/C			-	12,920
Seoincheon	C/C			9,211	13,010
Shinincheon	C/C			-	13,017
Boryeong	C/C			-	13,025
Busan	C/C			-	13,004
Hallim	C/C			8,972	-
Anyang	C/C			-	13,025
Bucheon	C/C			-	13,013
K I E Co.	C/C			-	13,023
L G Bugog	C/C			-	13,028
Yulchon	C/C			11,731	13,014
Namjeju	D/P			8,867	-
Jeju	G/T			8,948	-

Source: Statistics of Electric Power in KOREA (2005) (KEPCO)

<Table 8> Results of CO_2 emission reductions

	Annual Emissions in tones of CO_2	**Total over 7 years in tones of CO_2**
Emission reduction	**315,440**	**2,208,080**

Appendix 5. Further background information on monitoring plan

Plans for survey on the post environmental impacts

Among the environmental impacts which would be assumed to resulted from this project activity, impacts on preservation on cheerful surroundings will be monitored periodically in order to prevent the impacts, to manage and to establish a counter plan against unexpected negative impacts in accordance with the provision of "Act on Assessment of Impacts of Works on Environment, Traffic, Disasters, etc."(Ministry of Environment bulletin, Number 200-1, 29, January, 2001)

1 Project manager

Project manager of Plans for survey on the post environmental impact is a project participant, Korea water Resources Corporation, and will monitor the reduction facility which are mentioned on Environmental Impact assessment, and whether the facility is established and operated properly.

2 Survey period

Survey period of the post environmental impact resulting from the project activity will be performed from the date of start of construction to 5 years after completion of construction in accordance of the provision of clause 6, article 25 of Act on Assessment of Impacts of Works on Environment, Traffic, Disasters, etc , and 「Addenda 1. Subject activity and survey period project under Article 3 Enforcement Decree of the Act on Assessment of Impacts of Works on Environment, Traffic, Disasters, etc.

3 Survey plan

3.1 Survey items

Survey items are selected from major impact items on the base of environmental impact estimation and the result of assessment under construction and operation, and according to this, ten items are selected such as weather, geography, topography, flora and fauna, ocean environment and physics and atmosphere, wastes, noise and vibration.

3.2 Survey area

Survey area is selected from the zones of possible pollution occurrence areas within which are suggested in the report of Environmental Impact assessment.

3.3 Survey Location and method, survey cycle

The location of survey on the post environmental impacts is selected based on the inventory of situation and estimation location taken in EIA considering construction site and topographical condition.

<Table 1> Survey Location and method, survey cycle

classification		contents	Survey location	method	cycle
weather	At construction and operation	Wind direction, wind speed, temperature, humidity, rainfall	Representative location 1	Spot and document survey	ordinary
Topography . Geology	At construction	Stabilizing issue of soil extraction, fertile soil, soil erosion, recovery of extracting site	Soil extraction site	Spot measurement and survey	quarterly
Ocean geology	At construction and at opation	Change of topography	Inside and outside do Sihwa lake	Spot or document survey	Every three years
	At opartion	Change of Components of sediment	9 locations of Sihwa lake and 8 locations of open sea	Spot survey	quarterly
flora . fauna	At construction	Issue of recovery of soil extracting site	Soil extraction site	Spot survey	quarterly
	At construction and operation	Birds	Shihwa lake, soil extracting site(under construction)		
	At construction	Mammals ,amphibian, reptile, insects	Soil extraction site		
	At construction and operation	Tide line	3 Lines of Sihwa lake and 2lines of open sea		
	At construction and operation	Floral and faunal plankton, spawn, fry.	Line 4 of Sihwa lake and line 3 open sea		
		Benthic organisms	9 locations of Sihwa lake and 8 locations of open sea		
ocean environment	At construction and operation	22 items a including Salinity, COD, and SS	9 locations of Sihwa lake and 8 locations of open sea	Spot measurement and survey	quarterly
		Operation status of pollution prevention layer	Inside and outside of Sihwa Lake	Spot measurement and survey	frequently
	At construction and operation	12 items including Ignition loss, TS, and TOC	9 locations of Sihwa lake and 8 locations of open sea	Spot measurement and survey	quarterly

Ocean physics	At construction and operation	Tide	2 lines of open sea and 1 line of inland sea	Spot measurement and survey	quarterly
atmosphere	At construction	SO_2,CO, NO_2, PM-10, O_3, Pb	2 locations around project site 2 locations around soil extraction site	Spot measurement and survey	quarterly
wastes	At construction	Waste oil occurrence and treatment condition, Waste water purification facility condition, waste wood occurrence and treatment condition	Forest damage area in the project site waste oil storage	Spot survey	quarterly
Noise and .vibration.	At construction	Construction noise, explosion vibration reduction facility establishment and management	1 locations around soil extraction site 1 locations around project site	Spot measurement and survey	quarterly
Water quality	At construction	19 items including pH, BOD, SS	1 locations around soil extraction	Spot measurement and survey	quarterly

Appendix 6. Summary of post registration changes

Project participant revised the PDD with respect to monitoring management structure according to company reorganization and changed the short name of the company from KOWACO to K-water.