Project design document form for small-scaleCDM project activities

(Version 06.0)

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	LG Solar Energy Taean Photovoltaic Power Plant Project
Version number of the PDD	07
Completion date of the PDD	04/11/2015
Project participant(s)	LG Solar Energy
Host Party	Republic of Korea
Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)	・ Sectoral scope: 1 Energy industries (renewable-/non-renewable sources) ・ Selected methodology: AMS-I.D “Grid connected renewable electricity generation” (Version 15.0) ・ No standardized baseline(s) applicable
Estimated amount of annual average GHG emission reductions	12,275 tCO2 e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>> The proposed project activity involves implementation and operation of a 13.772 MW photovoltaic power plant for grid connection in Bangal-li area of Taean county. The project area had traditionally been used as salt farm where salt had been produced by evaporating seawater. However, in 1997, Ewon tide embankment was constructed and it stopped supply of seawater into the area. As a result, salt could not be produced any longer so that the land has been abandoned. The purpose of the project activity is to contribute sustainable development by the way of building a large scale photovoltaic power plant onto the abandoned land so as to supply electricity to the Korean nation-wide power grid

A.2. Location of project activity

A.2.1. Host Party

>> Republic of Korea

A.2.2. Region/State/Province etc.

>> Chungcheongnam-do

A.2.3. City/Town/Community etc.

>> Taean-gun

A.2.4. Physical/Geographical location

>> The project site is located in the west coast of Korean peninsula, Bangalli, Taean county, Chungnam province of Korea. (latitude of 36.53°N and longitude of 126.13°E)

Address: 440-11 Bangalli, Taean county, Chungnam province of Korea (Site#1)
152-5 Bangalli, Taean county, Chungnam province of Korea (Site#2)

Figure 1 Location of LG SE Taean PV Power Plant in Korean Peninsula

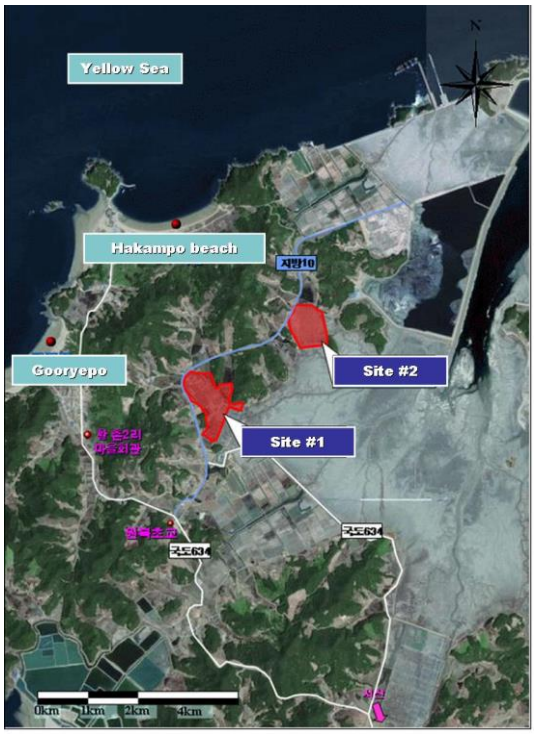


Figure 2 Location of Project Sites #1, #2

Figure 3 Site#1 Ground View (befor construction)

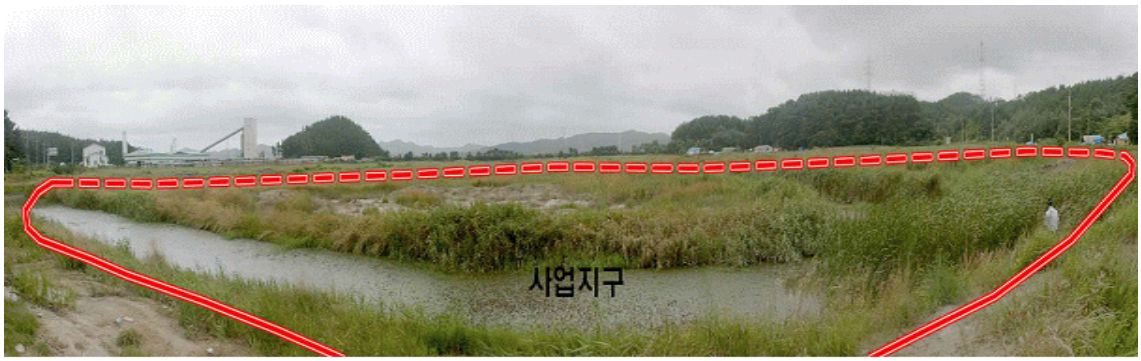


Figure 4 Site#2 Ground View (before construction)

Figure 5 Site #1 Bird's-eye View (imagenary)

Figure 6 Site#1 Ground View (after construction)

Figure 7 Site #2 Bird's-eye View (imagenary)

Figure 8 Site#2 Ground View (after construction)

A.3. Technologies and/or measures

>> The technology used for the project is photovoltaic (PV) electricity power generation. The PV generation is based on solar cell technology, which converts sunlight into electricity. Solar cells are usually installed in the form of a solar module where a number of solar cells are wired together. One solar module used for the project plant can generate 170~220W of electricity.

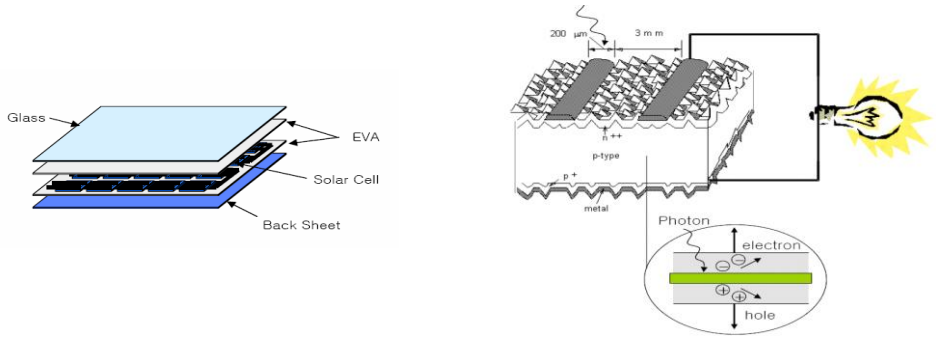


Figure 9. Solar Module and Photovoltaic Technology

Module Manufacturer	Type	Output	Efficiency	Installed	Total Output	Location
Conergy (Deutschland)	Poly	220W	13.50%	18,080	3,977.60KW	#1 (A,B,C)
Conergy(Deutschland)	Poly	210W	12.90%	13,920	2,923.20KW	#1 (A,C)
Conergy(Sweden)	Poly	215W	13.00%	9,280	1,995.20KW	#1 (B)
BP Solar(India/US)	Poly	170W	13.50%	19,888	3,380.96KW	#2 (D,E)
Schott(Deutschland)	Poly	175W	13.30%	8,544	1,495.20KW	#2 (D,E)
Total				**69,712**	**13,772.16KW**	

Table 1. Module Types of LG SE Taean PV Power Plant

For LG SE Taean PV project, over 69 thousands of modules are installed on 13 hundreds lines of steal structure – called arrays. They are firmly constructed on concrete foundation so as to stand still against strong wind at the speed of 60m/sec.

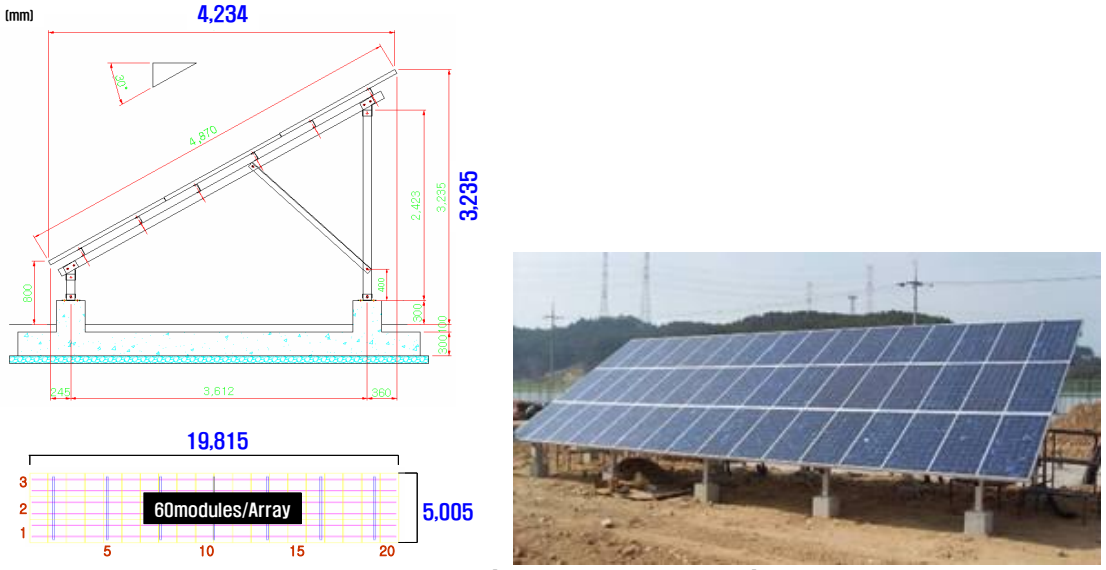


Figure 10 Array Design

The arrays are set up in five zones located in two sites – three zones in site #1, two in site #2. Each zone has one electricity facility room, where inverters, ACB, transformers, VCB and other equipment are sheltered so that each of them can cover 2~3MWp capacity. Each room is connected to a grid connection point (red dots in Figure 11.) through which electricity is sent.

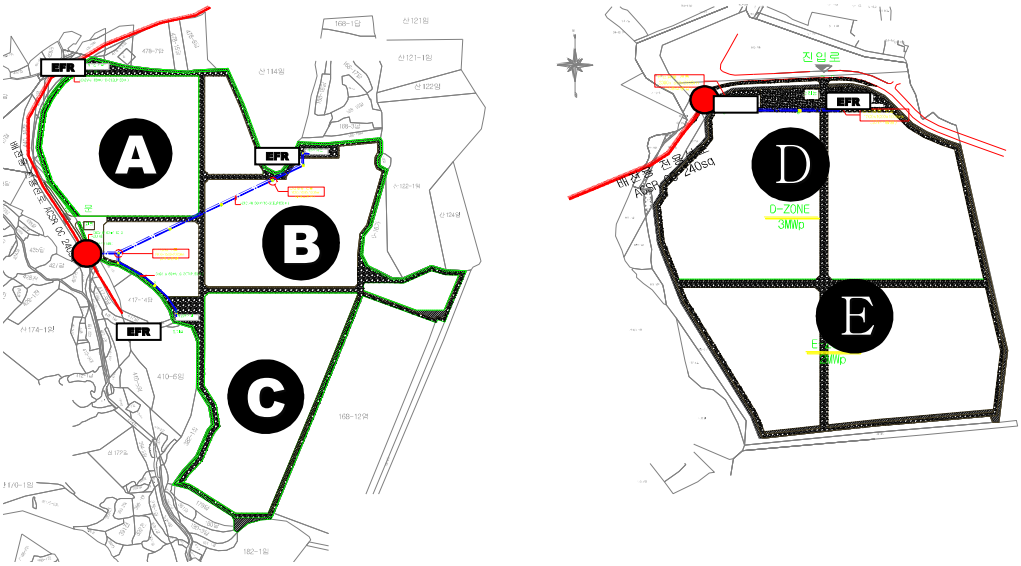


Figure 11 Plant Zoning A~E

Room	Capacity
A	2,928KW
B	2,989.6KW
C	2,978.4KW
D	2,933.44KW
E	1,942.72KW
Total	**13,772.16KW**

Table 2 Generation Capacity of EFRs

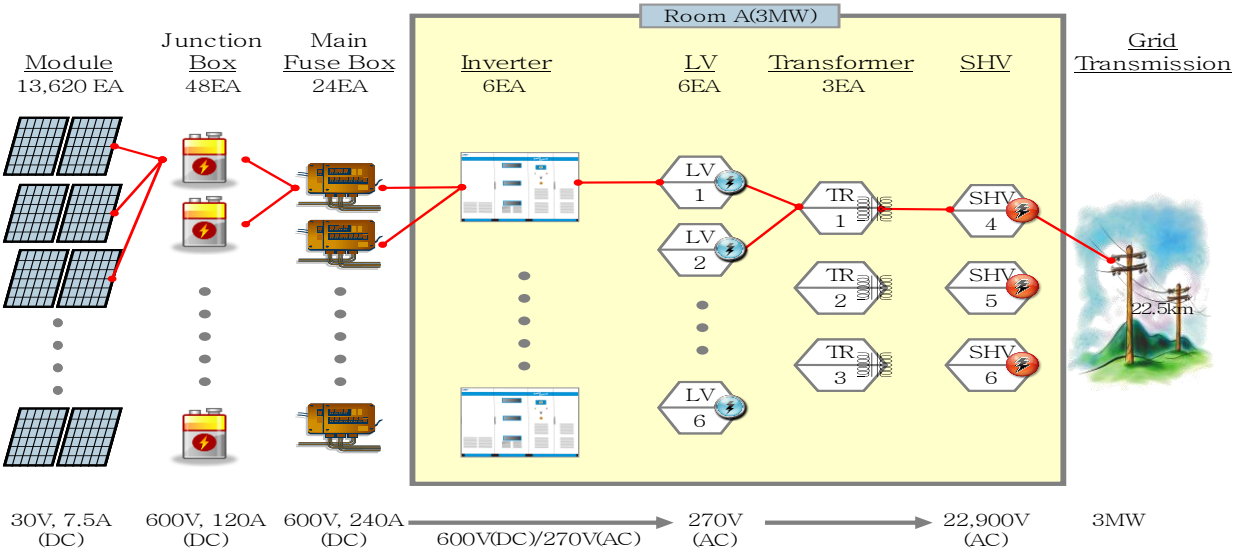


Figure 12 Power Generation Process

The generated electricity is transmitted to the nearest transformer station – Taean transformer station - of the national grid. Since there had not been available power transmission line between the plant and the transformer station, new transmission line had to be established by Korea Electric Power Corporation at the project participant's cost. The length of the line reaches about 23km – about 3km underground and the rest on poles, by which 22.9kV, 395A of electricity can be carried.

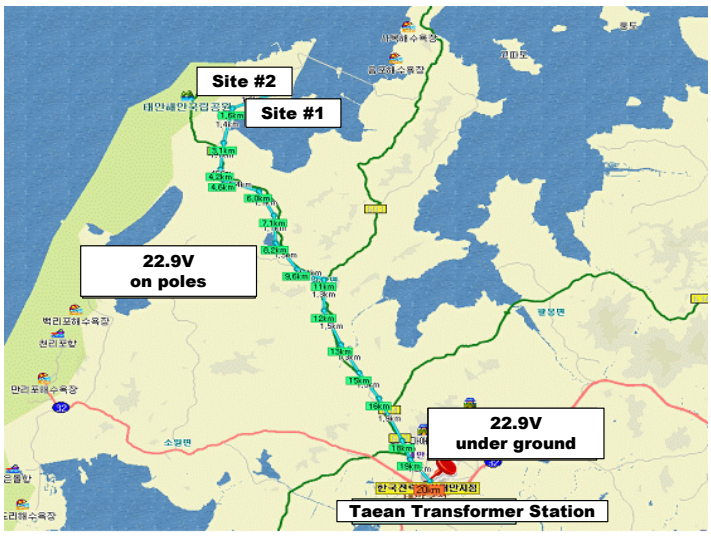


Figure 13 Transmission line between LG SE Taean PV Plant and Taean Transformer Station

KPX has changed their rule for regulating electricity market from total amount basis to net amount basis since 01/01/2010. So, LG Solar Energy needs to minimize the electricity usage for efficient operation of power plant. Accordingly, the relevant activities of saving the energy had been steadily implemented in the power plant.

At the end of 2012, LG CNS had proposed to install additional PV module and small ESS (Energy Storage System) to reduce the electricity usage for operating power plants. After reviewing the proposal, LG Solar Energy had decided to accept it as a part of the energy saving in the power plant.

On February 04, 2013, LG Solar Energy and LG CNS had signed an agreement to build PV + ESS together. LG Solar Energy had built 90kw PV system (80kw for 1st power plant, 10kw 2nd power plant) and LG CNS had built 144kWh ESS and this PV/ESS system had started up from July 01, 2013.

This system used for only internal plant operation purpose not for sale. The electricity produced by the system is firstly used for the plant operation, and the surplus electricity generated is stored in the ESS. If the ESS is fully charged, the surplus electricity is transferred to the Grid without cost. Thus, the electricity transferred to the Grid for sale is not increased and also installed capacity of the project for power plant is not changed.

A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Korea (host)	Private entity : LG Solar Energy	No

A.5. Public funding of project activity

>> This project activity is funded only by a private entity, which means any public funding from Parties included in Annex I to the Convention is not involved

A.6. Debundling for project activity

>> According to the Appendix C to the simplified modalities and procedures for the small-scale CDM project activities, this project activity is not a debundled component of a large scale project

activity since there is no registered small-scale CDM project activity nor an application to register another small-scale CDM project activity :

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

Since Taean Photovoltaic Power Plant is the first project of the project participant, LG Solar Energy, there cannot be any other possible component to debundle for the project participant

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

B.1. Reference of methodology and standardized baseline

>> Version 15 of AMS-I.D. 'Grid connected renewable electricity generation'

B.2. Project activity eligibility

>> In the provisions of simplified modalities and procedures for small scale CDM project activities Type I. D(version 15), it reads "This category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit."

In this respect, the activity falls in the category of AMS I-D since i) the only source of energy generation of the power plant is photovoltaic, ii) and the capacity of Taean photovoltaic power plant estimated is 13.772 MWp, which is lower than 15MW.

B.3. Project boundary

>> According to the modalities and procedure for small scale CDM project activities type I.D, the project boundary encompasses the physical, geographical site of the renewable generation source. Thus, the boundary of Taean photovoltaic project is the 295,166 ㎡ area including #1 site 187,251 ㎡ and #2 site 107,915 ㎡.

B.4. Establishment and description of baseline scenario

>> The project category of the proposed activity is AMS I-D, as shown in the B.2 in the document. Hence, the baseline for the activity should be of the category AMS I-D. The paragraph 10 and 11 of version 15 of the "Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories AMS I-D" states that:

For all other systems, the baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in kWh of electricity produced by the renewable generating unit multiplied by an emission factor.

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

Where:

BE_y Baseline Emissions in year *y*; t CO_2

$EG_{BL,y}$ Energy baseline in year *y*; kWh

EF_{CO2} CO_2 Emission Factor in year y; t CO_2e/kWh

The Emission Factor can be calculated in a transparent and conservative manner as follows:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system'.

OR

(b) The weighted average emissions (in kg CO2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used. Calculations must be based on data from an official source (where available) and made publicly available

Thus, the baseline emissions of Taean photovoltaic project is the kWh produced by the power plant(energy baseline) multiplied by an emission factor, reflecting the existing power plants. To calculate 'in a transparent and conservative manner', option (a) will be applied. The reasons are as follows;

1. The power of the grid where the Taean plants are to be connected is generated not only by fuel oil and/or diesel fuel. That means the emission factors for diesel generator systems which are given in the paragraph 9 of the simplified baseline and monitoring methodology for AMS I-D cannot be used. The emission coefficient must be calculated as a combined margin.

2. There is no average emission data of the current generation mix from an official source made publicly available. That necessary data must 'produced' by calculation of a combined margin.

Following table 6 illustrates all key information and data used to determine the baseline emissions.

Parameter	Value	Source
GEN $_{j, y}$ (MWh) is the electricity delivered to the grid by source *j*.	Refer to <Annex3-7>,	Statistics of Electric Power in KOREA (2004, 2005, 2006) (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 <Annex3-1>, <Annex3-2>, <Annex3-3>	Statistics of Electric Power in KOREA (2004, 2005, 2006) (KEPCO)
Calorific Values by Power Plant	Refer to <Annex3-4>, <Annex3-5>, <Annex3-6>	Statistics of Electric Power in KOREA (2004, 2005, 2006) (KEPCO)
CO_2 Emission Factor	Refer to <Annex3-8>	2006 IPCC Guidelines for National Greenhouse Gas Inventories Vol.2 Energy
Operating Margin Emissions Factor (in t CO_2/MWh)	0.7281	Calculated
Build Margin Emissions Factor (in t CO_2/MWh)	0.3860	Calculated
Baseline Emissions Factor (in t CO_2/MWh)	0.6426	Calculated

Table 3 Information and data for the baseline emission calculation

B.5. Demonstration of additionality

>> According to the attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities, project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

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

(b) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;
(c) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;

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

However, in the document, (a) investment barrier and (c) barrier due to prevailing practice will be explained to demonstrate and assess additionality of the project

Investment barrier

The most significant barrier is an investment barrier, which means the proposed project is not profitable itself so that it would not be implemented without considering the CDM and GHG issues. To illustrate the profitability of a certain project, net present value (NPV) and internal rate of return (IRR) are frequently used. Here, only are NPV investigated to clear that the Taean PV project is not profitable itself since NPV is better than IRR when a case is in deficit, as the proposed project. The NPV discount rate, however, 5.05% is applied to the calculation – that is the average value of Korean government bond(10years) rate from 2003 to 2007.[1]

Items	Value	Remarks
General Description		
Installed capacity	13.772	MW
Efficiency[2]	3.8	hrs/day
Annual ouput	19,101.76	MWh
Operation period	20	years
Crediting period	7	Years (1st of 20 years renewable periods)
Electircity price[3]	98.16	won/kWh
Expected revenue		
Sale of electricity	37,501 million	KRW
CER Revenue[4]	4,774 million	KRW

[1] The average value was calculated by the project participant based on the statistics offered by the Korean National Statistical Office. The intention was to calculate five year average value of the government bond from the year project decision has been made.

[2] The efficiency has been conservatively determined based on sunshine duration of the project area and characteristics of PV system. However, the number 3.8hrs is higher than 3.6hrs(15%), which is commonly accepted efficiency rate and also used in the official report, <The reform of FiT for renewable energy and RPS transition> (Korean Ministry of Knowledge Economy, 2006, p.201).

[3] The price value is the highest monthly average in 2007, related table has been inserted on the last worksheet in the financial analyses file.

Expenses[5]		
Operating expenses(maintenance)	13,976 million	KRW
Insurance	4,614 million	KRW
Interest	33,832 million	KRW
Total investment	97,640 million	KRW
Shareholder's Equity	29,292 million	KRW
Loan fund	68,348 million	KRW
Loan Condition		
Loan Interest Rate (year)	6.6%	%
Deferment of Redemption	2	years
Term of Redemption	10	years

Table 4 Financial parameters for calculation of NPV of total investment of the Project

Taean PV Project		**NPV**[6]
Without CER Revenue	Project	-85,902 million won
	Equity (30%)	-92,255 million won
With CER Revenue	Project	-82,939 million won
	Equity (30%)	-89,292 million won

Table 5 NPV of Taean PV project

As seen in the table 8, the NPV of Taean PV project is negative regardless of CER revenue. That means to invest to the project is simply not profitable. The reason of the deficit is the fact that the revenue from the sales of electricity cannot afford the initial investment cost of PV power plant construction. In other words, PV technology is still immature and economically not feasible. It consists of a substantial investment barrier to the proposed project.

The substantiality of the investment barrier becomes clearer when 'a sensitivity analyses' is considered. It is to see how the NPVs change as some selected figures assumed for the calculation of the NPVs are modified. To see how the investment barrier is real, we tested project profitability by adding up 15% or 30% to the price and 5% or 10% efficiency(generation hours per day) of the initial case for revenue increase, while reducing 5% or 10% from the investment and operation cost of the initial case.

Price

There are two prices considered in the financial model – electricity price and CER price. The most of the revenue is from electricity sales. The historical variation in the unit price of electricity sale from 2002 to 2007 is 5.92% minimum, 27.59% maximum, and 12.36% average. Therefore, the sensitivity analysis has been resonabley carried out with 15% and 30% range.

	2002	**2003**	**2004**	**2005**	**2006**	**2007**
Price(KRW/kWh)	**47.32**	**50.48**	**55.78**	**61.97**	**79.07**	**83.75**

[4] Emission Factor 0.6426tCO_2/MWh is applied as shown in B.6.3 and Average CER Price(KRW/ton) in 2007, 19,477KRW is applied. (calculated, with CER price of Reuter Index and average exchange rate in 2007)

[5] Initially expected operation and insurance cost was higher. However, it turns out about 18.6 billinon throughout the actual operation and the number has been replaced for the accuracy for the investment analysis.

[6] In Korea, there is a governmental subsidy policy for power plants of renewable energy sources including photovoltaic power based on the Act on the Promotion of the Development and Use of New and Renewable Resources of Energy(amended in March 2002). However, according to the meeting report of the 22nd EB which was held on 23-25 November 2005, the subsidy adopted after 11 November 2001 does not need to be included in the economic analysis for the project. Thus, in this analysis, effects by the governmental subsidy are not taken into account.

Ratio(%)	**-**	**6.68**	**10.5**	**11.1**	**27.59**	**5.92**

Table 6 Electricity price (KPX[7])

Efficiency

The efficiency 3.8 hours is determined by the amount of sun light and characteristics of the PV system such as equipment efficiency and array structure types. That means possible increase of system efficiency is quite limited. This is even more certain when considering the module efficiency is generally regarded decreasing, during relatively long project period, 20 years. Thus, the typical range, 5%~10% , is applied.

Investment

Over 98% of investment is related to the cost for building of PV plant such as construction, engineering and grid connection cost. These costs are already determined by contract, so that the amount of investment cannot exceed 5% or 10% of the initial amount.

Operation cost

The operation cost is mainly comprised of facility management fee and salaries, the level of which generally depends on market prices. When considering Korea's economic development and its history of inflation, it is hardly acceptable that the operation cost level decreases lower than 10%.

	Conditions				**NPV (without CER Revenue)**
	Price (Electricity & CER)	**Effiiciency**	**Investment Cost**	**O&M Cost**	
Project	Without alteration				**-85,902 million won**
	+15%	+5%	-5%	-5%	**-75,757 million won**
	+30%	+10%	-10%	-10%	**-65,262 million won**
Equity	Without alteration				**-92,255 million won**
	+15%	+5%	-5%	-5%	**-81,792 million won**
	+30%	+10%	-10%	-10%	**-70,979 million won**

Table 7 Result of Sensitivity Analysis

As shown in the table 10, as the revenue increases and the cost decreases, NPV increases. However, even in the most profitable cases, the NPV of the project is still far below zero. It means if we assume even more favorable case for the project profitability, it still can be said that there is an investment barrier at in-negligible height.

Barrier due to prevailing practice

The other barrier is of prevailing practice. It can simply be explained by considering what types of electricity generation is dominant in the country. It has been shown in figure 14 and table 11 below.

[7] From KPX's Electric Power Statistics Information System (http://epsis.kpx.or.kr/)

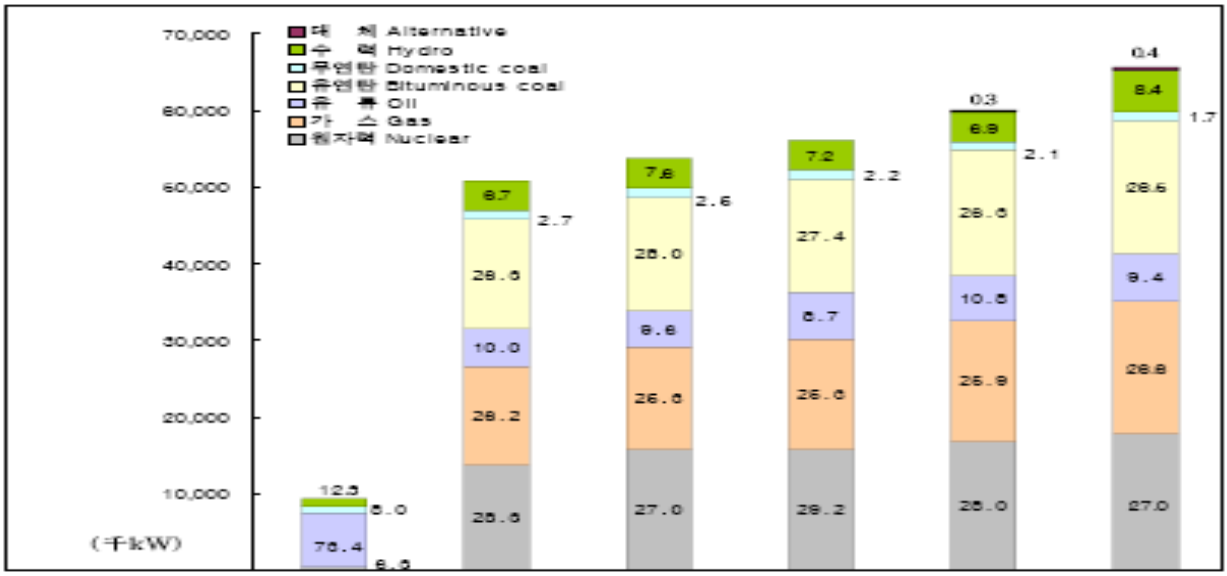


Figure 14 Installed Generating Capacity (By Energy Source)[8]

(單位 Unit : MW)

區分 Item / 年度 Year		1980	2002	2003	2004	2005	2006
水力 Hydro		1,157	3,876	3,877	3,829	3,829	5,485
火力 Thermal	國內炭 Coal (Domestic)	750	1,191	1,191	1,125	1,125	1,125
	石 炭 Coal (Bituminous)	–	14,740	14,740	16,340	16,840	17,340
	油類 Oil	6,897	4,660	6,011	6,048	6,091	6,172
	가스 Gas	–	13,618	14,518	15,746	16,447	17,436
原子力 Nuclear		587	15,716	15,716	16,716	17,716	17,716
代替에너지 (alternative)		–	–	–	158	210	240
計 Total		9,391	53,801	56,053	59,961	62,258	65,514

Table 8 Installed Generating Capacity (By Energy Source)[9]

As shown in the table above, thermal energy has recently been a major source of power generation in Korea, while alternative energy share was only 0.4% of the whole generating capacity. Moreover, the meaning 'alternative' includes all different sources of energy, for example, wind power, bio diesel, tidal energy and so on. The photovoltaic power plant's share is simply far below the number.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

>> There are different options in "Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories AMS I-D". In this section, methodological choices made in this document will be explained along with a few steps stated in the baseline methodology procedure of "Tool to calculate the emission factor for an electricity system". According to the statement ;

Project participants shall apply the following six(or seven) steps:

STEP 1. Identify the relevant electricity systems.

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

[8] <Summary of Statistics of Electric Power in Korea>, KEPCO, 2007

[9] Source: <KEPCO in Brief>, '07.3, KEPCO homepage
http://cyber.kepco.co.kr/kepco/customer/electric_info/statistical_sum.jsp

STEP 3. Select a method to determine the operating margin (OM).

STEP 4. Calculate the operating margin emission factor according to the selected method.

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

STEP 6. Calculate the build margin emission factor.

STEP 7. Calculate the combined margin (CM) emissions factor.

1. Choice of project electricity system or connected electricity system *(Step 1)*

For determining the electricity emission factors, a relevant project electricity system must be delineated. A project electricity system, as defined in the tool for calculation of the emission factor, means the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints. In this sense, it is clear that the project electricity system to be applied is the whole Korean national grid system since all power plants, including Taean photovoltaic power plant, are physically connected to each other through transmission and distribution lines constituting the grid.

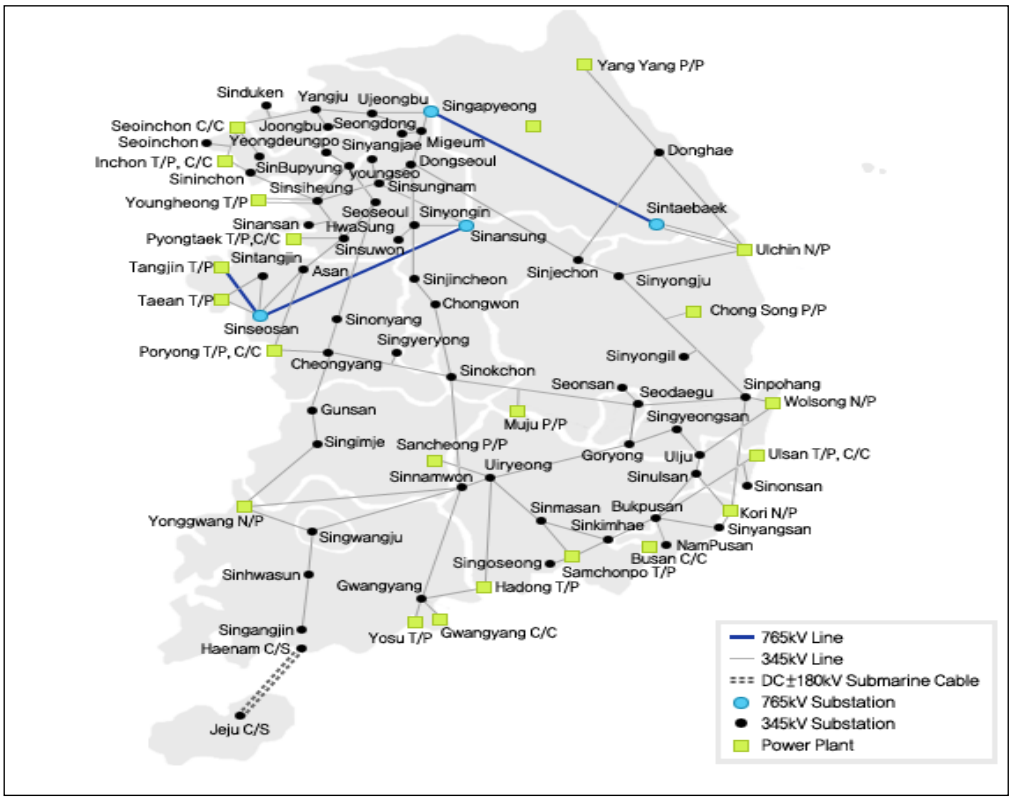


Figure 15 Korean National Grid Map

2. Choise whether to include off-grid power plants in the project electricity system *(Step 2, optional)*

There are two options for profect participants in this step :

Option I: Only grid power plants are included in the calculation.

Option II: Both grid power plants and off-grid power plants are included in the calculation.

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor. However, the option I has been taken here so that off-grid power plant data are not taken into account for calculation of the operation margin and build margin emission factor.

3. Choice of Operating Margin(OM) Method *(Step 3)*

According to AMS I-D, The calculation of the operating margin emission factor (EFgrid,OM,y) is based on one of the following methods:

(a) Simple OM, or

(b) Simple adjusted OM, or

(c) Dispatch data analysis OM, or

(d) Average OM.

Any of the four methods can be used, however, the simple OM method (option a) can only be used if low-cost/must-run resources[10] constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

To clarify whether (a) Simple OM method can be applied, the total ratio of low-cost/must-run generation in total power generation of the grid must be examined. Table 12 shows percentage of the low-cost/must-run resource generation in Korea during the five most recent years.

Unit: GWh

Year	Total Power Generation	Others	Low-cost/Must-run					
			Hydro	Domestic Coal	Nuclear	Alternative Energy	Total	Ratio
2002	306,474	176,915	5,311	5,144	119,103	-	129,558	**42.3%**
2003	322,452	176,915	6,887	5,398	129,672	-	141,957	**44.0%**
2004	342,148	200,620	5,861	4,603	130,715	350	141,529	**41.4%**
2005	364,638	207,783	5,189	4,484	146,779	404	156,856	**43.0%**
2006	381,181	222,391	5,219	4,312	148,749	511	158,791	**41.7%**

Table 9 Low-cost/must-run Ratio of Power Generation in Korea[11]

In Korea, as shown above, the rate of the low cost/must run power generation does not exceed 50 % of the total power generation. Therefore, option (a) Simple OM method can be chosen to calculate the OM of the grid.

4. Choice of ex ante or ex post option *(Step 3)*

For the simple OM, as mentioned in the 'Tool to calculate the emission factor for an electricity system', the emissions factor can be calculated using either of the two following data vintages:

- Ex ante option: A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period, or

[10] In AMS I-D, it is said that "They(low-cost/must-run resources) typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation". Here, however,

[11] Source: <KEPCO in Brief>, '07.3, KEPCO homepage http://cyber.kepco.co.kr/kepco/customer/electric_info/statistical_sum.jsp

- Ex post option: The year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring

.

In this document, 'Ex ante option' has been selected between two options above. That means the emission factor which is calculated from a 3-year generation-weighted average will be valid during the crediting period.

5. Choice of calculation of the simple OM *(Step 4)*

As described in the 'Tool to calculate the emission factor for an electricity system', the simple OM emission factor is calculated as the generation-weighted average CO2 emissions per unit net electricity generation (tCO2/MWh) of all generating power plants serving the system, not including low-cost / must-run power plants / units. It may be calculated:

Option A: Based on the net electricity generation and a CO2 emission factor of each power unit;

or

Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

Detailed data on fuel consumption and net electricity generation of each power plant in Korea can be found in the report, 'Statistics of Electronic Power in Korea', which is annually published by Korea Electric Power Corporation(KEPCO). The company is the only and major public company, and in charge of the whole country's power generation, purchasing and distribution so that the availability for the purpose is unquestionable. Thus, in this document, option A has been chosen and OM calculation formula should be as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_{m} EG_{m,y} \cdot EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:

$EF_{grid,OMsimple,y}$ = Simple operating margin CO2 emission factor in year y (tCO2/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$EF_{EL,m,y}$ = CO2 emission factor of power unit m in year y (tCO2/MWh)

m = All power units serving the grid in year y except low-cost / must-run power units

y = The relevant year as per the data vintage chosen in Step 3

6. Choice of determination of $EF_{EL,m,y}$ *(Step 4)*

Additionally, there are three different options for determination of emission factor of power unit m in year y($EF_{EL,m,y}$).

- Option A1 - When for a power unit m data on fuel consumption and electricity generation is available,
- Option A2 - When for a power unit m only data on electricity generation and the fuel types used is available,

• Option A3 - When for a power unit m only data on electricity generation is available

As stated above, since data on fuel consumption and net electricity generation of each power plant in Korea are both available, Option A1 has been chosen. Thus, the emission factor (*EFEL,m,y*) should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum_{i,m} FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

$EF_{EL,m,y}$ = CO2 emission factor of power unit m in year y (tCO2/MWh)

$FC_{i,m,y}$ = Amount of fossil fuel type i consumed by power unit m in year y (Mass or volume unit)

$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type i in year y (GJ/mass or volume unit)

$EF_{CO2,i,y}$ = CO2 emission factor of fossil fuel type i in year y (tCO2/GJ)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

m = All power units serving the grid in year y except low-cost/must-run powerunits

i = All fossil fuel types combusted in power unit m in year y

y = The relevant year as per the data vintage chosen in Step 3

6. Identification of the group of power units to be included in the build margin *(Step 5)*

According to the tool to calculate the emission factor, there are two options in order to select sample group of power units for calculation of BM.

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

(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

In addition, the tool requires project participants to choose the set of power units that comprises the larger annual generation.

	Net Generation (MWh)	**% in Total Net Generation of the electricity system**	**Group Selected**
(a) The set of five power units that have been built most recently	**22,474**	**0.0062%**	
(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that	**76,847,524**	**21.0329%**	○

have been built most recently			

Table 10. Choice of the set of power plants for BM calculation

As shown in table 13, the 2006's annual generation of the set of the five most recent power units was 22,474MWh (0.0062% of total generation of the grid system), and this is much smaller than that of the option (b) - 20% most recent power capacity additions power plants capacity additions in the electricity system - that reaches over 76,849,524MWh in annual generation in 2006, comprising over 21% of the total power generation in the same period. In sum, the latter, option (b) in the tool document, was chosen by comparing amounts of annual generation in 2006, the most recent year when reliable statistics are available.

7. Choice in terms of vintage of data *(Step 5)*

In terms of vintage of data for calculation of BM, following two options are available for project participants:

Option 1. For the first crediting period, calculate the build margin emission factor ex-ante based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2. For the first crediting period, the build margin emission factor shall be updated annually, ex-post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex-ante, as described in option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

Here, option 1 is chosen and, as required by the tool to calculate the emission factor, the build margin emission factor will be updated after the first crediting period.

8. Choice in terms of vintage of data *(Step 6)*

The build margin emissions factor is the generation-weighted average emission factor (tCO2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \cdot EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:

$EF_{grid,BM,y}$ = Build margin CO2 emission factor in year y (tCO2/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year

y (MWh)
$EF_{EL,m,y}$ = CO2 emission factor of power unit m in year y (tCO2/MWh)
m = Power units included in the build margin
y = Most recent historical year for which power generation data is available

9. Choice of weighting factors when calculating combined margin *(Step7)*

When calculating the combined margin(CM), project participants are required to decide weighting factors. In the document of the tool to calculate the emission factor, the combined margin emissions factor is used as follows:

$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$

For Taean photovoltaic project, wOM and wBM must be 0.75 and 0.25, respectively, since the emission factor calculation tool document explicitly sets default weighting factor values for solar power generation project, like Taean case:

- Wind and solar power generation project activities: w_{OM} = 0.75 and w_{BM} = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods.

B.6.2. Data and parameters fixed ex ante

Data/Parameter	$FC_{i,m,y}$
Unit	kg (Coal, LNG), kℓ(Heavy oil, Diesel oil)
Description	Amount of fossil fuel type i consumed by power plant / unit m in year y
Source of data	Statistics of Electronic Power in KOREA (KEPCO)
Value(s) applied	See Annex 3
Choice of data or Measurement methods and procedures	The statistics is officially released figures; the most reliable data source as well as publicly accessible
Purpose of data	For the calculation of baseline emission
Additional comment	

Data/Parameter	$NCV_{i,y}$
Unit	kcal/kg (Coal, LNG), kcal/ℓ(Heavy oil, Diesel oil)
Description	Net calorific value of fossil fuel type i in year y
Source of data	Statistics of Electronic Power in KOREA (in 2004, 2005, 2006) (KEPCO)
Value(s) applied	See Annex 3
Choice of data or Mea surement methods and procedures	The statistics is officially released figures; the most reliable data source as well as publicly accessible
Purpose of data	For the calculation of baseline emission

Additional comment	• Since the initial data unit from the official statistics is kcal, it was converted to the unit of kJ using converting factor 4.1868 (1cal=4.1868J) • According to the 'data and parameters' of "Tool to calculate the emission factor for an electricity system" adopted by EB35[12], The gross calorific value (GCV) of the fuel can be used, if gross calorific values are provided by the data sources used.

Data/Parameter	**EF_y**
Unit	tonCO_2/MWh
Description	CO_2 emission factor of fossil fuel type i in year y
Source of data	Calculated
Value(s) applied	See Annex 3
Choice of data or Measurement methods and procedures	Complying with the 'data and parameters' of "Tool to calculate the emission factor for an electricity system" adopted by EB35[13], IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories were applied.
Purpose of data	For the calculation of baseline emission
Additional comment	

Data/Parameter	**$EG_{m,y}$**
Unit	MWh
Description	Net electricity generated and delivered to the grid by power plant / unit m connected to the electricity system (the Korean national grid) in year y
Source of data	Statistics of Electronic Power in KOREA (in 2004, 2005, 2006) (KEPCO)
Value(s) applied	See Annex 3
Choice of data or Measurement methods and procedures	The statistics is officially released figures; the most reliable data source as well as publicly accessible
Purpose of data	For the calculation of baseline emission
Additional comment	

B.6.3. Ex ante calculation of emission reductions

>> **Baseline emission**

(a) The capacity of the project (solar power plant) is 13.772 MW and coefficient of utilization is expected to be about 15.83%(3.8 hours per day). Therefore, projected electricity produced by the project is 19,101.76 MWh per year

(b) As $EF_{grid,OM,y}$ is 0.7281tCO_2/MWh, and
$EF_{grid,BM,y}$ is 0.3860tCO_2/MWh,
$EF_{grid,CM,y}$ is (0.7281*0.75) + (0.3860*0.25) = 0.6426 tCO_2/MWh

(c) Baseline emission = electricity produced by the project * emission factor,
= 19,101.76 MWh/yr * 0.6426 tCO2/MWh ≒ 12,275 tonCO2/yr

Project emission

[12] p. 20.

[13] p. 21.

Project emission is zero

Ex-ante emission reduction
Emission reduction = Baseline emission – Project emission
= 12,275 tonCO2/yr – 0 tonCO2/yr = 12,275 tonCO2/yr

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

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2010.8~2011.7	12,275	0	0	12,275
2011.8~2012.7	12,275	0	0	12,275
2012.8~2013.7	12,275	0	0	12,275
2013.8~2014.7	12,275	0	0	12,275
2014.8~2015.7	12,275	0	0	12,275
2015.8~2016.7	12,275	0	0	12,275
2016.8~2017.7	12,275	0	0	12,275
Total	**85,925**	**0**	**0**	**85,925**
Total number of crediting years	7			
Annual average over the crediting period	12,275	0	0	12,275

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	**$EG_{TaeanPV,MP}$**
Unit	MWh
Description	Net electricity generated and delivered to the grid by LG Taean PV power plant in a monitoring period MP
Source of data	Continuously measured data from
Value(s) applied	19,101.76 MWh per year (expected)
Measurement methods and procedures	• Measurement of electricity generation is two-folded. One is by KPX power generation meters and the other is by the plant's monitoring system, • The data measured by KPX's metering system will be sent and stored in the KPX system. It is open to the project participant and will be used to calculate GHG emission reduction. • Also the plant's monitoring system will record real-time data on net generation amount of electricity which is sent to the grid, separately from KPX metering. However, it is 'supporting' data which can be referred for the purpose of any malfuction or error of the KPX's metering (system). • For this purpose, the chief manager of the plant operation periodically (daily/weekly/monthly) check and report the appropriateness and consistency of the data from both sides.
Monitoring frequency	• Daily , Monthly

QA/QC procedures	• Metering equipment is checked on installation and sealed to secure appropriateness of the data by a reliable national organization (Korea Power Exchange). • The metering equipment for power generation will be tested and calibrated every 3.5 years ± 6 months years. • The metering equipment for plant operation will be calibrated for every 8 years from installation. • The integrity of the data will be assured by regular cross-checking process between data stored in a main server of the project power plant and in the information system of KPX
Purpose of data	For the calculation of emission reduction
Additional comment	

B.7.2. Sampling plan

>> Not applicable

B.7.3. Other elements of monitoring plan

>> As mentioned in B.2, the activity falls in the category of AMS I-D since i) the only source of the power plant is photovoltaic, ii) and the capacity of Taean photovoltaic power plant estimated is 13.772 MWp, which is lower than 15MW, and iii) electricity generated is sent to the grid connected to the PV power plant. Therefore, the project is included in the category AMS I-D. For the project activity where methodology AMS I-D is applied, monitoring shall consist of metering the electricity generated by the renewable technology. Thus, the monitoring plan for LG Taean PV power plant is mainly about how to accurately measure the amount of the electricity generation sent to the electricity system.

Measurement of electricity generation is two-folded. One is by KPX power generation meters, which are installed in each of 5 electricy rooms(A~E). The other is by the plant's monitoring system, which is designed to gather electricity data from each steps of power generatio process. For the power generation measurement sent to the grid, the former measument method plays a main role, while the latter takes a rather supporting role for accurate measurement in the case of malfunction or error of the KPX main meters.

As for the PV/ESS installed at the project site in 2013, it does not include in the monitoring plan. The data from this PV/ESS are monitored by its own monitoring system and the generated power is not sold to the Grid.

KPX Monitoring Point

The amount of power generated sent to the grid by Taean PV plant is recorded by power generation meters, which are installed in each of 5 electricity rooms(A~E). Figure 16 shows power generation meter installation in one of the 5 rooms which have the same equipment configuration. The meters are placed at the end of the PV power generation systems, to record the exact amount of power sent to the grid.

Net generation amount, the only data to be monitord, will be calculated by deducting electricity used for plant operation from the total generated amount. The electricity for plant operation is separately metered and recorded by KEPCO for billing, so the data provided by the company is to be used for the net generation calculation. The meters for the plant operation electricity are installed and managed separately in project site #1 and #2, by KEPCO.

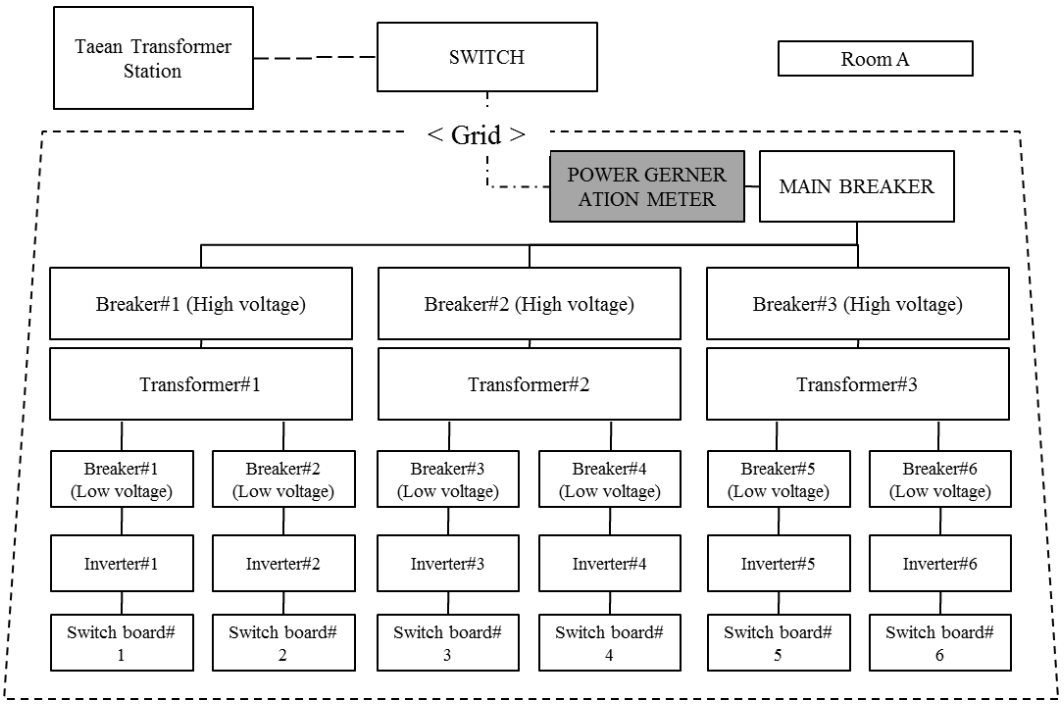


Figure 16 Monitoring Point (Room A)

In 'Guideline for PDD completion for SSC', it is mentioned that the data monitored and required for verification and issuance are to be kept for a minimum of two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later. All the recorded data are to be sent to the server of the plant monitoring system, and stored securely and semipermanantly.

Metering equipment for power generation

The meter model, ZMD405 by Namjun Corp. and its maintenance for Taean PV plant fulfills related regulations, "Rules for electricity market operation".

Figure 17 ZMD405 by Namjun Corp.

Tolerance

The regulation sets up the standard about tolerance of the meter used for power generation plants as follws:

Facility	Meter tolerance
Above 20,000kW	Class 0.2
Above 10,000kW~20,000kW	Class 0.5
Above 500kW~10,000kW	Class 1.0
500kW and below	Class 2.0

Table 11. Error tolerance standard[14]

The tolerance of the installed model is class 0.5 (active power). This is more accurate class than required for Taean facility(2.9MW), which falls in the category above 500kW~10,000kW(class 1.0 meter).

Manintenance (Test and verification)

By the regulation, the error tolerance of the installed meters in Taean PV plant is required to be tested for every 3.5 years ± 6 months and the meters must be verified when initial verification period (7years) is expired[15]. The meters will be maintained properly, comprising the relative regulation on test and verification.

Metering equipment for plant operation

The meter models for plant operation are installed and monitored by KEPCO (3rd party) and the following models are installed.

Figure 18 Meters for plant operation.

Tolerance

The tolerance of the installed model is class 1.0(active power). This is more accurate class than the required for the plant operation (70kW, 45kW), which falls in the category below 500kW (class 2.0 meter).

Maintenance (Test and verification)

By KEPCO, the meters will be calibrated every 8 years.

[14] "Rules for electricity market operation", KPX(Korea Power Exchange), 2008.11, p.210.

[15] "Rules for electricity market operation", KPX(Korea Power Exchange), 2008.11, p.212~213.

Operational and Management Structure

The organization structure for operation of the Taean PV plant is shown below – under supervision of the chief manager, there are two management units, facility management and operational management team. The main roles of the facility management team are more related to power generation such as monitoring and conducting emergency measures, while the operation management team members are in charge of ordinary management such as security, cleaning etc.

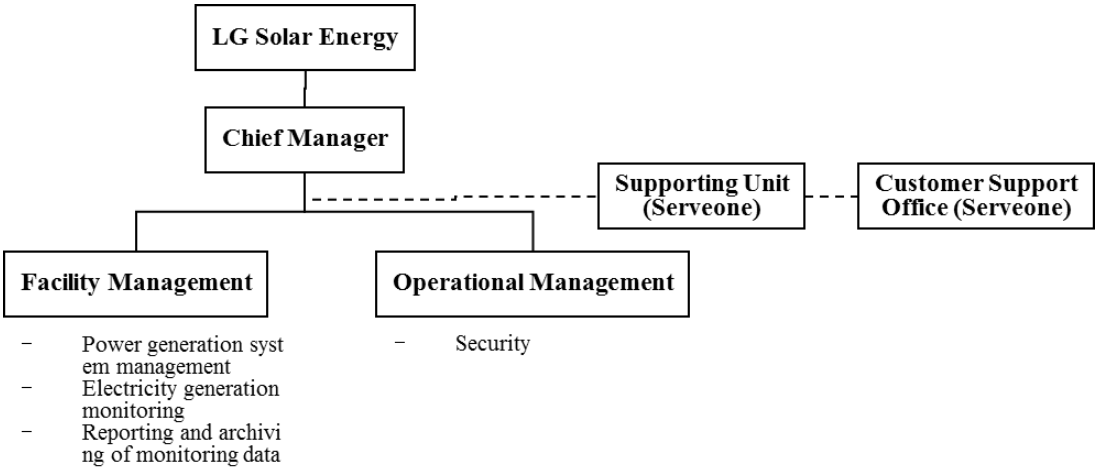


Figure 19 Operational and Management Structure

Monitoring Process and Roles

As mentioned above, monitoring is mainly conducted by the facility management team on a real-time basis. The accumulated numbers are reported to the chief manager, who is in charge of review and report the result to the LG Solar Energy. The data are also checked with the data which are recorded and maintained by the KPX, and in the case of any inconsistency, the facility management team would investigate the reason of the inconsistency and correct the misrecorded data if any error is witnessed.

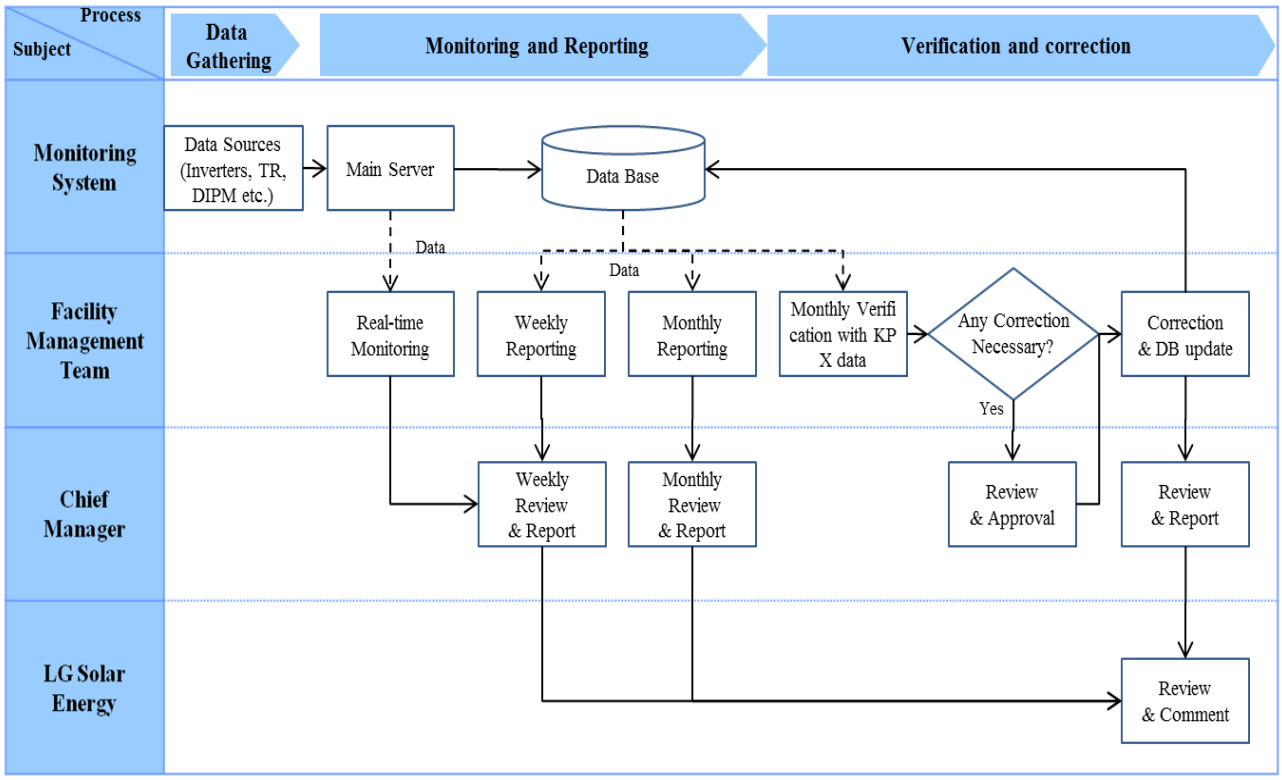


Figure 20 Monitoring Process

Facility Management Team

- Real-time monitoring
- Periodically report on the amount of electricity generated by the plant
- Data verification & correction
-

Chief Manager

- Periodical report review
- Report to LG Solary Energy on the PV plant operation & monitoring
- Data correction approval
-

LG Solar Energy

- Periodical report review
- Mobilizaiton of resources to resolve issues related to the plant operation & monitoring

Monitoring System

The generation data of the project power plant are electrically measured and recorded by web-based real-time monitoring system. It consists of inverter's data logger, digital integrated protection and monitoring equipment(DIPM)of , VCB/ACB, TR, data control servers(DCS), anemometers, thermometers, pyranometer(solar radiation measurement), remote terminal unit(RTU), client PCs and network device such as repeaters and switches.

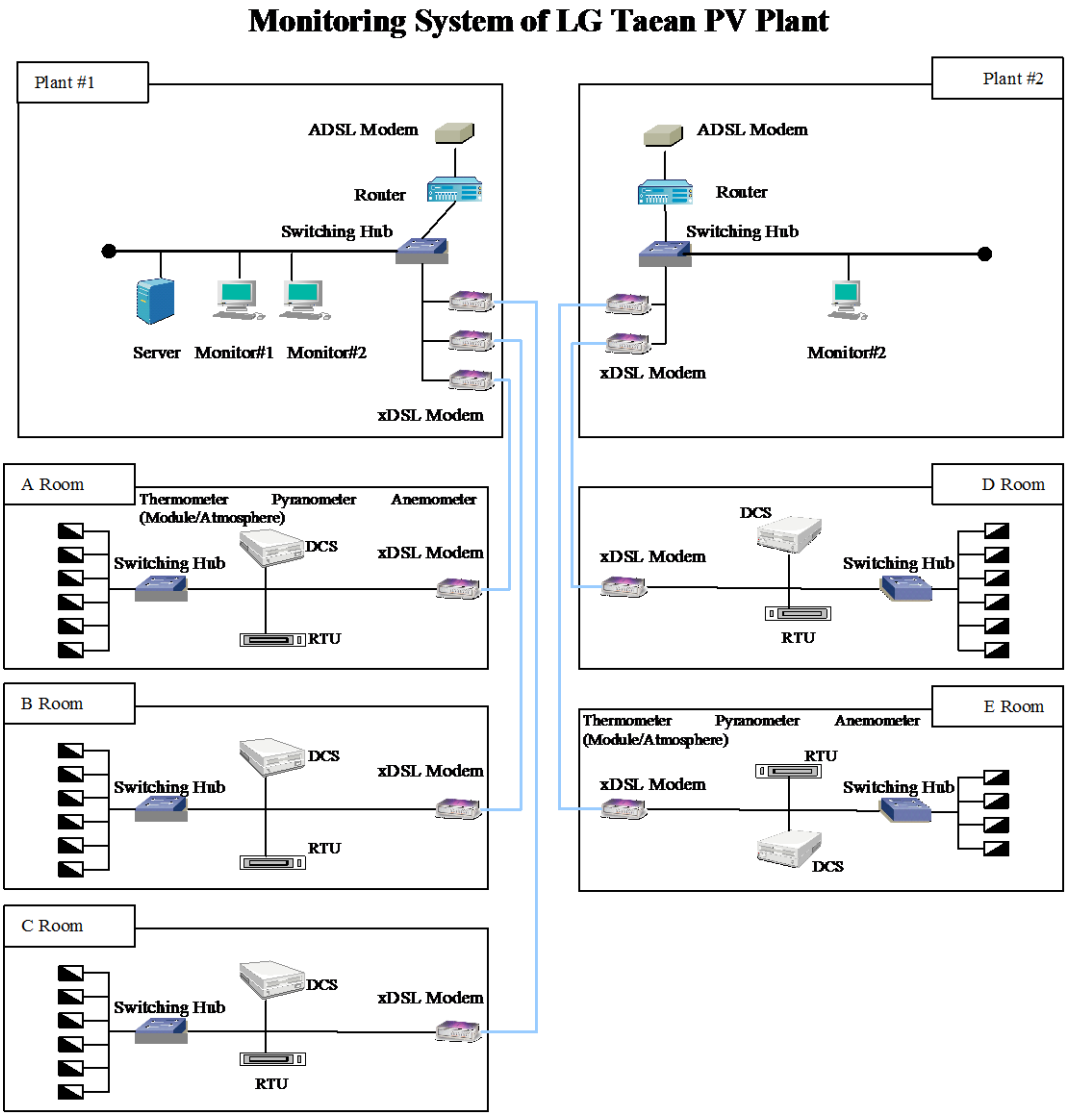


Figure 20 Monitoring System of LG Taean PV Plant

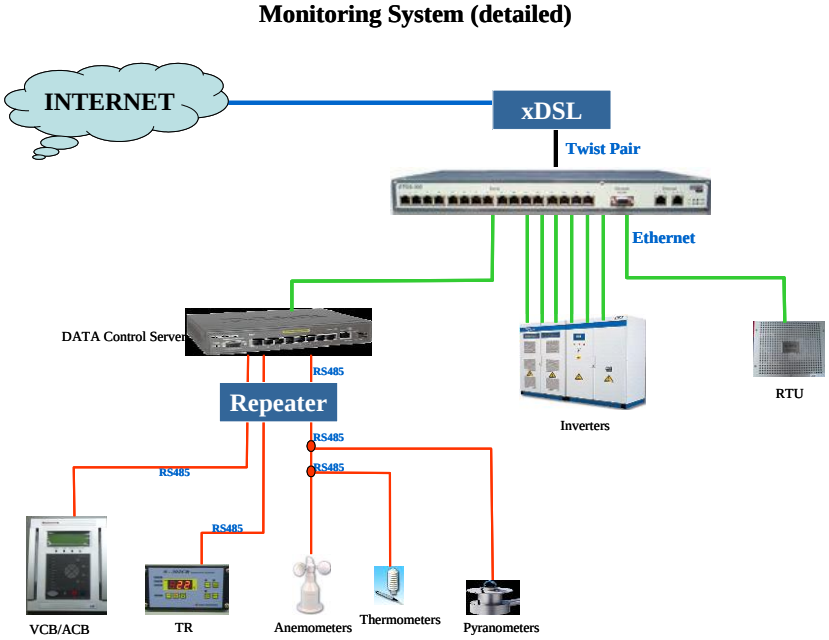


Figure 212 Monitoring System Details

The plant operation data gathered from each steps of generation process –distribution panels, TR, DIPM, inverters etc. – are sent to and recorded in the main server. Managers who are in charge of monitoring and electricity equipment can instantly check data itself and any malfunction of the equipment through the monitors linked to the main servers. The accumulated data in the main server can be reported on screen and can be printed.

QA / QC

Quality of Monitoring and metering equipment

- The KPX monitoring and metering equipment is installed in accordance with "Law regarding measurement" and "Act on operation of electricity market." Engineers of Korea Power Exchange investigate and seal the meter after confirmation of complying with the regulations.

- All the meters used for Taean PV project is qualified with the official certification. They are also tested and calibrated before installation, and for accuracy of metering, they are required to go through the test and calibration process properly (3.5years ± 6 months for metering equipment for power generation , 8 years for metering equipment for plant operation).

Data quality

- The data on electricity generation collected by the equipment are stored in the main server of Taean PV plant and sent to Korea Power Exchange simultaneously.

- The data kept two separate places are compared regularly to each other. In case of any data inconsistency, the operation condition of electricity meters and other equipments are to be examined. If any defection is discovered, correction procedure is to be followed.

Process Control of Managers of monitoring and electricity safety

- Chief manager and staff of electricity facility management unit are in charge of monitoring process while security management staffs are mainly responsible for the physical security relating to electricity facility room where DIPMs are installed. There are also supporting units of LG Solar Energy and Serveone, with technical expertise, which will help the staffs in part-time basis

- Real-time monitoring through the integrated monitoring system and casual eye-checks on operation status in the electricity facility rooms are carried out by working staffs, regularly on daily basis.

Staffs

- Staffs are assigned complying with related national regulations and standards.

- They have taken training courses below which are designed and prepared by vendors and construction companies

    - Switch board management / Relay maintenance (10/6/2008)

    - Inverter operation and management / DC junction box management (11/6/2008)

    - Monitoring CCTV operation (after CCTV system installed)

- Especially, staffs in charge of electricity safety must understand standards and regulations on power plant operation; they are required to attend various courses by laws, including 'Law

regarding measurement', 'Act on operation of electricity market and 'Electricity safety' once a year.

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

>>

- Date of completion of the application of the baseline : 30/06/2008
- Responsible monitoring department : Facility Management Team (LG SE Taean PV Power Plant)
- Responsible monitoring person for the Project : Gwang-han LEE / Serveone
- Practical monitoring person : electricity safety manager / Serveone
- Baseline emission factor calculating person : Jungzoo LEE / LG CNS

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>> According to the guidelines for completing the simplified project design document (version 05), the starting date of a CDM project activity is the date on which the implementation or construction or real action of a project activity begins. The major milestones of the Taean project relating to determination of the starting date are as follows:

- Agreement by the board members of LG Corp. to establish LG Solar Energy : 10/10/2007
- Acquisition of the permission for power generation business : 24/12/2007
- Signing of bank loan agreement for the project : 25/1/2008
- Start of the power plant construction : 17/3/2008
- PV engineering and procurement contract : 23/5/2008
- Completion of 1st draft of PDD : 30/6/2008

Even though the earliest date above is 10/10/2007, the agreement on the date is about establishment of the company, not the project itself. Thus, the earliest date which is fit to the definition given by the guideline is the date of acquisition of power generation permission, 24/12/2007. That means the date should be determined as the project start date.

However, Taean project has continuously been considered as a CDM project since decision of establishment of LG Solar Energy was made by the board members, which happened two and a half month earlier than the project start date, 24/12/2007. In the report submitted to the board meeting, it is clear that the Taean project is planned as one of the company's CDM project. On 13/11/2007, about 40 days before the company obtained power generation permission, an internal plan for CDM process was reported to the CEO of LG Solar Energy. Thus, it is clear that the Taean project was considered as CDM project prior to the start date. Both documents mentioned above are checked by the DOE and copies are submitted.

Date	Description	Comment
10/10/2007	**Agreement by the board members of LG Corp. to establish LG Solar Energy** : LG Corp., the holding company of LG group, decided to implement Taean CDM project and, for the implementation, selected board members formally agreed establishment of LG Solar Energy.	**Prior Consideratin Date**
24/12/2007	**Acquisition of the permission for power generation business** : LG Solar enegy acquired permission for photovoltaic power generation business from MOCIE, the former organization of the current Ministry of Knowledge Economy of Korea(MKE).	
25/1/2008	**Signing of bank loan agreement for the project** : After all the issues and conditions for financing for Taean project are settled LG Corp. and KB(Kookmin Bank) sigend for the loan agreement.	
17/3/2008	**Start of the power plant construction** : the plant construction was started with ground leveling	
23/5/2008	**PV plant construction contract** : including civil engineering, construction, PV engineering and procurement	**Start Date of the Project**
30/6/2008	**Completion of 1st draft of PDD**	

Table 12 Milestones of the start of Taean project

C.1.2. Expected operational lifetime of project activity

>> 20 years

Project lifetime is generally determined from how long the major equipment can be used. For a photovoltaic project, the most important parts are PV modules and inverters – they are not only essential for energy transition process from sunlight into electricity but also cost almost two thirds of the whole project budget. The PV module suppliers for the project guarantee 20 to 25 years of its 80% performance while the inverter maker designed it for an operation of more than 20years. That means reasonable operation lifetime of the project activity can be expected 20 years at least. All related documents are submitted to DOE.

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>> The project activity will use a renewable crediting period

C.2.2. Start date of crediting period

>> The starting date of the first crediting period will be the date of registration, however, it is expected to be 23/8/2010.

C.2.3. Length of crediting period

>> 7 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>> According to the provisions of Enforcement Decree of the Act on Assessment of Impacts of Works on Environment, Traffic, Disasters, etc, any solar, wind, fuel cell electricity power generation plant facility with capacity of more than 100,000kW is subject to Environmental Investigation Assessment(EIA). That means project participant is not required to carry out the EIA since the capacity of LG SE Taean PV power plant, 13.772 MW is the number which is far below than the criterion.

Instead, a solar power plant project whose capacity is below 100,000kw falls under the category of Prior Environmental Review(PER). The PER report on the LG SE Taean PV power plant project was submitted to local and national government agencies including ME (Ministry of Environment), and MKE (Ministry of Knowledge Economy)[16]. Through the review and consultation of the agencies, any significant negative environmental impact is not reported. However, some points are suggested to which the project participant should pay more attention in order to minimize negative impacts that may take place. In response to the suggestions, project participant executed counter measures and set up management plan to monitor latent environmental risks during the project period.

PER Summary

PER Results

- As a whole, there are little impacts from the project on the surrounding environments except some negative influences such as construction noise and fly dirt from soil levelling, which are expected during construction period.

- Therefore, in order to minimize those negative influences, vehicle washing facilities are planned to be installed at the entrance of the site so that every construction vehicle can be washed on their exits.

- For construction noise, it is confirmed that the project participant planned various counter measure such as use of low-noise/vibration machineries, building soundproofing fences around the construction sites, compliance with noise control manual, etc.
- During operation, since the power plant runs automatically, it does not give birth to any polluted water or industrial waste.

- It is concluded that as far as the control plans for each environmental impact are properly prepared and executed until the end of the project period, environmental impacts can be minimized and the proposed purposes of the project can be satisfied.

Opinion and Suggestion from Local Governments

[16] At the time of submission of the PER report, MOCIE (Ministry of Commerce, Industry, and Energy)

- After some options including “No Action(baseline)” have been considered, option 1 (the construction of LG SE Taean PV power plant), securing of eco-friendly clean energy, is regarded as the most appropriate.

- Some environmental aspects need consideration:

  - ✓ Fly dirt from soil levelling
  - ✓ Surrounding landscape
  - ✓ Tree planting
  - ✓ Reflected lights from solar cell modules
  - ✓ Rainwater and natural disaster

Government Agencies

- Project participant should invite local residents comment with project plan which includes environmental consideration such as :
-

  - ✓ Surrounding landscape from major scenic point
  - ✓ Investigation on existence of animals or plants worthy of preservation
  - ✓ Necessary counter measures to cope with pollutants from near Taean thermal power plant and yellow sand flown from China
  - ✓ Fly dirt caused by transportation of soil for site levelling
  - ✓ Migratory birds driven by the ‘2007 Korea oil spill’

Responsive Action Taken by the Project Participant

- Actions taken to minimize those negative influences :
-

  - ✓ For construction noise
    - Use of low-noise, low-vibration construction equipment
    - Erecting soundproofing fences for sound insulation of construction fields
  - ✓ For fly dirt
    - Vehicle washing facility
    - Instalment of dirt-proofing nets for construction areas close to residents
  - ✓ For landscape
    - Planting trees and grasses around the project sites and under the module arrays
  - ✓ For rainwater drainage against natural disaster
    - Digging drainage canal around the sites
    - Reinforcement of side slanting surfaces of the canal with iron-netted rocks and nets on the spots where high-speed water flows are expected

- By doing in-depth investigation, some comments have been considered but it was revealed that impacts can be coped with by ordinary measure : Migratory birds, Surrounding landscape from major scenic point, etc.
-
- Including clauses for minimization of negative environmental impacts in the field manual such as 20km/h speed limit for vehicles in construction areas.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>> Stakeholders of the project have been approached in three groups:

1. Public who are not expected to have direct concerns in the whole province or national level, or people who may have indirect interests.
2. Local residents who live near the project sites who are under the possibility of directly impacts to their daily lives and properties.
3. Local government and Urban Planning Committee

For the group #1, mass media such as newspaper and broadcast has been the main channel for communication. In the newspaper such as Maeil Business, Dailian, Daejeon Ilbo, detailed information on implementation of the project are carried to the public. Moreover, major broadcasting companies like KBS, MBC, SBS have plans to send reports on LG SE Taean PV plant. Through the publication and broadcasting, group #1 stakeholders' comments are invited by having them aware of the project and how it is promoted.

More direct approaches were taken for the group #2. Every family who lives around the project site was visited and interviewed by the project participant. Briefings for local communities were held twice on February 19th and April 17th, to explain how the project is planned and hear their comments to be taken into account for project implementation. Also the field office established on the spot of the power plant installation was always open to visitors so that any local people freely come and comment on the project.

Even the review of Urban Planning Committee is one of the necessary procedures for achieving government permission of the project, which was also one of the most important for the participant to listen to the stakeholders' comments. Comments from local governments' organizational units of various functions were reviewed by committee members. They were selected and invited by the local government to reflect non-biased comments from various fields of community – such as professors, business owners, technical experts as well as government officers.

All the comments from different sources are recorded and reviewed in a weekly meeting. Informative comments were shared and proper actions were discussed when necessary. CEO of the project participant attended and presided the meeting and the project manager has the responsibility of the execution as well as reporting the progress of the action plan

E.2. Summary of comments received

>>

Public and mass media

Newspaper and broadcast news mentioned implication and effect of the LE SE Taean PV project.

- ✓ "The construction of (LG SE) PV plant will accelerate Taean county's balanced development." ("Taean county becoming the 'clean energy Mecca'", Daejeon Ilbo, June 8th, 2008)

- ✓ "Through the project, LG group will accelerate its investment on PV related industry." ("LG SE, the Largest PV Power Plant", Maeil Business, December 26th, 2007)

- ✓ "The LG SE PV plant will help Taean, whose local economy were 'polluted' by '2007 oil spill', to become a clean energy town, which is also beneficial to balanced development of Korea." ("Boosting Taean County RE Complex - LG SE Taean Office Opening"Dailian, February 19th, 2008)

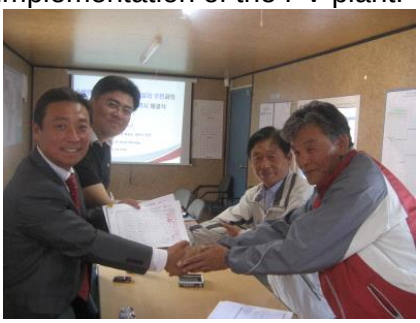
- ✓ "This project is the largest PV power plant in Korea, and the amount of electricity generated by the plant is expected to be equivalent to the amount of electricity over 8 thousand houses can use." ("Electricity from Sunlight Supplied to 8 thousand houses", Maeil Business, May 6th, 2008)

- ✓ "This project is promoted to cope with GHG and global warming issue, and will contribute growth of renewable energy industry. It is expected to reduce about 12,000 ton of CO_2 by PV power generation." ("LG, constructs the largest PV Plant in Taean" , Yeonhap, July 6th, 2008)

Local communities and residents

At first, residents and people of the local communities did not take a favourable view of the project because of misunderstanding of PV power plant. They believed that power plants are essentially emits pollutants and a PV power plant absorbs sunlight and radiates ultraviolet, which is harmful to human bodies. However, through repeated contacts and explanation on truths of PV technology and its benefits, they agreed to implementation of the PV plant.

1st Project Briefing on Feb.13rd, 2008



2nd Project Briefing on Apr.17, 2008

Welcoming Placard (April, 2008)

- **Figure 22 Activities for communication with local residents and welcoming placard from the community**

However, some residents around the projects sites required additional contribution to the local community including:

- ✓ Construction of agricultural facilities like ponds and roads

- ✓ Employment of local human resources

- ✓ Reconsideration of bottom ash for soil foundation of the project sites

- ✓ Reinforcement of week points of the drainage canal

Local Government

Comment from VP

Vice president of Taean County attended official opening ceremony and commented on the project "Taean County is now in trouble from the oil spill. It is expected that this opening ceremony would be a start for the county to reborn as a clean energy county."

Comments from the urban planning committee,

- The project conforms to 'Ener-pia'[17] project which is promoted by local government of Taean County to contribute renewable energy policy and strike balanced development.

- The value of PV power generation is increasing considering GHG issue and limit of natural resources. The LG SE PV project, which is promoted on the ground of abandoned salt farm area, must be highly welcomed since it is closely related and expected to play an important role for the renewable energy complex plan.

- It is recommended that some points need additional consideration for visitors' convenience:

    - ✓ Observatory deck and exhibition room
    - ✓ Internal / external roads
    - ✓ Parking areas

E.3. Report on consideration of comments received

>> The project participant agreed to do the following measures.

- For comments from local communities and residents :

    - ✓ construct agricultural facilities like ponds and roads
    - ✓ consider local human resources as first option during the operation period
    - ✓ change material for soil foundation of the sites from bottom ash to normal soil even though cost increases are expected
    - ✓ Reinforce week points of the drainage canal around the sites

- For comments from local governments:

    - ✓ build up observatory deck and exhibition room
    - ✓ expand roads and parking areas

- From the public, no significant comment which calls for responsive action was received.

[17] The name of renewable energy complex promoted by Taean County

SECTION F. Approval and authorization

>>

The project activity had received Host Country Approval from the host DNA (dated 12/02/2010) and it was submitted.

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	LG Solar Energy
Street/P.O. Box	24 Yeouido-dong Yeongdeungpo-gu
Building	FKI Tower,24
City	Seoul
State/Region	
Postcode	150-756
Country	KOREA
Telephone	+82-2-2099-0330
Fax	+82-2-2099-0095
E-mail	jrkim@cnspartner.com
Website	
Contact person	
Title	Chief Executive Officer
Salutation	Mr
Last name	Kim
Middle name	
First name	Jeong Rae
Department	
Mobile	+82-10-3933-1182
Direct fax	+82-2-2099-0095
Direct tel.	+82-2-2099-0330
Personal e-mail	

The information of project participant had been changed and thus, MoC was changed. The changed information is valid as of 31/03/2015

Appendix 2. Affirmation regarding public funding

There is no public funding invested for this project.

Appendix 3. Applicability of methodology and standardized baseline

Please refer section B.

There is no further background information on applicability of selected methodology.

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

<Annex4-1> Data on fuel consumption for plants in the Operating Margin (2004)

Plants			Consumption			
			Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L. N. G (t)
Sub-bituminous Coal	Honam	#1	885,758	606	300	0
		#2	783,300	1,714	335	0
	Samchonpo	#1	1,624,500	0	1,674	0
		#2	1,564,986	0	744	0
		#3	1,467,177	0	814	0
		#4	1,538,768	0	785	0
		#5	1,707,777	0	230	0
		#6	1,734,977	0	652	0
	Yonghung	#1	1,114,254	0	27,916	0
		#2	459,217	0	18,314	0
	Boryeong	#1	1,599,557	0	311	0
		#2	1,555,055	0	616	0
		#3	1,427,263	0	574	0
		#4	1,560,014	0	179	0
		#5	1,397,343	0	422	0
		#6	1,559,785	0	350	0
	Taean	#1	1,438,094	0	999	0
		#2	1,509,379	0	310	0
		#3	1,415,585	0	390	0
		#4	1,539,502	0	254	0
		#5	1,547,217	0	329	0
		#6	1,531,751	0	230	0
	Hadong	#1	1,389,739	0	533	0
		#2	1,515,681	0	145	0
		#3	1,501,027	0	670	0
		#4	1,397,482	0	737	0
		#5	1,501,672	0	318	0
		#6	1,379,396	0	689	0
	Dangjin	#1	1,502,885	0	294	0
		#2	1,523,605	0	211	0
		#3	1,404,465	0	605	0
		#4	1,434,844	0	528	0
Heavy Oil	Ulsan	#1	0	73,408	114	0
		#2	0	65,316	82	0
		#3	0	71,305	554	0
		#4	0	420,739	1,238	0
		#5	0	513,497	931	0
		#6	0	527,083	1,603	0
	Youngnam	#1	0	347,107	837	0
		#2	0	248,049	274	0
	Yosu	#1	0	181,712	571	0
		#2	0	316,523	436	0
	Pyungtaek	#1	0	204,664	247	2,095

		#2	0	209,664	232	2,515
		#3	0	179,921	240	3,791
		#4	0	192,294	225	3,217
	Namjeju	#1	0	16,510	6	0
		#2	0	16,040	13	0
	Jeju	#1	0	15,306	7	0
		#2	0	118,473	73	0
		#3	0	124,160	41	0
LNG	Seoul	#4	0	0	1	22,409
		#5	0	0	3	117,908
	Incheon	#1	0	0	0	10,523
		#2	0	0	0	11,094
		#3	0	0	149	4,235
		#4	0	0	171	526
Combined Cycle	Pyungtaek	C/C	0	0	21	98,846
	Ilsan	C/C	0	0	0	593,548
	Bundang	C/C	0	0	0	653,880
	Ulsan	C/C	0	0	0	347,076
	Seoincheon	C/C	0	0	88	1,209,806
	Shinincheon	C/C	0	0	0	1,587,638
	Boryeong	C/C	0	0	0	988,548
	Busan	C/C	0	0	2,687	1,298,418
	Hallim	C/C	0	0	28,796	0
	Anyang	C/C	0	0	0	270,559
	Bucheon	C/C	0	0	0	258,596
	KIE Co.	C/C	0	0	0	467,583
	LG Bugog	C/C	0	0	0	260,653
	Yulchon	C/C	0	0	596	7,388
Internal Combustion	Namjeju	D/P	0	57,808	80	0
	Jeju	G/T	0	0	2,232	0

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

<Annex4-2> Data on fuel consumption for plants in the Operating Margin (2005)

Plants			Consumption			
			Coal (t)	Heavy oil (kl)	Diesel oil (kl)	L. N. G (t)
Sub-bituminous Coal	Honam	#1	870,214	961	278	0
		#2	912,497	338	185	0
	Samchonpo	#1	1,534,223	0	1,220	0
		#2	1,731,265	0	626	0
		#3	1,723,152	0	377	0
		#4	1,632,334	0	1,029	0
		#5	1,516,654	0	1,415	0
		#6	1,546,663	0	1,001	0
	Yonghung	#1	2,081,972	0	4,541	0
		#2	1,761,395	0	2,903	0
	Boryeong	#1	1,440,343	0	761	0
		#2	1,388,532	0	551	0
		#3	1,589,150	0	90	0
		#4	1,421,343	0	63	0
		#5	1,587,999	0	156	0
		#6	1,260,305	0	627	0
	Taean	#1	1,508,570	0	621	0
		#2	1,323,078	0	395	0
		#3	1,494,175	0	650	0
		#4	1,383,297	0	365	0
		#5	1,411,398	0	742	0
		#6	1,504,962	0	417	0
	Hadong	#1	1,513,930	0	284	0
		#2	1,410,099	0	792	0
		#3	1,422,196	0	472	0
		#4	1,511,054	0	567	0
		#5	1,345,648	0	614	0
		#6	1,520,774	0	331	0
	Dangjin	#1	1,438,702	0	637	0
		#2	1,437,473	0	632	0
		#3	1,549,041	0	141	0
		#4	1,544,010	0	134	0
		#5	499,714	0	5,701	0
		#6	38,671	0	1,779	0
Heavy Oil	Ulsan	#1	0	70,183	750	0
		#2	0	67,296	585	0
		#3	0	53,085	662	0
		#4	0	375,417	1,971	0
		#5	0	363,992	1,676	0
		#6	0	352,776	1,708	0
	Youngnam	#1	0	359,910	844	0
		#2	0	190,085	584	0
	Yosu	#1	0	106,919	434	0
		#2	0	218,356	346	0
	Pyungtaek	#1	0	293,214	118	3,553
		#2	0	321,188	140	2,641
		#3	0	308,042	132	1,784
		#4	0	311,245	138	2,047
	Namjeju	#1	0	14,628	15	0
		#2	0	15,031	12	0

	Jeju	#1	0	12,564	12	0
		#2	0	129,516	0	0
		#3	0	122,866	48	0
LNG	Seoul	#4	0	0	0	49,143
		#5	0	0	1	108,761
	Incheon	#1	0	0	0	4,365
		#2	0	0	0	8,505
		#3	0	0	372	746
		#4	0	0	400	6,620
Combined Cycle	Pyungtaek	C/C	0	0	1	110,953
	Ilsan	C/C	0	0	0	533,188
	Bundang	C/C	0	0	0	671,944
	Ulsan	C/C	0	0	0	470,131
	Seoincheon	C/C	0	0	335	989,645
	Shinincheon	C/C	0	0	0	1,458,763
	Boryeong	C/C	0	0	0	1,161,510
	Incheon	C/C	0	0	0	281,813
	Busan	C/C	0	0	0	1,211,144
	Hallim	C/C	0	0	29,686	0
	Anyang	C/C	0	0	0	261,202
	Bucheon	C/C	0	0	0	261,705
	POSCO POWER	C/C	0	0	0	445,253
	G S Bugog	C/C	0	0	0	297,976
	Yulchon	C/C	0	0	159	194,534
Internal Combustion	Namjeju	D/P	0	56,727	37	0
	Jeju	G/T	0	0	2,869	0
	Jeju	D/P	0	31,808	72	0

Source: Statistics of Electric Power in KOREA (KEPCO, 2006)

<Annex4-3> Data on fuel consumption for plants in the Operating Margin (2006)

Plants			**Consumption**			
			Coal (t)	**Heavy oil (kl)**	**Diesel oil (kl)**	**L. N. G (t)**
Sub-bituminous Coal	Honam	#1	781,139	1,113	279	0
		#2	859,736	1,251	359	0
	Samchonpo	#1	1,696,271	0	860	0
		#2	1,508,082	0	1,362	0
		#3	1,519,385	0	457	0
		#4	1,521,263	0	1,818	0
		#5	1,665,339	0	977	0
		#6	1,770,348	0	428	0
	Yonghung	#1	2,004,193	0	2,548	0
		#2	2,129,118	0	2,545	0
	Boryeong	#1	1,638,140	0	306	0
		#2	1,389,425	0	1,137	0
		#3	1,323,779	0	514	0
		#4	1,610,928	0	82	0
		#5	1,296,455	0	541	0
		#6	1,553,273	0	518	0
	Taean	#1	1,354,832	0	514	0
		#2	1,532,209	0	162	0

		#3	1,338,967	0	575	0
		#4	1,548,909	0	133	0
		#5	1,542,775	0	544	0
		#6	1,294,577	0	1,113	0
	(신규)	#7	61,910	0	4,799	0
	Hadong	#1	1,373,049	0	515	0
		#2	1,543,074	0	293	0
		#3	1,549,094	0	153	0
		#4	1,376,612	0	796	0
		#5	1,554,524	0	242	0
		#6	1,371,801	0	690	0
	Dangjin	#1	1,380,527	0	966	0
		#2	1,570,077	0	161	0
		#3	1,402,916	0	433	0
		#4	1,386,317	0	1,549	0
		#5	1,456,458	0	745	0
		#6	1,216,582	0	3,051	0
	(신규)	#7	1,008	0	505	0
Heavy Oil	Ulsan	#1	0	72,243	605	0
		#2	0	80,187	469	0
		#3	0	96,459	518	0
		#4	0	360,919	3,729	0
		#5	0	375,985	3,678	0
		#6	0	378,331	3,694	0
	Youngnam	#1	0	107,090	1,016	0
		#2	0	95,127	1,494	0
	Yosu	#1	0	99,129	281	0
		#2	0	215,957	291	0
	Pyungtaek	#1	0	261,458	141	3,997
		#2	0	277,025	166	5,687
		#3	0	303,858	134	3,891
		#4	0	245,602	103	3,473
	Namjeju	#1	0	11,406	17	0
		#2	0	9,772	14	0
	(신규)	#3	0	46,504	2,509	0
	Jeju	#1	0	8,603	23	0
		#2	0	113,679	64	0
		#3	0	117,464	67	0
LNG	Seoul	#4	0	0	1	69,383
		#5	0	0	1	152,891
	Incheon	#1	0	0	0	6,945
		#2	0	0	0	5,223
		#3	0	0	311	15,426
		#4	0	0	311	12,454
Combined Cycle	Pyungtaek	C/C	0	0	45	84,054
	Ilsan	C/C	0	0	1,384	556,504
	Bundang	C/C	0	0	0	720,381
	Ulsan	C/C	0	0	0	536,196
	Seoincheon	C/C	0	0	1,066	1,199,196
	Shinincheon	C/C	0	0	0	1,641,038
	Boryeong	C/C	0	0	0	998,683
	Incheon	C/C	0	0	0	484,606
	Busan	C/C	0	0	0	1,396,417
	Hallim	C/C	0	0	48,475	0
	Anyang	C/C	0	0	0	230,969
	Bucheon	C/C	0	0	215	225,713
	POSCO POWER	C/C	0	0	0	408,018
	G S Bugog	C/C	0	0	0	389,811
	Yulchon	C/C	0	0	0	315,132

Internal Combustion	Namjeju	D/P	0	51,347	111	0
	Jeju	G/T	0	0	8,264	0
	Jeju	D/P	0	52,907	0	0

Source: Statistics of Electric Power in KOREA (KEPCO, 2007)

<Annex4-4> Data on caloric value in the Operating Margin (2004)

Plants			Caloric value			
			Coal	Heavy oil	Diesel oil	LNG
			Caloric Value (kcal/kg)	Caloric Value (kcal/l)	Caloric Value (kcal/l)	Caloric Value (kcal/kg)
Sub-bituminous Coal	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	
Heavy Oil	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	

	Pyungtaek	#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	
LNG	Seoul	#4			9,070	13,011
		#5			9,070	13,014
	Incheon	#1				13,038
		#2				13,039
		#3			8,951	13,038
		#4			8,949	13,021
Combined Cycle	Pyungtaek	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			9,250	13,004
	Hallim	C/C			8,972	
	Anyang	C/C				13,025
	Bucheon	C/C				13,013
	KIE Co.	C/C				13,023
	LG Bugog	C/C				13,028
	Yulchon	C/C			11,731	13,014
Internal Combustion	Namjeju	D/P		9,901	8,867	
	Jeju	G/T			8,948	

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

<Annex4-5> Data on caloric value in the Operating Margin (2005)

Plants			**Caloric value**			
			Coal	**Heavy oil**	**Diesel oil**	**LNG**
			Caloric Value (kcal/kg)	**Caloric Value (kcal/l)**	**Caloric Value (kcal/l)**	**Caloric Value (kcal/kg)**
Sub-bituminous Coal	Honam	#1	5,392	9,835	8,809	0
		#2	5,376	9,854	8,804	0
	Samchonpo	#1	5,913	0	8,841	0
		#2	5,924	0	8,883	0
		#3	5,897	0	9,000	0
		#4	5,898	0	8,943	0
		#5	5,347	0	8,614	0
		#6	5,376	0	9,000	0
	Yonghung	#1	6,131	0	8,935	0
		#2	6,053	0	8,947	0

	Boryeong	#1	5,830	0	8,943	0
		#2	5,816	0	8,943	0
		#3	5,882	0	8,740	0
		#4	5,890	0	8,748	0
		#5	5,882	0	8,749	0
		#6	5,901	0	8,749	0
	Taean	#1	6,000	0	8,692	0
		#2	6,009	0	8,684	0
		#3	6,007	0	8,676	0
		#4	5,999	0	8,705	0
		#5	6,032	0	8,676	0
		#6	6,017	0	8,691	0
	Hadong	#1	6,003	0	8,940	0
		#2	5,997	0	8,928	0
		#3	5,998	0	8,982	0
		#4	5,999	0	8,938	0
		#5	5,995	0	8,975	0
		#6	5,995	0	8,928	0
	Dangjin	#1	5,962	0	8,834	0
		#2	5,962	0	8,915	0
		#3	5,935	0	8,844	0
		#4	5,941	0	8,828	0
		#5	6,115	0	8,904	0
		#6	6,221	0	11,095	0
Heavy Oil	Ulsan	#1	0	9,900	9,116	0
		#2	0	9,903	9,113	0
		#3	0	9,908	9,119	0
		#4	0	10,001	9,122	0
		#5	0	9,993	9,122	0
		#6	0	9,979	9,118	0
	Youngnam	#1	0	7,482	8,942	0
		#2	0	7,729	8,943	0
	Yosu	#1	0	9,960	8,887	0
		#2	0	9,944	8,886	0
	Pyungtaek	#1	0	9,903	8,943	12,898
		#2	0	9,905	8,961	12,872
		#3	0	9,907	8,949	12,942
		#4	0	9,909	8,949	12,893
	Namjeju	#1	0	9,878	9,318	0
		#2	0	9,879	9,307	0
	Jeju	#1	0	9,932	8,885	0
		#2	0	9,929	0	0
		#3	0	9,925	8,938	0
LNG	Seoul	#4	0	0	0	13,002
		#5	0	0	9,070	13,008
	Incheon	#1	0	0	0	13,032
		#2	0	0	0	13,025
		#3	0	0	8,964	13,030
		#4	0	0	8,954	13,026
Combined Cycle	Pyungtaek	C/C	0	0	8,950	13,030
	Ilsan	C/C	0	0	0	13,011
	Bundang	C/C	0	0	0	13,025

	Ulsan	C/C	0	0	0	12,750
	Seoincheon	C/C	0	0	9,200	13,009
	Shinincheon	C/C	0	0	0	13,013
	Boryeong	C/C	0	0	0	13,030
	Incheon	C/C	0	0	0	13,012
	Busan	C/C	0	0	0	13,000
	Hallim	C/C	0	0	8,973	0
	Anyang	C/C	0	0	0	13,025
	Bucheon	C/C	0	0	0	13,003
	POSCO POWER	C/C	0	0	0	13,024
	G S Bugog	C/C	0	0	0	13,756
	Yulchon	C/C	0	0	10,930	13,023
Internal Combustion	Namjeju	D/P	0	9,877	8,975	0
	Jeju	G/T	0	0	8,919	0
	Jeju	D/P	0	9,932	8,954	0

Source: Statistics of Electric Power in KOREA (KEPCO, 2006)

<Annex4-6> Data on caloric value in the Operating Margin (2006)

Plants			**Caloric value**			
			Coal	**Heavy oil**	**Diesel oil**	**LNG**
			Caloric Value (kcal/kg)	**Caloric Value (kcal/l)**	**Caloric Value (kcal/l)**	**Caloric Value (kcal/kg)**
Sub-bituminous Coal	Honam	#1	5,436	9,809	8,917	0
		#2	5,407	9,823	8,870	0
	Samchonpo	#1	5,937	0	8,814	0
		#2	5,942	0	8,814	0
		#3	5,858	0	8,814	0
		#4	5,861	0	8,803	0
		#5	5,236	0	9,000	0
		#6	5,255	0	9,000	0
	Yonghung	#1	6,072	0	8,891	0
		#2	6,086	0	8,899	0
	Boryeong	#1	5,768	0	8,855	0
		#2	5,766	0	8,943	0
		#3	5,845	0	8,943	0
		#4	5,824	0	8,943	0
		#5	5,845	0	8,749	0
		#6	5,834	0	8,749	0
	Taean	#1	5,982	0	8,749	0
		#2	5,978	0	8,371	0
		#3	5,983	0	8,649	0
		#4	5,979	0	8,665	0
		#5	5,934	0	8,665	0
		#6	5,960	0	8,665	0
		#7	5,965	0	8,558	0
	Hadong	#1	5,969	0	8,838	0
		#2	5,959	0	8,928	0
		#3	5,958	0	8,928	0
		#4	5,969	0	8,825	0
		#5	5,963	0	8,911	0
		#6	5,967	0	8,901	0
	Dangjin	#1	5,882	0	8,975	0
		#2	5,906	0	8,978	0
		#3	5,886	0	9,007	0
		#4	5,875	0	9,015	0
		#5	6,046	0	8,955	0

		#6	6,120	0	8,895	0
		#7	5,818	0	8,984	0
Heavy Oil	Ulsan	#1	0	9,915	9,120	0
		#2	0	9,923	9,120	0
		#3	0	9,919	9,120	0
		#4	0	10,030	9,120	0
		#5	0	10,033	9,120	0
		#6	0	10,035	9,120	0
	Youngnam	#1	0	10,138	8,845	0
		#2	0	10,110	8,862	0
	Yosu	#1	0	9,963	8,798	0
		#2	0	9,954	8,796	0
	Pyungtaek	#1	0	9,707	8,943	12,941
		#2	0	9,719	8,943	12,941
		#3	0	9,747	8,949	12,859
		#4	0	9,693	8,949	12,963
	Namjeju	#1	0	9,908	8,974	0
		#2	0	9,908	8,952	0
		#3	0	9,898	8,938	0
	Jeju	#1	0	9,870	8,873	0
		#2	0	9,952	8,973	0
		#3	0	9,953	8,973	0
LNG	Seoul	#4	0	0	9,070	13,018
		#5	0	0	9,070	12,882
	Incheon	#1	0	0	0	13,036
		#2	0	0	0	13,028
		#3	0	0	8,982	13,018
		#4	0	0	8,981	13,024
Combined Cycle	Pyungtaek	C/C	0	0	8,950	13,030
	Ilsan	C/C	0	0	8,989	13,017
	Bundang	C/C	0	0	0	13,025
	Ulsan	C/C	0	0	0	12,646
	Seoincheon	C/C	0	0	9,200	13,025
	Shinincheon	C/C	0	0	0	13,025
	Boryeong	C/C	0	0	0	13,034
	Incheon	C/C	0	0	0	12,998
	Busan	C/C	0	0	0	13,017
	Hallim	C/C	0	0	8,954	0
	Anyang	C/C	0	0	0	13,028
	Bucheon	C/C	0	0	10,927	13,013
	POSCO POWER	C/C	0	0	0	13,031
	G S Bugog	C/C	0	0	0	13,030
	Yulchon	C/C	0	0	0	13,376
Internal Combustion	Namjeju	D/P	0	10,246	8,907	0
	Jeju	G/T	0	0	8,792	0
	Jeju	D/P	0	9,617	0	0

Source: Statistics of Electric Power in KOREA (KEPCO, 2007)

<Annex4-7> Data on net generation in the Operating Margin (2004~2006, MWh)

Plants			Net Generation (2004)	Net Generation (2005)	Net Generation (2006)
Sub-bituminous Coal	Honam	#1	1,855,554	1,787,715	1,622,639
		#2	1,625,399	1,875,790	1,782,016
	Samchonpo	#1	3,974,202	3,810,079	4,161,219
		#2	3,839,080	4,323,618	3,703,880
		#3	3,652,769	4,343,666	3,779,585
		#4	3,811,371	4,112,297	3,816,997
		#5	4,147,957	3,542,728	3,761,205
		#6	4,185,213	3,643,969	4,065,091
	Yonghung	#1	2,986,382	5,623,299	5,337,432
		#2	1,172,450	4,658,862	5,727,937
	Boryeong	#1	4,014,109	3,547,140	3,988,848
		#2	3,915,285	3,433,608	3,423,101
		#3	3,746,265	4,124,745	3,409,486
		#4	4,097,489	3,698,705	4,133,946
		#5	3,660,240	4,121,314	3,364,148
		#6	4,093,207	3,283,477	3,987,488
	Taean	#1	3,780,097	3,992,112	3,556,797
		#2	3,975,123	3,484,251	4,035,753
		#3	3,732,363	3,957,054	3,528,613
		#4	4,048,258	3,653,534	4,069,820
		#5	4,091,406	3,744,413	4,013,235
		#6	4,056,835	3,999,847	3,381,867
		#7	-	-	159,677
	Hadong	#1	3,688,313	3,997,914	3,607,063
		#2	4,028,529	3,732,583	4,068,036
		#3	3,997,064	3,769,077	4,079,158
		#4	3,724,757	3,989,315	3,631,374
		#5	4,013,845	3,553,901	4,092,625
		#6	3,685,698	4,037,763	3,610,222
	Dangjin	#1	3,986,406	3,797,307	3,598,820
		#2	4,038,457	3,798,078	4,115,891
		#3	3,711,787	4,081,017	3,666,490
		#4	3,801,495	4,079,557	3,610,984
		#5	-	1,318,670	3,946,931
		#6	-	96,365	3,392,395
		#7	-	-	1,474
Heavy Oil	Ulsan	#1	271,544	262,393	275,016
		#2	244,246	255,812	306,668
		#3	268,231	200,518	376,132
		#4	1,759,376	1,549,091	1,511,557
		#5	2,141,162	1,500,935	1,583,846
		#6	2,196,344	1,454,644	1,589,838
	Youngnam	#1	973,872	1,022,470	359,205
		#2	665,973	531,006	323,595
	Yosu	#1	723,968	430,310	403,547
		#2	1,304,109	904,597	906,849
	Pyungtaek	#1	850,533	1,258,662	1,123,948
		#2	880,646	1,376,342	1,198,620
		#3	751,633	1,321,167	1,304,568
		#4	800,854	1,338,204	1,052,228
	Namjeju	#1	50,294	44,602	34,448
		#2	48,714	44,654	28,686
		#3	-	-	179,033
	Jeju	#1	44,659	36,266	24,748
		#2	486,401	532,700	462,023

		#3	509,330	502,189	479,676
LNG	Seoul	#4	90,322	207,498	306,558
		#5	480,919	444,324	685,011
	Incheon	#1	47,491	16,450	32,932
		#2	49,144	37,727	24,366
		#3	19,018	130	78,669
		#4	594	29,202	62,414
Combined Cycle	Pyungtaek	C/C	596,001	659,932	497,441
	Ilsan	C/C	3,281,407	2,873,958	3,038,165
	Bundang	C/C	3,650,122	3,742,073	4,059,300
	Ulsan	C/C	2,329,524	3,131,075	3,608,435
	Seoincheon	C/C	8,353,619	7,001,031	8,726,521
	Shinincheon	C/C	11,596,955	10,543,280	11,797,500
	Boryeong	C/C	6,979,928	8,221,926	7,089,662
	Incheon	C/C	-	2,055,016	3,648,288
	Busan	C/C	9,884,075	9,076,327	10,455,401
	Hallim	C/C	96,435	100,346	175,356
	Anyang	C/C	1,506,070	1,433,978	1,286,480
	Bucheon	C/C	1,425,073	1,404,160	1,241,795
	KIE Co.	C/C	2,809,983	-	-
	POSCO POWER	C/C	-	2,571,095	2,338,128
	G S Bugog	C/C	1,894,996	2,189,808	2,911,683
	Yulchon	C/C	36,366	1,300,627	2,276,276
Internal Combustion	Namjeju	D/P	274,089	268,073	239,690
	Jeju	G/T	3,016	5,069	15,986
	Jeju	D/P	-	151,759	252,764
Total			**187,514,442**	**195,045,196**	**206,605,295**

Source: Statistics of Electric Power in KOREA (KEPCO, 2005, 2006, 2007)

<Annex4-8> CO_2 Emission Factors (IPCC, 2006)

Fuel	Carbon Emission Factor(tC/GJ)
Bituminous Coal	0.0895
Heavy Oil	0.0755
Diesel Oil	0.0726
LNG	0.0543

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories Vol.2 Energy

<Annex4-9> List of power units of most recent capacity addition(20% net generation of the grid in 2006)

Name	Type	Date	Unit Capacity(kWp)	Number of Unit	Capacity	Net Generation in 2006 (MWh)
Cheongsong pumping #2	Hydro	'06.12	300,000	1	300,000	21,542
S&P Solar	Solar	'06.10	700	1	700	106
Namhae Solar	Solar	'06.10	1,000	1	1,000	297
Yongheng solar	Solar	'06.9	1000	1	1,000	242
HanlajJeunggong Solar	Solar	'06.9	1,000	1	1,000	287
Namjeju #1	Heavy Oil	'06.09	100,000	1	100,000	179,033
Cheongsong pumping #1	Hydro	'06.9	300,000	1	300,000	39,965
Yangyang pumping #4	Hydro	'06.8	250,000	1	250,000	62,801
Enepark	Solar	'06.8	300	1	300	85
Yangyang pumping #3	Hydro	'06.6	250,000	1	250,000	97,896
Goheung Solar	Solar	'06.6	800	1	800	619
Hadongho	Small Scale	'06.06	825	1	825	1,294

	Hydro					
Jangseong	Small Scale Hydro	'06.05	260, 960	1	1,220	514
Maebongsan-wind power*	Wind	'06.5	850	3	2,550	5,399
Dangjin #6	Bituminous Coal	'06.04	500,000	1	500,000	3,392,395
Yangyang pumping #2	Hydro	'06.4	250,000	1	250,000	93,471
Bundang fuel cell	Fuel Cell	'06.3	250	1	250	290
Sinchang-wind power	Wind	'06.3	850	2	1,700	2,969
Yangyang pumping-wind	Wind	'06.3	1,500	2	3,000	1,788
Yangyang pumping #1	Hydro	'06.2	250,000	1	250,000	62,801
Sunchun Solar*	Solar	'05.12	150	1	850	220
Sunchun Solar*	Solar	'05.12	700	1	850	1,027
Dangjin #5	Bituminous Coal	'05.10	500,000	1	500,000	3,946,931
Samcheonpo solar	Solar	'05.10	100	1	100	118
Taean solar	Solar	'05.8	120	1	120	127
Yulchon C/C(ST)*	LNG	'05.7	197,900	1	197,900	857,231
WunjeongLFG*	Solar	'05.7	1,058	1	1,058	5,806
Jeju D/P	Heavy Oil	'05.6	40,000	1	40,000	252,764
Incheon C/C(ST)*	LNG	'05.6	182,081	1	182,081	1,319,230
Incheon C/C(GT)*	LNG	'05.6	160,729	2	321,458	2,329,058
Daegok	Small Scale Hydro	'05.6	300	1	300	1,740
Dongwha	Small Scale Hydro	'05.5	200, 800	2	1,000	2,434
Ulchin #6	Nuclear	'05.4	1,000,000	1	1,000,000	7,401,424
Busan Bio-gas	Bio Gas	'05.1	1,058	2	2,116	7
Maebongsan-wind power*	Wind	'04.12	850	2	1,700	3,599
Yongheng #2	Bituminous Coal	'04.11	800,000	1	800,000	5,727,937
New Solar Energy	Solar	'04.9	200	1	200	216
Daegwanryung-wind power*	Wind	'04.8	660	1	660	863
Yongheng #1	Bituminous Coal	'04.7	800,000	1	800,000	5,337,432
Yulchon C/C(GT)*	LNG	'04.7	163,800	2	327,600	1,419,045
Ulchin #5	Nuclear	'04.7	1,000,000	1	1,000,000	7,879,757
Busan C/C(ST)*	LNG	'04.3	150,000	1	150,000	871,283
Busan C/C(GT)*	LNG	'04.3	150,000	2	300,000	1,742,567
Busan C/C(ST)*	LNG	'04.2	150,000	1	150,000	871,283
Busan C/C(GT)*	LNG	'04.2	150,000	2	300,000	1,742,567
Hankyung-wind power	Wind	'04.2	1,500	4	6,000	18,371
Chunsang	Small Scale Hydro	'04.1	250	1	250	183
Cheongju LFG	LFG	'04.1	1,000	1	1,000	6,906
Gunsan-wind power*	Wind	'04	750	2	1,500	2,023
WunjeongLFG	LFG	'03.12	1,060	2	2,120	11,613
Daegwanryung-wind power*	Wind	'03.11	660	3	1,980	2,588
Gunsan-wind power*	Wind	'03.9	750	2	1,500	2,023
Busan C/C(ST)*	LNG	'03.6	150,000	2	300,000	1,742,567

Sangwon ENC*	LFG	'03.6	380	1	380	667
Daejun Geumgodong	LFG	'03.6	865	4	3,460	12,768
Busan C/C(GT)*	LNG	'03.5	150,000	4	600,000	3,485,134
Hoicheon ENC	LFG	'03.5	1,000	2	2,000	4,501
Muju	Small Scale Hydro	'03.4	400	1	400	555
Seohee-ENC	LFG	'03.4	1,000	6	6,000	33,895
Sangwon ENC*	LFG	'03.3	1,000	3	3,000	5,269
Ducksong*	Small Scale Hydro	'03.1	300	2	600	1,824
Yonggwang #6	Nuclear	'02.12	1,000,000	1	1,000,000	7,969,957
Gunsan-filing	LFG	'02.12	1,000	1	1,000	4,195
Gunsan-wind power*	Wind	'02.11	750	2	1,500	2,023
Boryeong C/C(ST)*	LNG	'02.8	150,000	4	600,000	2,363,221
Taean #6	Bituminous Coal	'02.5	500,000	1	500,000	3,381,867
Pohang-hodong	LFG	'02.5	1,000	2	2,000	12,320
Yonggwang #5	Nuclear	'02.5	1,000,000	1	1,000,000	7,681,293
POSCO POWER(#4ST)*	LNG	'02.1	150,000	1	150,000	194,844
Sanchong	Small Scale Hydro	'01.12	400	1	400	1,385
Sangwon ENC	LFG	'01.12	1,300	5	6,500	11,416
Sanchong pumping #2	Hydro	'01.11	350,000	1	350,000	204,444
Taean #5	Bituminous Coal	'01.10	500,000	1	500,000	4,013,235
Total						**76,849,547**

Appendix 5. Further background information on monitoring plan

Please refer to section B.7.

There is no further background information on monitoring plan.

Appendix 6. Summary of post registration changes

Below are changed after the registration.

- Changes to project design of registered project activity

(Add in SECTION A.- Description of project activity)

1. Additional facility (PV and ESS) is installed to reduce the power usage for the plant operation. Even though the facility had been installed at the project site, the amount of electricity transferred to the Grid (for sale) is not increased beyond the amount of the registered PDD. The electricity generated from the PV/ESS is only used for the operation of plant not sale.

- Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

(Add in SECTION B.7.- Monitoring plan)

1. According to the FAR raised from the 1st verification, the information of metering equipment for plant operation is included in the monitoring plan.
2. According to the National regulation, the test interval for metering equipment for power generation is changed from 3 years to 3.5 years ± 6months

- Contact information of project participants and responsible persons/entities

(Changed in Appendix 1.)

- The information of project participant had been changed and thus, MoC was changed. The changed information is valid as of 31/03/2015.

According Document information

Version	*Date*	*Description*
06.0	9 March 2015	Revisions to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Editorial improvement.
05.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the project design document form for small-scale CDM project activities (these instructions supersede the "Guidelines for completing the project design document form for small-scale CDM project activities" (Version 01.1)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Change the reference number from *F-CDM-SSC-PDD* to *CDM-SSC-PDD-FORM*; • Editorial improvement.
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	13 March 2012	EB 66, Annex 9 Revision required to ensure consistency with the “Guidelines for completing the project design document form for small-scale CDM project activities”
03.0	15 December 2006	EB 28, Annex 34 • The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.
02.0	08 July 2005	EB 20, Annex 14 • The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
01.0	21 January 2003	EB 07, Annex 05 Initial adoption.

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