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

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Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Point of Use Abatement Device to Reduce SF_6 emissions in LCD Manufacturing Operations in the Republic of Korea (South Korea)
Version 14
February 4, 2010

A.2. Description of the project activity:

LG Display Co.,Ltd. (LGD) currently uses SF6 in its LCD manufacturing process in Plant 2/3, Plant 4/5, P6 in Gumi, South Korea and Plant 7 in Paju, South Korea. The project will install abatement devices on all the exhaust from the dry etching processes to destroy much of the SF_6 currently vented from the process.

SF6 is used in the production process of LCD panels to etch the substrates. To date, no substitute for the role SF6 plays in the dry etching process is available on the market. Some part of the SF6 gas is consumed in the dry etching process and is changed into by-products that are not greenhouse gases. The remaining SF6, mixed with air and other by-products, is vented into the atmosphere.

For each plant, LG (LG International Corp. (LGI) and LG Display Co.,Ltd. (LGD) collectively) will install end-of-pipe abatement devices using the best available technology to destroy the vast majority of SF6 that is not destroyed or converted in the dry etching process. In order to capture the actual amount of SF6 entering and subsequently leaving the abatement device, LG will undertake an extensive ongoing monitoring operation. This will include installing and maintaining Fourier Transform Infrared (FTIR) devices on both the inlet and outlet of the abatement device to continuously monitor the concentration of SF6 and calculate the mass of SF6 destroyed. This result will be converted into a carbon equivalent value and any emissions resulting from electricity and/or fuel consumption of the abatement device will be subtracted to arrive at the emission reduction value for the project activity. LG will also undertake the numerous quality controls and anti-gaming measures required by the methodology to ensure an accurate and conservative result.

Steps in Project:

1. Gather Historic Data: The anti-gaming measures of the methodology require specific information about the historic consumption of SF6 and the use of substrate in the plants. LGD has gathered this data for the three years prior to January 31, 2009. This data has been entered into a data base and the results are included in the Annex 3 of this document.

2. Design and Install the Abatement Device and Monitoring System: The design of the abatement system will be critical to the ultimate success of the project. In addition, the monitoring system will also be designed appropriately to ensure the full compliance with the methodology. LG will share the engineered design of the abatement system with the validator including information on the suppliers of the major components.

3. On-Going Monitoring Plan: The on-going monitoring plan is perhaps the most important part of the project. LG or its designees will undertake frequent checks of the abatement devices and monitoring equipment and perform the calibrations as required by the methodology.

4. Training of Staff and Equipment: As part of the project activity, LG and its key suppliers will provide training for staff in how to use the equipment and ensure the monitoring activities conform to the methodology.

5. Contribution to Sustainable Development: This project will reduce the emissions of a potent greenhouse gas identified that would otherwise be emitted into the atmosphere. In addition it meets the following sustainability criteria:

a. The project is in compliance with all laws of the country.
b. It is in line with national policies since Korea having ratified the Kyoto Protocol has a stated national goal of reducing greenhouse gas emissions
c. The project will significantly reduce greenhouse gas emissions as documented in the PDD.
d. It has a limited additional use of fossil fuels to incinerate the SF6 so a small negative environmental impact from fossil fuel combustion to gain a larger greenhouse gas reduction.
e. There should be no adverse impacts on the local community as the emissions from the abatement device are minimal and not particularly polluting.
f. There will be minimal impact on the entire industrial footprint of the LG production facility.
g. The abatement technology being transferred through this project could provide critical expertise and knowledge for both LG and Korea.
h. A full-scale continuously operational abatement operation should only make further investments and operations of similar abatement systems in Korea easier to plan and implement.
i. There is a profit sharing agreement in place with the local parties taking the vast majority of the CDM value.
j. Local suppliers are playing a major role in the implementation of the project helping the local economy and offering employment opportunities. Some additional employment opportunities will be available in the operation of the unit.

A.3. Project participants:

Name of Party involved (host) indicates a Host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Government of the Republic of Korea (Host)	• LG International Corp. • LG Display Co.,Ltd.	No
United Kingdom	• Climate Change Capital Carbon Fund II s.a.r.l.	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Republic of Korea

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

Gyeongsangbuk-do and Gyeonggi-do

A.4.1.3. City/Town/Community etc:

Gumi and Paju

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

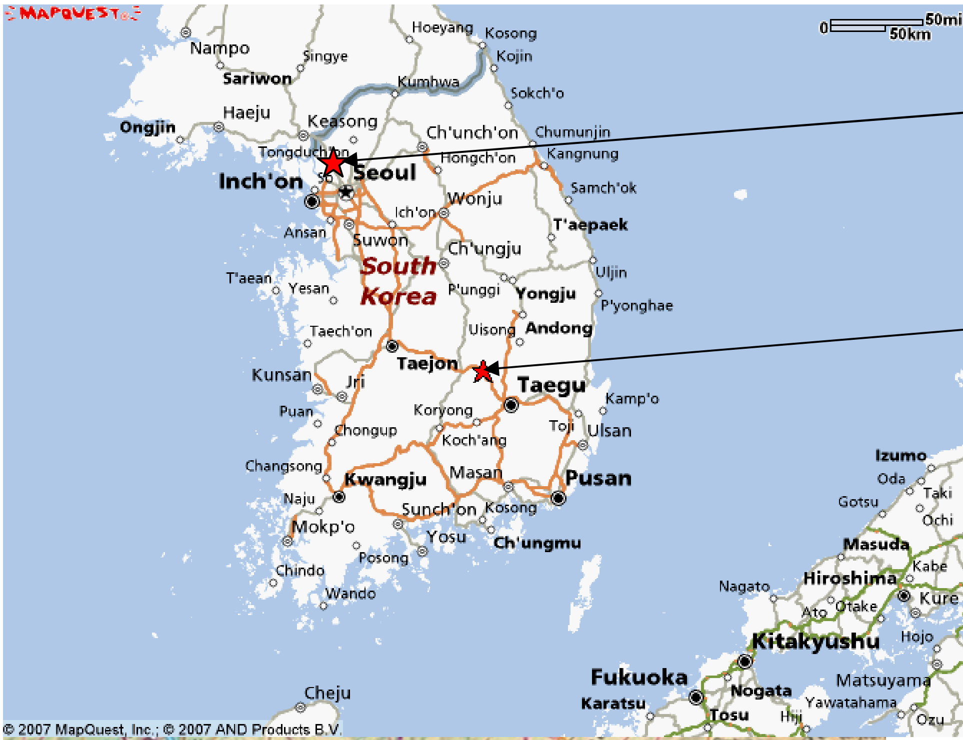
LG Display Plant 2/3 ((36º 6’ 33” N 128º 24’ 40” E), Plant 4/5 (36º 5’ 26” N 128º 24’ 40” E), Plant 6 (36º 5’ 40” N 128º 24’ 40” E), Plant 7 (37º 48’ 33” N 126º 40’ 20” E)
Gumi and Paju, South Korea
Connected to the South Korean Electricity Grid

The Plant 2/3, Plant 4/5, Plant 6, are based in Gumi which is located in the western part of Korea's Gyeongsangbuk-do(Province), 277.5 km. south of Seoul and 167 km. north of Busan and Plant 7 is located in Paju, Gyeonggi-do, 50 km. west of Seoul.

Dimensions : 616.03 km2 (Gumi), 672.42 km2 (Paju)
Population : 390,000 people (Gumi), 320,000 people (Paju)
Climate : Annual average temperature (degrees celsius): 14.2 (Gumi), 11.0 (Paju)
Average annual rainfall: 1323 mm (Gumi), 1302 mm (Paju)

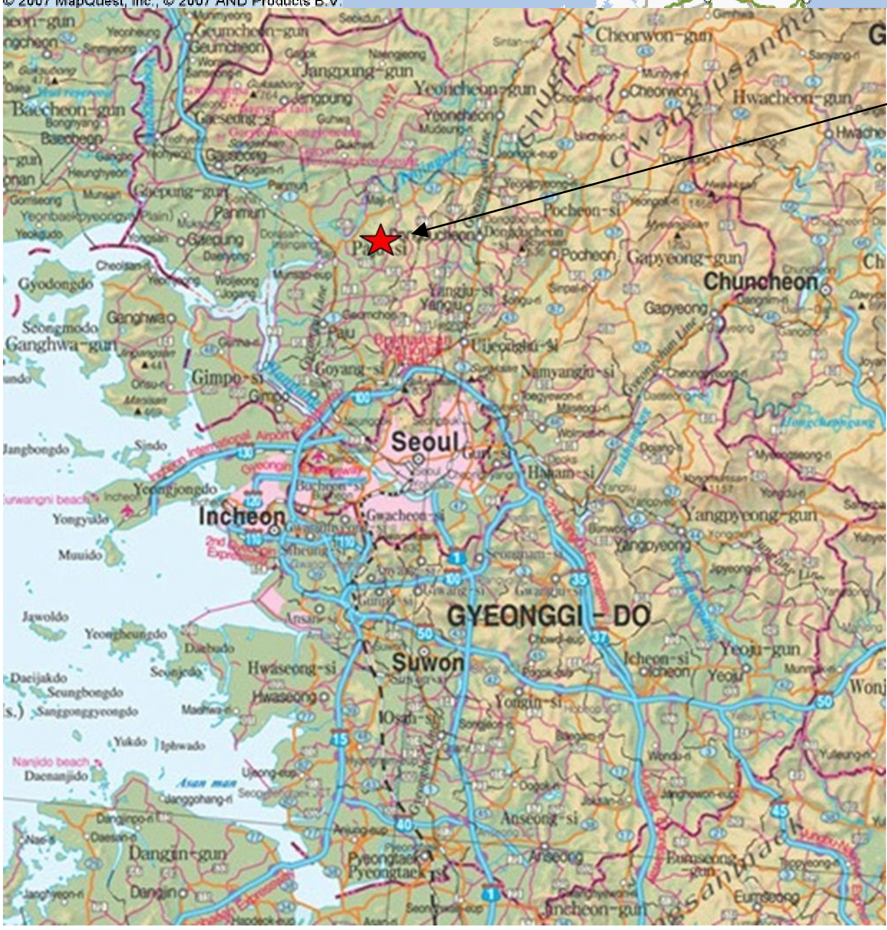
The Gyeongbu Railroad line and Gyeongbu Expressway cross Gumi. The Nakdong River flows north to south through Gumi. The Commuter Railroad line and Jayou way reach Paju. The Imjin River flows east to west through Paju.

Gumi is very important for South Korea's economy. It contains more than 725 companies with over 80,000 workers. Around 450 companies are located in Gumi National Industrial Complexes 1, 2, 3, and 4. The rest operate in the Sandong, Goa, and Haepyeong rural industry complexes. Major production: High-tech electronics like LCD's, PDP's, and telecommunication equipment. More than 10% of national export is generated in Gumi. Paju is a newly developed industrial complex, which consists of LCD Manufacturing, LCD materials and equipment.

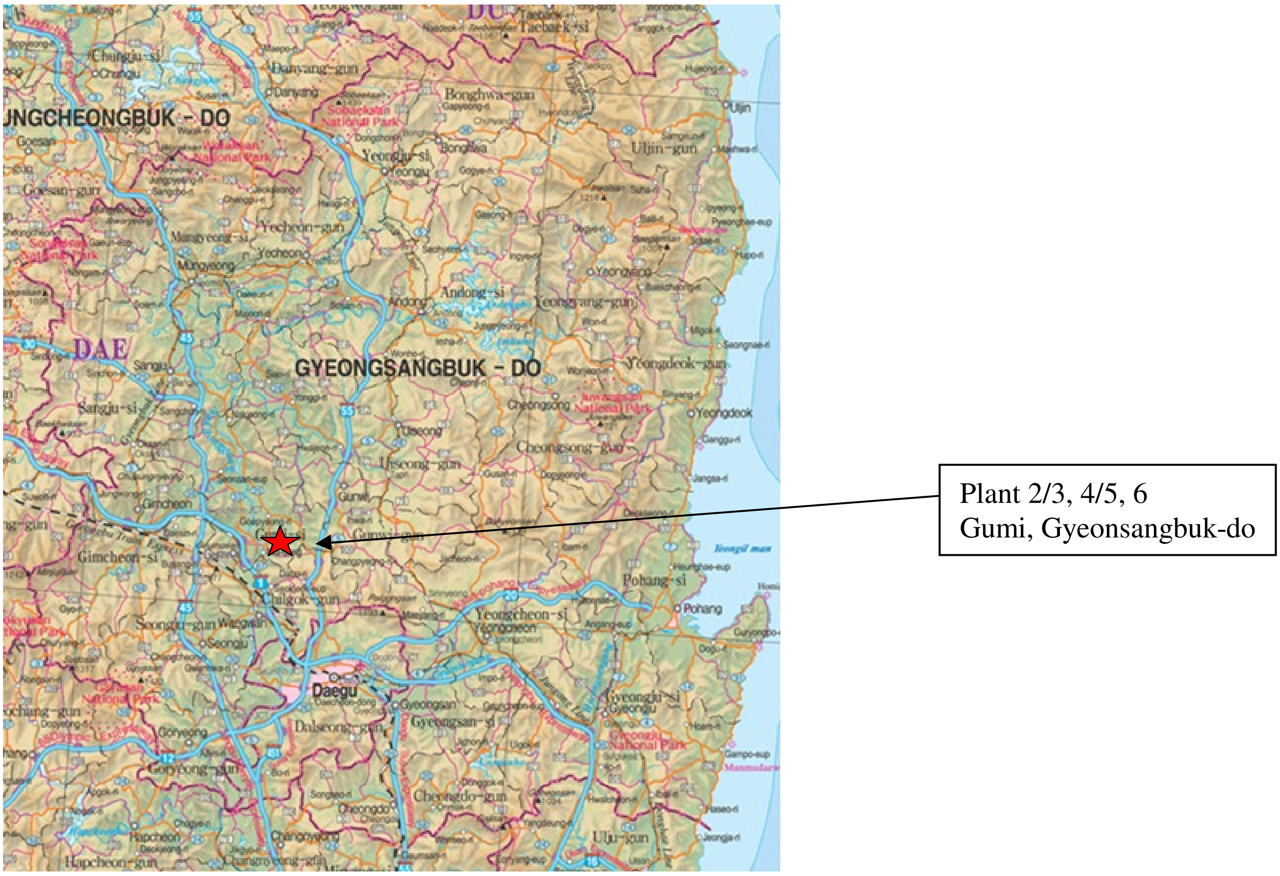


Plant 7,
Paju, Gyeonggi-do

Plant 2/3, 4/5, 6,
Gumi, Gyeongsanbuk-do



Plant 7
Paju, Gyeonggi-do



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

(4) Manufacturing industries
(11) Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride

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

This project will install the necessary abatement equipment required to destroy SF6 that is vented from the Dry Etching processes in the manufacture of LCD panels. Specifically, the abatement technology requires temperatures greater than 1,200 degrees C to break down and destroy the SF6.

a) Currently no abatement device or related equipment is installed in the project boundary to destroy SF6 and all the non-reacted SF6 is now vented into the atmosphere. The project will install brand new equipment with the sole purpose of destroying the GHG emissions from SF6 and no existing equipment will be replaced.

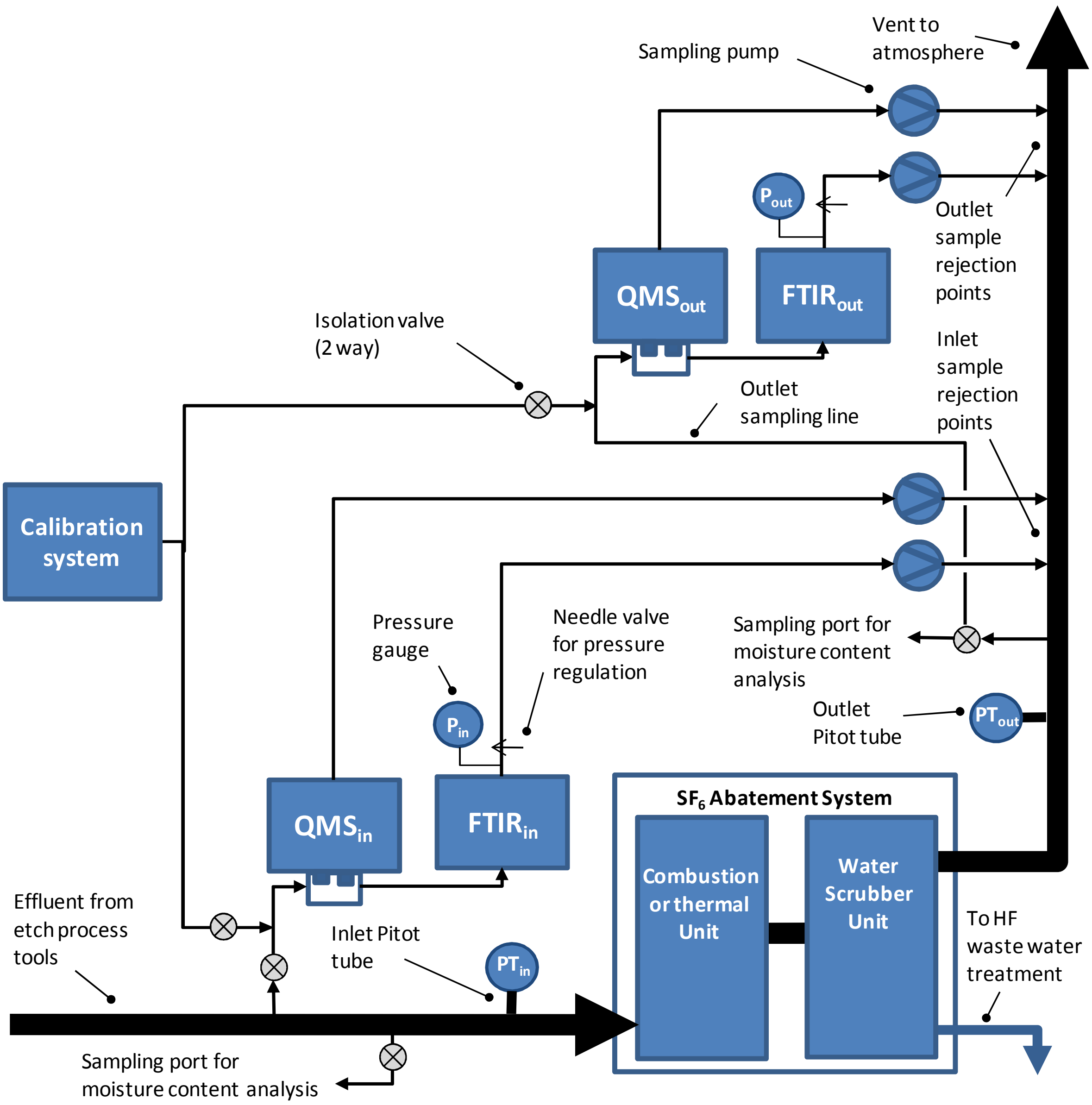
b) The planned abatement technology to be employed in the initial installation –P6 is a CO-01 Abatement Device designed by the Korean company Save Technology Co. Ltd. Future devices to be installed in other plants following registration may have different makes, model numbers, and specifications based on the plant requirements. Installation of the abatement system in P6 was completed at the end of 2009 and installation additional systems to be applied in other plants will commence just after project registration and will be operational within one year. The only purpose of the abatement device which operates between 1200 and 1350°C is to destroy SF6 emissions as they exit the plant. The ventilated gas from the LCD manufacturing process flows into the abatement device and is subjected to an extremely high temperature. The purpose of the abatement device

which has a 10 year expected lifespan is to destroy the SF6 present in the ventilated air. The device will generate some CO2 from the combustion of fuel. This eliminates almost all the SF6 in the ventilated air. The specifications for the CO-01 for the P-6 plant are as follows:

Abatement Device Specifications for P-6 Plant	
ITEM NO.	CO-01
SERVICE NAME	REACTOR
QUANTITY	1 SET Per Plant
TYPE	HORIZONTAL & CYLINDRICAL
HEAT CAPACITY	10.4 GJ/HR (2.5 x10^6 Kcal/hr)
TREATMENT CAPACITY (SF6 GAS)	40.2 Nm^3/MIN
TOTAL CAPACITY (Overall Gas)	109 Nm^3/MIN
RESIDENCE TIME	1 SECOND (CHAMBER)
DIMENSION	2,400mm x 7,800mmL

In addition, several other pieces of equipment will be installed to ensure the safe and seamless operation of the abatement system. This includes a Quencher, Emergency Water Tank, 1st scrubber, 2nd scrubber, pretreatment system, and softening system. These additional installations will ensure that the non-GHG emissions from the abatement process are minimal and well within legally accepted limits.

The key components of the monitoring system is expected to include annubar devices supplied by the South Korean Company Taehung M&C Corp, FTIR provided by the South Korean Company Joowon Industrial Co. Ltd., and the QMS purchased from the South Korean Company Bongil Inc. Detailed descriptions of the equipment have been provided to the Validator including copies of operational manuals. The figure below captures the general design of the system. Much more detailed engineering schematics have been provided to the validator.



c)The baseline scenario is the same as the situation that exists before the project is implemented-no abatement device in place.

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

Please indicate the chosen crediting period and provide the total estimation of emission reductions as well as annual estimates for the chosen crediting period. Information on the emission reductions shall be in indicated using the following tabular format.

Year	Annual estimation of emission reductions in tonnes of CO_2e
Year 1 (April, 1, 2010 ~ March, 31, 2011)	494,087
Year 2 (April, 1, 2011 ~ March, 31, 2012)	1,387,458

Year 3 (April, 1, 2012 ~ March, 31, 2013)	1,387,458
Year 4 (April, 1, 2013 ~ March, 31, 2014)	1,387,458
Year 5 (April, 1, 2014 ~ March, 31, 2015)	1,387,458
Year 6 (April, 1, 2015 ~ March, 31, 2016)	1,387,458
Year 7 (April, 1, 2016 ~ March, 31, 2017)	1,387,458
Year 8 (April, 1, 2017 ~ March, 31, 2018)	1,387,458
Year 9 (April, 1, 2018 ~ March, 31, 2019)	1,387,458
Year 10 (April, 1, 2019 ~ March, 31, 2020)	1,387,458
Total estimated reductions (tonnes of CO_2e)	12,981,209
Total number of crediting years	10 years
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	1,298,121

For Year 1, the abatement system in P6 alone will be operational and the other facilities will be under construction. After Year 1, all systems will be fully operational.

A.4.5. Public funding of the project activity:

No public funding will be used for this activity

SECTION B. Application of a baseline and monitoring methodology

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

"Point of Use Abatement Device to Reduce SF6 emissions in LCD Manufacturing Operations"
Approved baseline and monitoring methodology AM0078 v.1.1

"Combined tool to identify the baseline scenario and demonstrate additionality." v.2.2

"Tool to calculate the emission factor for an electricity system." v.2

"Tool to calculate baseline, project and/or leakage emissions from electricity consumption." v.1

"Tool to calculate project or leakage CO2 emissions from fossil fuel combustion." v.2

"Guidelines for objective demonstration and assessment of barriers" EB50 Annex 13

"Guidelines on the assessment of investment analysis" EB51 Annex 58

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

This methodology was written in conjunction with this project. The project will destroy SF6 that would otherwise be vented into the atmosphere as described in the methodology. In addition, the project conforms to the methodology applicability criteria as follows.

- The methodology only applies to existing production lines with at least 3 years information of SF6 purchase and consumption and production of LCD substrate by 31 January 2009. The crediting period is limited to the remaining lifetime of the production lines existing at the time of registration;

  This is the case in this project. Only existing production lines with 3 years of historical data as of January 31, 2009 are included in the project. LGD has provided this information to the DOE. The average lifetime of LCD manufacturing plants is expected to be more than 30 years at least. LGD has performed numerous maintenance activities including periodic preventive maintenance of equipments in order to keep its equipments in best operational conditions and has been substituting old devices with brand new equipment. The lifetime of LCD plant depends on the condition of FABs which are usually steel structure with more than 30 years life expectancy. The followings are the commissioning date of each plant

Location	FAB No.	Commissioning date	Remaining lifetime
Gumi	P2	February, 1998	18 years
	P3	July, 2000	20 years
	P4	March, 2002	22 years
	P5	May, 2003	23 years
	P6	August, 2004	24 years
Paju	P7	January, 2006	26 years

Considering the above commissioning dates of each plant, the minimum remaining lifetime of the LCD production lines is 18 years, which is much longer than the 10 years of the crediting period of the proposed project.

- The maximum treatment capacity of the abatement system is sized for the application in correlation to observed historical flow. The maximum SF6 flow entering the abatement device, from all chambers combined, is below the maximum SF6 abatement capacity of the abatement device and where the total flow of effluents (SF6 plus all other by-products and diluents) does not exceed the total flow capacity of the abatement device;

The abatement devices are designed to ensure that the total flow does not exceed the total flow capacity of the abatement device. This is documented in the engineering design plans provided to the DOE at validation. According to the engineering design has been provide to the DOE, the abatement system for P6 is designed for a total flow of SF6 of 40.2NCMM(before pre-treatment, 37.2 NCMM) while the historical flows are much closer to 32.3NCMM(before pre-treatment). The flow rate of effluent gas from all plants, from P2 to P6,were measured by SILLAENTECH.co.ltd and the result has been provided to the DOE. These measurements will be used to ensure the flow does not exceed the total capacity for the device for the additional abatement devices. The following is data on measured flow rate of each plant and required capacity of each abatement device to be installed.

Location	FAB No.	Measured flow rate	Required Capacity
Gumi	P2/3	57.7 NCMM	Greater than 63.0 CMM
	P4/5	130.6 NCMM	Greater than 143.0 CMM
Paju	P7	47.4 NCMM	Greater than 53.0 CMM

- No law or regulation which mandate decomposition, destruction, recycle or substitution of SF6 or any component of exhaust gases containing SF6 exist;

This is the case in South Korea. There is no law regulating GHG emission in Korea and, furthermore, SF6 is not a regulated gas according to Clean Air Conservation Act in Korea

- The SF6 destruction should occur at the same industrial site where the SF6 is used, and SF6 destroyed is not imported from other facilities;

The abatement units are all to be installed at the site of SF6 consumption. No SF6 emissions will be imported from other sites. This is clear from the engineering design plans provided to the DOE at validation..The engineering design plans provided to the DOE ensures that the abatement device will be directly connected to etching chambers where SF6 is used and there is no bypath connected to other LCD Manufacturing facilities. Furthermore, the DOE has inspected the pipelines during the site visiting.

- The measurement with respect to determining SF6 flow to the abatement device are taken immediately before the abatement device, without any other devices located in between which is capable of changing the SF6 flow through transformation or decomposition;

This is clear from the engineering design plans provided to the DOE at validation. To ensure that the measurement will be taken immediately before the abatement device, a pre-treatment facility will be installed ahead of inlet measurement system which includes FTIR , QMS and flow meter. According to the engineering design, some process air(approximately 3NCMM) is injected during the pre-treatment process. Flow rate is increased by newly injected air so it causes decrease of SF6 concentration. The purpose of inject air is insulation.(sealing air) This is why inlet FTIR and QMS are installed after the pre-treatment device. The measurement systems are directly connected to the abatement device and there is no equipment affecting SF6 flow between the inlet measurement devices and the abatement device

- Where the applicability conditions of US EPA Methods 1 and 2 are satisfied (i.e. the flow is not cyclonic or swirling and the stack has a circular cross section with a diameter greater than 0.3 meter);

  This is clear from the engineering design plans provided to the DOE at validation. (Diameter of Inlet pipe is 0.35m, and outlet is 0.6m and the annubar will be located 7 times of diameter far from inlet curve and at least 3 times from outlet curve).

- The facility will provide the necessary notices concerning safety and health in order to install and operate the abatement device and monitoring facilities;

  An official notice issued by Korea Occupational Safety & Health Agency has been provided to the DOE at validation and the notice clearly declares that the abatement device is not a subject to any permit or notice under Industrial Safety & Health Act in Korea. Therefore, there is no necessary notice concerning safety and health which the project participants need to obtain in order to install and operate the abatement device and monitoring facilities

- SF6 is not temporarily stored for subsequent destruction.

  This is clear from the engineering design plans provided to the DOE at validation. According to the engineering design made by the manufacturer, temporary storage of SF6 is technically impossible. The abatement system will be installed as "in-line system". The system will be directly connected to process chamber and there is no bypath except the line connected to the existing acid scrubber which will be used only for emergency and the existing scrubber does not have any storage tank. Furthermore, as the Bypath is located ahead of inlet measurement devices, it will not be included in the actual emission reduction measuring even if some of SF6 leaks to this bypath. In addition, several blowers will be installed to pull SF6 from the etching chambers to the system. Most importantly, maintaining constant pressure is very critical for LCD manufacturing, therefore, if SF6 is stored, it will cause huge damage to LCD manufacturing system.

- It is demonstrated by test data by the manufacturer or the project proponent that the abatement technology does not generate known non-CO_2 greenhouse gas such as fluorocompounds, including non-Kyoto gases, at detection levels.

  This can be seen in the manufacturer's specification that the composition of the outlet gas does not include other flourocompounds at detection levels.

- In addition, the applicability conditions included in the tools referred to above apply.

  Compliance with these additional criteria has been demonstrated to the DOE during validation.

- This methodology in its present form is not applicable to Chemical Vapor Deposition (CVD) processes that use SF6.

  <u>*No CVD devices are included in the project.*</u>

- Methodologies using this tool (the Combined Tool to Identify the Baseline Scenario and Determine Additionality 2.2) are only applicable if all potential alternative scenarios to the proposed project activity are available options to project participants.

  All the alternative scenarios are available to the project developer.

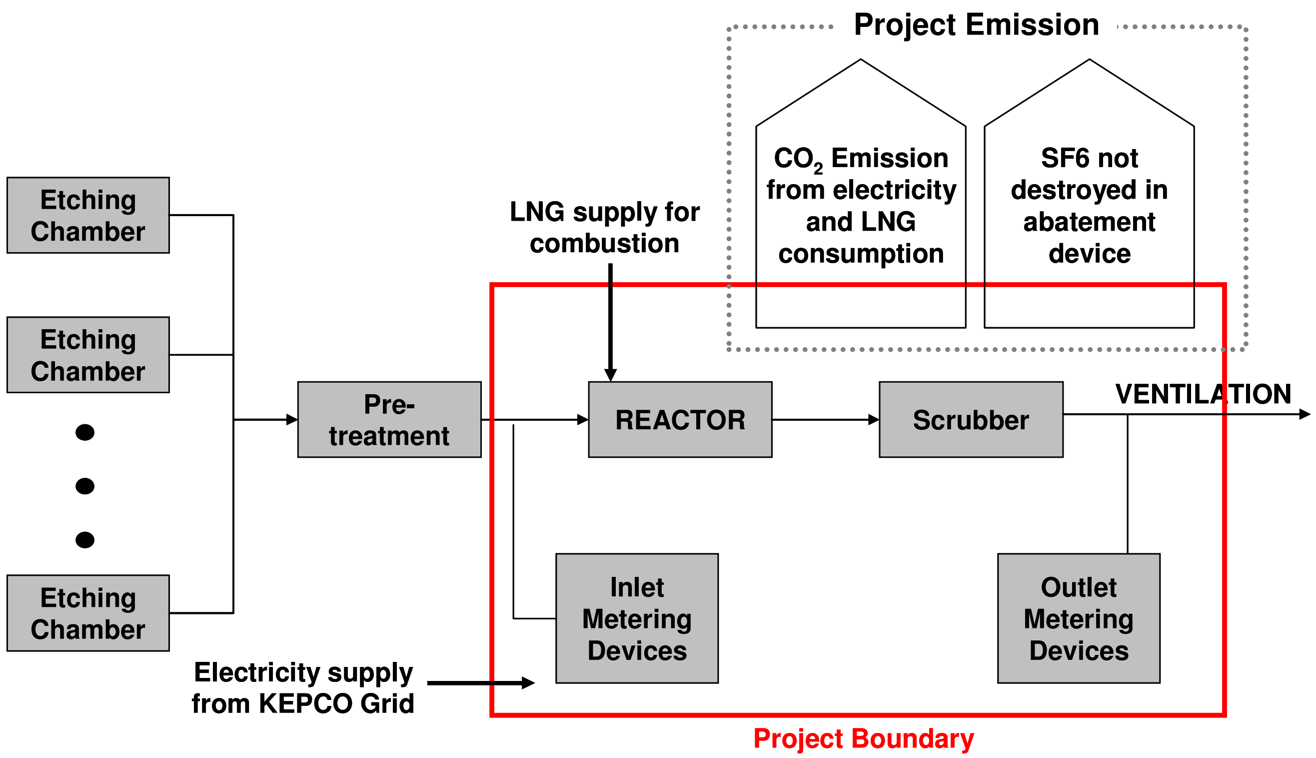
- The '**Tool to calculate the emission factor for an electricity system**' is also referred to as the "Tool to calculate project emissions from electricity consumption" for the purpose of calculating project and leakage

emissions in case where a project activity consumes electricity from the grid or results in increase of consumption of electricity from the grid outside the project boundary.

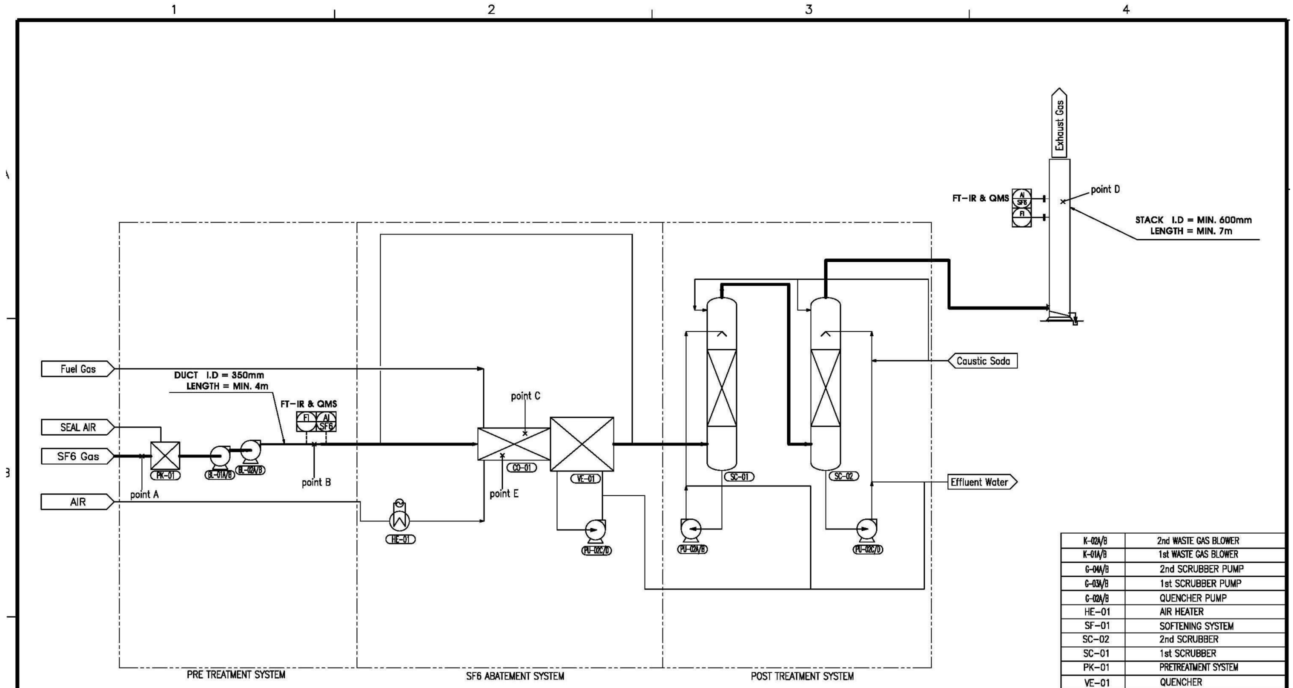
This project activity consumes electricity from the grid.

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

The project boundaries for this project are the LCD manufacturing plants listed in section A.4, but more specifically, the project will incorporate an end of pipe solution at each of the plants. The schematic below provides a very detailed overview of the actual equipment involved in the scope of the project design. The abatement device will destroy SF6 but will also generate some CO2 from the consumption of fuel.

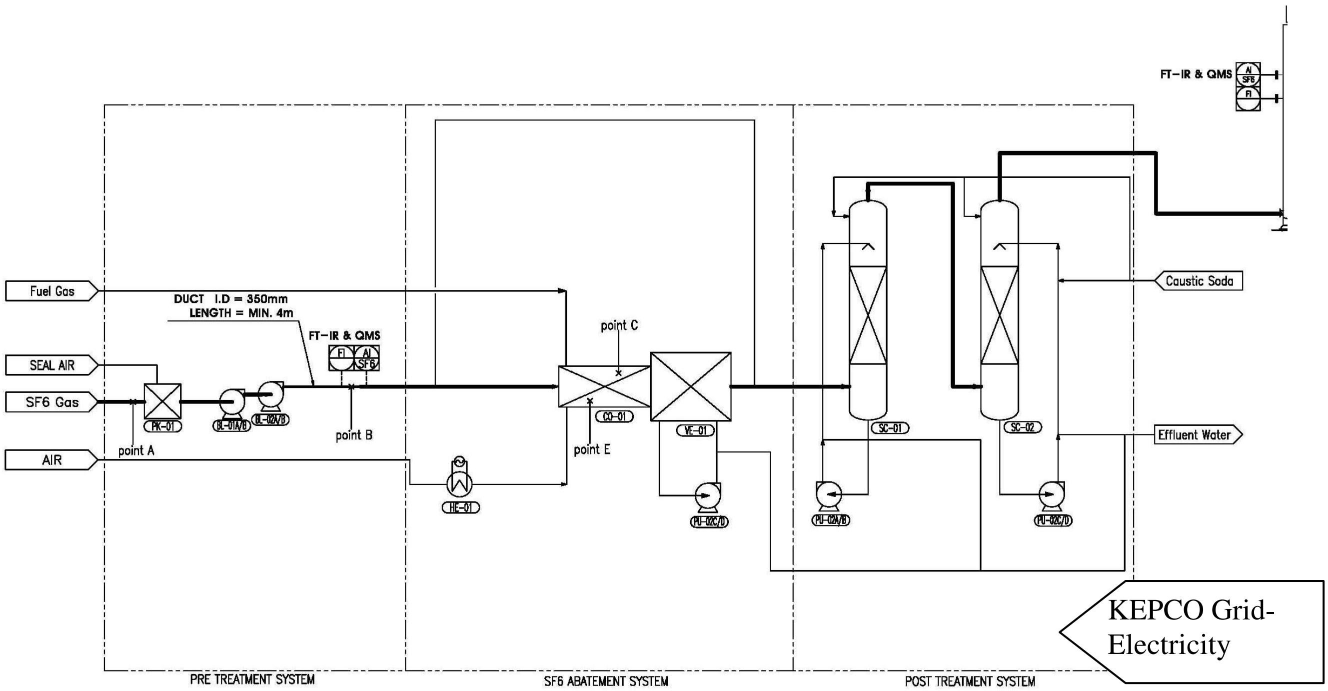


And the followings are more detailed engineering design of the abatement system.



Electricity is supplied to the system from grid

point A	point B	point C	point D	point E
Flowrate : 37.2NCMM SF6 : 500 ppm HF : 170 ppm HCl : 70 ppm Cl2 : 0.05 ppm DUST : 8 mg/Nm3 TEMP : 15℃ PRESS : −100~−200mmAq	Flowrate : 40.2NCMM SF6 : 460 ppm HF : 1.7 ppm HCl : 0.7 ppm Cl2 : 0.00 ppm DUST : 2 mg/Nm3 TEMP : 24℃ PRESS : 1,000~2,300mmAq	REACTOR CAPACITY : 109NCMM RETENTION TIME : 1sec TEMP : 1200~1,350℃ PRESS : 1,200mmAq	Flowrate : 109NCMM SF6 : 17 ppm ↓ HF : 1.5 ppm ↓ SOx : 35 ppm ↓ NOx : 60 ppm ↓ DUST : 15 mg/Nm3 ↓ TEMP : 50~70 C PRESS : ATM	LNG: 3~3.9NCMM COMBUSTION & SEAL AIR : 36~41NCMM



K-02A/B	2nd WASTE GAS BLOWER
K-01A/B	1st WASTE GAS BLOWER
G-04A/B	2nd SCRUBBER PUMP
G-03A/B	1st SCRUBBER PUMP
G-02A/B	QUENCHER PUMP
HE-01	AIR HEATER
SF-01	SOFTENING SYSTEM
SC-02	2nd SCRUBBER
SC-01	1st SCRUBBER
PK-01	PRETREATMENT SYSTEM
VE-01	QUENCHER
CO-01	REACTOR
NO.	DESCRIPTION

point A	point B	point C	point D	point E
Flowrate : 37.2NCMM SF6 : 500 ppm HF : 170 ppm HCl : 70 ppm Cl2 : 0.05 ppm DUST : 8 mg/Nm3 TEMP : 15 C PRESS : −100~−200mmAq	Flowrate : 40.2NCMM SF6 : 460 ppm HF : 1.7 ppm HCl : 0.7 ppm Cl2 : 0.00 ppm DUST : 2 mg/Nm3 TEMP : 24 C PRESS : 1,000~2,300mmAq	REACTOR CAPACITY: 109NCMM RETENTION TIME : 1sec TEMP : 1200~1,350 C PRESS : 1,200mmAq	Flowrate : 109NCMM SF6 : 17 ppm ↓ HF : 1.5 PPM ↓ SOx : 35 ppm ↓ NOx : 60 ppm ↓ DUST : 15 mg/Nm3 ↓ TEMP : 50~70°C PRESS : ATM	LNG: 3~3.9NCMM COMBUSTION & SEAL AIR : 36~41NCMM

	Source	Gas	Included?	Justification / Explanation
Baseline	SF_6 used in the etching process in LCD Manufacturing Process	CO_2	No	There are no CO2 emissions related to the project in the baseline case.
		SF_6	Yes	This is the primary gas, which will be abated in the project scenario.
Project Activity	Produced in the operation of the abatement device from fuel and/or electricity consumption	CO_2	Yes	The abatement device will consume fuel and electricity that would not be consumed in the baseline case.
	SF6 not destroyed in abatement device	SF6	Yes	Small amounts of SF6 will not be destroyed by the abatement device and will be counted as project emissions

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

The baseline scenario will be determined using the "Combined tool to identify the baseline scenario and demonstrate additionality."

As per step 1a of the baseline the following is a list of plausible alternative scenarios:

The following are the potential baseline scenarios,

1. Undertaking this project, using an abatement device without CDM.
2. Continuing using SF6 without any abatement devices, the current situation
3. Using a substitute gas for SF6.
4. Continuing to use SF_6 but undertaking a concerted effort to capture and reuse the SF_6.
5. Process modifications/optimization to minimize SF6 consumption.

As per step 1b of the Tool, all of the alternatives are compliant will all mandatory laws and regulations. (Project proponent has provided the Air Pollution prevention Act in Korea and clearly demonstrated SF6 was not included in the list.)

Step 2a. List of potential barriers

Lack of prevailing practice- an official survey undertaken by Korea Display Industry Association (evidence type "g")

- Abatement systems as described in step four (common practice analysis) are not the prevailing practice in Korea due to huge investment and operating cost without financial return.
- SF6 capture and reuse is theoretical and untested in the LCD industry as the concentrations of SF6 gas are quite small compared to industries such as the electricity transmission sector where switch gear offers high concentrations of SF6 for recovery.
- The using alternative chemistry and trying to capture and reuse the SF6 would be a 'first of its kind' project type in Korea.

Technology barrier- a letter from cost innovations team of LG Display Co.,Ltd., a letter from environment technology team of LG Display Co.,Ltd. (evidence type "f")

- Although LG Display Co.,Ltd. is one of world top class LCD manufacturers in terms of technology and market share, the existing staff of LG Display Co.,Ltd. lacks the expertise to optimize the existing technology beyond their current optimization efforts .
- The concentrations of gas in the exhaust of the LCD manufacturing process are very low making capture and recycling complex and the tool makers would need to sanction the use of recovered and recycled SF6.

Step 2.b List of Plausible Baseline Scenarios without barrier to prevent implementation.

Alternative Scenarios	**Barriers**
1	According to the official survey undertaken by Korea Display Industry Association, the lack of prevailing practice, which caused by huge investment and operating cost, is a barrier to installing an abatement device..- **Not Plausible**
2	There are no recognizable barriers to maintaining the current scenario.- **Plausible**
3	The current chemistry is working well. SF6 is almost ubiquitous in LCD manufacturing and a technical replacement does not exist for dry etch processes. Any substitute gas would therefore be a 'first of its kind' project. As per the guidance of EB28 Annex 14 the project proponents have provided evidence type 'g' written documentation of independent expert

	judgments from an Industry Trade Association confirming this assessment from the Korean Display Industry Association (KDIA). In addition, the project developers LG have documented their lack of knowledge of any commercially available alternative chemistry in an official letter to the DOE which provides additional evidence as per the EB28 Annex 14 suggested evidence type 'f'. (Lack of Prevailing practice) - **Not Plausible.**
4	This technology is extremely new and unproven and its implementation would clearly constitute a 'first of its kind' which by EB definition from EB28 Annex 14 represents a Lack of Prevailing Practice barrier. In the future it may represent an attractive course, but does not currently represent a reasonable option compared to abatement. As no such project has been developed in Korea. Taiwan and Japan (an annex 1 country) it would therefore be a 'first of its kind' project. As per the guidance of EB28 Annex 14 the project proponents have provided evidence type 'g' written documentation of independent expert judgment from an Industry Trade Association. In addition, the project developers LG have documented their lack of knowledge of any commercially available SF6 capture and recycling in an official letter to the DOE which provides additional evidence as per the EB28 Annex 14 suggested evidence type 'f'. (lack of Prevailing practice) Other 'Technical Barriers' to this alternative further inhibit the project developer from overcoming the 'Lack of Prevailing Practice Barrier.' Developing an accepted SF6 recycling technology would have to deal with the relatively low concentrations of SF6 in the LCD exhaust compared to the higher SF6 concentration in other industries that have been able to utilize SF6 recovery and recycling. In addition, any change in prevailing practice involving SF6 capture and recycling would have to get the tool manufacturers to sanction the use of recycled gas in their tools. **– Not Plausible**.
5	This option would have no affect on the emissions of SF6 as the full array of process modifications /optimization actions to reduce SF6 consumption known to the optimization team have already been implemented and therefore additional optimization activities face the technology barrier of being beyond the current knowledge of the staff and run up against the limitations of the technology to be further optimized. As documented in attachment 22, the current staff has implemented an extensive optimization plan to reduce the consumption of SF6 in the process. In addition, the following letter from LG's 'Cost Innovations Team' responsible for these optimization activities indicates that they have completed the optimization to the complete extent of their existing knowledge and training. Further cost effective opportunities that would not damage the production process for optimization are not known to the team. If additional actions are implemented it will not affect the efficacy of the methodology which recalculates emission reduction each year based on actual SF6 used.-(Technology Barrier) **Not Plausible and does not affect successful outcome of the methodology.**

According to the Step 2.b, the alternative scenario 2, continuation of the existing scenario of venting the SF6, is the only plausible baseline scenario. It is therefore the baseline scenario. However, an investment analysis is performed to demonstrate that CDM revenue can alleviate the barrier which the alternative scenario 1 faces as outlined in the Step 2.b. As per EB28 Annex, the Project developers use an investment analysis as a quantitative argument to demonstrate that how CDM revenue alleviates the prevailing practice barriers in alternative scenario 1 that prevent the proposed project activity from occurring in the absence of the CDM. As highlighted in the previous section, option 1 faces prevailing practice barriers due to the large investment costs required to install abatement technology and the additional financial resources required to operate the device. The Investment Analysis documented below demonstrates the CDM revenue overcomes both the initial costs and the operation costs that prevent this project from occurring without CDM.

Demonstration on how CDM alleviates the identified barriers that prevent the project - According to the Step 2.b, the identified barrier that prevent the proposed project activities undertaken without CDM is Lack of prevailing practice in Korea which caused by huge investment and operating cost without financial return. Therefore, an investment analysis(qualitative approach) is performed to demonstrate that the CDM revenue can alleviate the barrier which the alternative scenario 1 faces in the Step 2.b.

Investment Analysis: As with most abatement technology, there is no direct financial, productivity, or other reason to undertake the abatement. The abatement unit costs a considerable amount of money to purchase. It costs money & time to operate and maintain. It takes up valuable space within the operations of the product manufacturer. It adds no direct value to the producer in increased production or reduced cost of production and as a result there is no incentive to abate SF_6.

As the chart below estimates there will be a direct cost to LG of US$ 176,000,000 to abate SF6 and zero financial benefit. Only the revenue from CDM will make the project financially viable. The sensitivity analysis using any financial measure would be conclusive given the immense costs and zero revenue generation potential of installing the unit. This is the reason why the proposed project activity without CDM faces the identified barrier in Step 2.b, lack of prevailing practice.

#	Option	Capital Investment	Annual Operating Cost (per unit)	Number of units required	Total Ten Year Benefit	Simple Total 10 year Net Benefit (Cost)
	Proposed CDM Project	P2/3: US$ 7.9 M P4/5: US$ 16.5 M P6: US$ 5.8 M P7: US$ 6.7 M	P2/3: US$ 3.1 M P4/5: US$ 6.2 M P6: US$ 2.0 M P7: US$ 2.7 M	1 1 1 1	US$205 million (Estimated)	US$ 28.8 M
1	SF_6 Abatement Device without CDM	P2/3: US$ 7.9 M P4/5: US$ 16.5 M P6: US$ 5.8 M P7: US$ 6.7 M	P2/3: US$ 3.1 M P4/5: US$ 6.2 M P6: US$ 2.0 M P7: US$ 2.7 M	1 1 1 1	US$0	(US$ 39.0 M) (US$ 78.6 M) (US$ 25.3 M) (US$ 33.3 M)
2	No SF6 Abatement Device	US$ 0	US$ 0	0	US$ 0	US$ 0

(Source: suppliers' quotation)

The Project Participant used various indicators such as BEP, IRR and NPV to perform investment analysis on the proposed project. However, in case of option one, SF_6 Abatement Device without CDM, these indicators are meaningless and BEP and IRR are even unable to be calculated as there is no financial return. In addition, there is no return on Investment and the project's NPV is a minus which would not meet the investment benchmark of any company including LGI which would at the very least meet the cost of capital. (Project developers have provided a financial analysis sheet to the DOE).

However, as can also be seen in a financial analysis provided to the DOE, the project with CDM is able to overcome the barrier as the CDM revenue can offset the investment cost and operating cost. The followings are values applied to financial analysis of the project with CDM and the result.

Exchange rate	**1,300 USD/KRW**	**Discount rate**	**8%**
Investment	**KRW 47,867 M**	**IRR**	**9%**
Working Capital	**KRW 6,959 M**	**NPV**	**KRW 2,325M**

Average Operating cost	**KRW 16,590M**	**Break even point**	**7 years**

(source: suppliers' quotation and financial analysis sheet made by Project Paticipants)

According to the analysis, the CDM revenue can offset the investment cost and operating cost. (the break even point is approximately 7 year) In conclusion, CDM can alleviate the identified barrier that prevents the proposed project activities undertaken without CDM and the proposed project activity is plausible only when CDM revenue is secured.

Given that the alternative scenario 2, continuation of the existing scenario of venting the SF6, is the only plausible baseline scenario according to the output of Step 2.b and since CDM can alleviate the indentified barrier that prevents the proposed project activities undertaken without CDM, step 4 – Common practice analysis, is undertaken to demonstrate that the proposed project is additional.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

Steps 1-3 of the Combined Tool are provided in section B.4 above to determine the only plausible baseline scenario is continuation of the current situation with no abatement system and SF6 emitted into the atmosphere.

Step 4. Common practice analysis

Common Practice: Abatement technology for SF_6 in the Korean LCD manufacturing industry is not standard practice. Information gathered to date indicates this is a first of its kind comprehensive SF6 abatement program in the LCD sector of Korea. The only unit that exists in Korea is a small pilot unit installed at one of LGD's plants. This was done as a voluntary early action as part of a corporate strategy to examine ways LGD could address climate change. It was undertaken in part to try to meet LGD's voluntary commitment to the World LCD Industries Cooperation Committee (WLICC). LGD has been using this pilot abatement device to assess critical data on cost, benefits, and other technical specification to inform potential future investments. As the CAPEX and OPEX costs are considerable with no resulting financial benefit (data from the device operator has been provided to the DOE), LGD and other Korean LCD manufacturers have not made a single additional investment in SF_6 abatement and have looked for other ways to try to address emissions by curtailing energy consumption. In order to be conservative this pilot plant was not included in the project.

According to an official survey recently undertaken by the Korea Display Industry Association, there is no case using substitute gas or recycled gas in Korea. Additionally, the survey revealed the only SF6 abatement system for the LCD industry in Korea is LGD's small pilot facility which has not been operating recently because of its huge operating cost. The Association also indicated that in other WLICC party countries – Japan and Taiwan, there is also no example in the LCD industry of complete SF6 gas substitution, SF6 being recycled or an SF6 abatement system in place which has a larger capacity than 5CMM.

Progress of the project

Date	Progress
March 12, 2007	Signed MOU with LGD for implementing this project
April 18, 2007	Signed CDM Consultancy Service Agreement with Quality Tonnes
May 31, 2007	Submitted NM238 to Meth Panel
February 8, 2008	EB rated NM238 "C"

April 16, 2008	Submitted NM271 to Meth Panel
February 13, 2009	EB rated NM271 "A"
May 27, 2009 ~ June 25, 2009	Uploaded this PDD on UNFCCC web site for public comments
June 1, 2009	Signed Equipment Purchase Agreement with SAVE Tech.
February 1, 2010	The full commissioning of the abatement system will be finished

Demonstration on the applicability of the official survey undertaken by KDIA for common practice analysis

As per EB28 Annex 14, the official survey undertaken by KDIA is acceptable only if KDIA is an independent industry association. Followings are explanation on the expertise of KDIA and their independence.

Korea Display Industry Association(KDIA) was founded for the following purposes and approved by Ministry of Science and Technology(July 2, 1990) and by Ministry of Commerce, Industry and Energy(June 13, 2007)

-Industrial Association : Promotes the comprehensive development of display related industry, strengthening the display industry and attempting mutual profits

-Research Guild: Promotes industrial development through technology innovation, solving the common bottleneck technology and state-of-art technology in display area, under mutual cooperation.

As stated above, research on technology innovation and common bottleneck of LCD industry is one of main businesses of KDIA. Therefore, KDIA is highly specialized in surveying and analyzing common practice of LCD industry in Korea.

KDIA is an independent body which consists of 204 member companies and is in no way answerable to one particular member. The provided official survey was undertaken by the Industrial Support Team of KDIA which is a professional staff hired to undertake independent studies and activities that support the membership at large but not any particular member. The staff who has undertaken this survey is hired by KDIA and does not belong to any particular member company. The Industrial Support Team's survey was undertaken without any oversight or managerial participation of any particular member of KDIA. The certificate of organization issued by Ministry of Commerce, Industry and Energy in Korea has been provided to DOE which requires KDIA to maintain its organizational independence.

The official website of KDIA(www.kdia.org) provides further information on its main business areas, member companies, organization structure and etc.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Baseline emissions for a crediting year *y* are calculated on the basis of mass of SF_6 entering the abatement device during the year *y*. In order to prevent intentional increase in baseline emissions, baseline emissions are limited within a cap derived from historical consumption of SF_6. Furthermore, any increase in SF6 consumption per unit of surface area of LCD substrate processed will be discounted by incorporating an "SF_6 consumption factor". Project emissions include emissions due to the incomplete destruction of the SF_6 in the abatement unit and CO_2 emissions from electricity and fuel consumption in the abatement device along with any SF_6 entering the abatement device that is not operating within prescribed conditions. Both electricity and fuel are required to operate the abatement device. The fuel used in the project is anticipated to be LNG.

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

Data / Parameter:	**GWP of** SF_6
Data unit:	$tCO2eq/tSF_6$
Description:	Global Warming Potential of SF_6
Source of data used:	IPCC
Value applied:	23,900
Justification of the choice of data or description of measurement methods and procedures actually applied :	Provided by the IPCC to calculate the global warming potential of SF_6
Any comment:	

Data / Parameter:	**Design capacity for existing Abatement Device** ($CAP_{SF6,ex}$)
Data unit:	Tonnes/year
Description:	Design capacity should be based the maximum flow allowed for normal operation of abatement device, based on the assumption that the existing abatement device is operating at full design capacity for the entire period of the year (i.e. 8760 hours).
Source of data used:	Historic operation design of existing plants
Value applied:	None- Not applicable
Justification of the choice of data or description of measurement methods and procedures actually applied :	There are no abatement devices on the existing lines of production or plants included in this project.
Any comment:	

Data / Parameter:	**Historical** SF_6 **consumption** ($CSF6, hist$)
Data unit:	Tonnes
Description:	Historical SF_6 consumption, calculated as the three years maximum consumption prior the implementation of the project activity before 31 January 2009. Consumption is defined as the total SF_6 purchased in a year, taking into account the change in inventory in a specific year.
Source of data used:	Record of purchase and inventory
Value applied:	see table below

Fab	$C_{SF6,hist}$ (Tonnes)
P2/3	20.78
P4/5	61.16
P6	76.23

<table>
<tr><td></td><td><table><tr><td>P7</td><td>98.45</td></tr><tr><td>total</td><td>256.62</td></tr></table></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures actually applied :</td><td>These values are the maximum consumption of SF6 over the three year historic period.
<table><tr><td rowspan="2">Fab</td><td colspan="3">Yearly SF6 consumption (kg)</td></tr><tr><td>'06</td><td>'07</td><td>'08</td></tr><tr><td>P2/3</td><td>18,450</td><td>20,781</td><td>19,530</td></tr><tr><td>P4/5</td><td>45,090</td><td>56,610</td><td>61,155</td></tr><tr><td>P6</td><td>55,024</td><td>73,990</td><td>76,226</td></tr><tr><td>P7</td><td>24,371</td><td>70,092</td><td>98,453</td></tr><tr><td>total or average</td><td>142,935</td><td>221,473</td><td>255,364</td></tr></table></td></tr>
<tr><td>Any comment:</td><td>Takes into account a 10% heel value based on the IPCC coefficient. (See attachment 13, New-attachment 7.1 and 7.2).</td></tr>
</table>

<table>
<tr><td>Data / Parameter:</td><td>Historical production of LCD substrate (SP-i)</td></tr>
<tr><td>Data unit:</td><td>m2</td></tr>
<tr><td>Description:</td><td>Historical production of LCD substrate (m2) during year i (where i =-1, -2, -3) prior the implementation of the project activity before January, 31, 2009</td></tr>
<tr><td>Source of data used:</td><td>Production record</td></tr>
<tr><td>Value applied:</td><td><table><tr><td rowspan="2">Fab</td><td colspan="3">Glass input(m2)</td></tr><tr><td>'06</td><td>'07</td><td>'08</td></tr><tr><td>P2/3</td><td>1,248,918</td><td>1,388,752</td><td>1,354,599</td></tr><tr><td>P4/5</td><td>3,477,234</td><td>4,196,473</td><td>4,551,720</td></tr><tr><td>P6</td><td>4,078,800</td><td>5,252,354</td><td>5,680,338</td></tr><tr><td>P7</td><td>2,438,002</td><td>6,020,234</td><td>7,559,469</td></tr><tr><td>total or average</td><td>11,242,954</td><td>16,857,813</td><td>19,146,126</td></tr></table></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures actually applied :</td><td>These are the recorded values from production management teams of each plant.</td></tr>
<tr><td>Any comment:</td><td>Data is arranged from February through January (i.e.‘06=Feb ‘06-Jan ’07)</td></tr>
</table>

Data / Parameter:	**Maintenance schedule for abatement device**
Data unit:	List of maintenance requirements
Description:	Complete maintenance schedule for the device
Source of data used:	Manufacturers specifications
Value applied:	A summary of this information is described in Attachment 2.l. .
Justification of the choice of data or description of measurement methods and procedures actually applied :	The manufacturer provides clear instructions on the schedule for proper maintenance.
Any comment:	

Data / Parameter:	**Maintenance schedule for FTIR measurement devices**
Data unit:	List of maintenance requirements
Description:	Complete maintenance schedule for the device
Source of data used:	The FTIR manufacturer's specifications.
Value applied:	A summary of this information is described in Attachment 4.1.
Justification of the choice of data or description of measurement methods and procedures actually applied :	The manufacturer of the FTIR offers clear maintenance specifications.
Any comment:	

Data / Parameter:	**Maintenance schedule for QMS measurement devices**
Data unit:	List of maintenance requirements
Description:	Complete maintenance schedule for the device
Source of data used:	The QMS manufacturer's specifications.
Value applied:	A summary of this information is described in Attachment 5.1.
Justification of the choice of data or description of measurement methods and procedures actually applied :	The manufacturer of the QMS offers clear maintenance specifications.
Any comment:	

Data / Parameter:	**Maintenance schedule for Annubar devices**
Data unit:	List of maintenance requirements and time between manual cleanup
Description:	Complete maintenance schedule for the Annubar devices
Source of data used:	Manufacturers specifications
Value applied:	A summary of this information is described in Attachment 3.1.
Justification of the choice of data or	The manufacturer provides clear instructions on the schedule for proper maintenance.

description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	$EF_{grid,CM,y}$
Data unit:	tCO_2/MWh
Description:	Combined margin CO_2 emission factor for grid connected power generation using ex-ante option of three most recent years of available data for the OM and the most recent information available at the time of submission for validation to the DOE for BM.
Source of data used:	Values have been calculated using the **"Tool to calculate the emission factor for an electricity system v.2" (see annex 3)**
Value applied:	0.5708 TCO2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	**This figure is calculated using the "Tool to calculate the emission factor for an electricity system v.2" and data taken from the most recent publication of key Data from KEPCO in Korea**
Any comment:	As per the **"Tool to calculate the emission factor for an electricity system v.2"**

Data / Parameter:	$\mathbf{C_{p.in}}$
Data unit:	dimensionless
Description:	Pitot tubes or Averaging Pitot Tube coefficient of the inlet Annubar device
Source of data used:	Annubar device manufacturer specification
Value applied:	1
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value has been provided by manufacturer.
Any comment:	This value has been applied to the device installed in P6. values of other devices to be installed in other plants will be same and it has been confirmed by the manufacturer. Those values can be verified at the first verification.

Data / Parameter:	$\mathbf{C_{p.out}}$
Data unit:	dimensionless
Description:	Pitot tubes or Averaging Pitot Tube coefficient of the outlet annubar device
Source of data used:	Annubar device manufacturer specification

Value applied:	1
Justification of the choice of data or description of measurement methods and procedures actually applied :	This value has been provided by manufacturer.
Any comment:	This value has been applied to the device installed in P6. values of other devices to be installed in other plants will be same and it has been confirmed by the manufacturer. Those values can be verified at the first verification.

Data / Parameter:	**Cross sectional area of the inlet stack (A_{in})**
Data unit:	m^2
Description:	The cross sectional of the circular inlet stack, which should be greater than 0.3 m in diameter.
Source of data used:	Based on engineering design.
Value applied:	0.0961625 (0.175m * 0.175m*3.14)
Justification of the choice of data or description of measurement methods and procedures actually applied :	A technical drawing of the equipment has been provided to the validator with this value.
Any comment:	Diameter of inlet stack is 0.35m This value has been applied to the inlet stack installed in P6. For However, values of inlet stacks to be installed in other plants, which are not invested yet, will be verified at the first verification.

Data / Parameter:	**Cross sectional area of the outlet stack (A_{out})**
Data unit:	m^2
Description:	The cross sectional of the circular outlet stack, which should be greater than 0.3 m in diameter.
Source of data used:	Based on engineering design.
Value applied:	0.2826 (0.3m * 0.3m*3.14)
Justification of the choice of data or description of measurement methods and procedures actually applied :	A technical drawing of the equipment has been provided to the validator with this value.
Any comment:	Diameter of outlet stack is 0.6m This value has been applied to the outlet stack installed in P6. For However, values of outlet stacks to be installed in other plants, which are not invested yet, will be verified at the first verification

B.6.3 Ex-ante calculation of emission reductions:

Estimated Annual Baseline Emissions

$$BE_{in,y} = k \cdot E_{SF6,y} \cdot GWP_{SF6} \qquad \textbf{EQ1}$$

This would yield the following baseline emissions:

Facility	SF6 Entering Abatement Device tonnes in year y - $E_{SF6.y}$	k	TSF6 GWP Tonnes CO2 /Tonne SF6	TCO2eq emissions tonnes $BE_{in,y}$
P2/3	4.58	1.000	23,900	109,499.91
P4/5	15.85	1.000	23,900	378,695.79
P6	23.30	1.000	23,900	556,980.12
P7	23.55	1.000	23,900	562,780.40
Total Baseline Emissions	**67.28**			1,607,956.22

where

$$E_{SF6,y} = \min\{E_{SF6,in,y}; 0.48 \times C_{SF6,y}; 0.48 \times C_{SF6,hist}\} \qquad \textbf{EQ2}$$

Facility	$E_{SF6,in,y}$ (Assuming default SF6 etch utilization efficiency of 70% and Heel 10% from expected purchase level (See IPCC Tier 2b emission factor)	0.48 x $C_{SF6,y}$	$C_{SF6,y}$	0.48 x $C_{SF6,hist}$	$C_{SF6,hist}$	$E_{SF6,y}$
P2/3	4.58	8.15	16.97	9.97	20.78	4.58
P4/5	15.85	28.17	58.69	29.35	61.16	15.85
P6	23.30	41.43	86.31	36.59	76.23	23.30
P7	23.55	41.86	87.21	47.26	98.45	23.55

Where

$$k = \begin{cases} 1 & ; SF_{6,ratio} \geq C_{SF6,y} \div SP_{project\cdot y} \\ \dfrac{SF_{6,ratio}}{C_{SF6,y} \div SP_{project\cdot y}} & ; SF_{6,ratio} < C_{SF_6,y} \div SP_{project\cdot y} \end{cases} \quad (4)$$

And

$$SF_{6,ratio} = \min\left(C_{SF6,-1} \div SP_{-1}; C_{SF6,-2} \div SP_{-2}; C_{SF6,-3} \div SP_{-3}\right) \quad (3)$$

Fab	C_{SF6}				SP			
	'06 (-3)	'07 (-2)	'08 (-1)	'09 (1)	'06 (-3)	'07 (-2)	'08 (-1)	09 (1)
P2/3	18,450	20,781	19,530	16,969	1,248,918	1,388,752	1,354,599	1,176,957
P4/5	45,090	56,610	61,155	58,685	3,477,234	4,196,473	4,551,720	4,525,666
P6	55,024	73,990	76,226	86,313	4,078,800	5,252,354	5,680,338	6,432,045
P7	24,371	70,092	98,453	87,212	2,438,002	6,020,234	7,559,469	8,724,449
total or average	142,935	221,473	255,364	**249,180**	11,242,954	16,857,813	19,146,126	**20,859,117**

Fab	$SF_{6,ratio}$ (Tonnes/m2) -3	$SF_{6,ratio}$ (Tonnes/m2) -2	$SF_{6,ratio}$ (Tonnes/m2) -1	$C_{sf6,y}$ ÷, $SP_{project,y}$ (Tonnes/m2) y	$SF_{6,ratio}$ (Tonnes/m2) minimum (-3,-2,-1)	k
P2/3	0.0000148	0.0000150	0.0000144	0.0000144	0.0000144	1.00000
P4/5	0.0000130	0.0000135	0.0000134	0.0000130	0.0000130	1.00000
P6	0.0000135	0.0000141	0.0000134	0.0000134	0.0000134	1.00000
P7	0.0000100	0.0000116	0.0000130	0.0000100	0.0000100	1.00000

Summary of the Calculation/Source of key Parameters used to calculate the mass of SF6 entering and exiting the abatement device

The calculations of key parameters used to calculate the mass of SF6 entering and exiting the abatement device are not included in the above estimation of $E_{SF6,in,y}$ and $E_{SF6,out,y}$. Instead, in the Baseline Emission calculation, $E_{SF6,in,y}$ is estimated by assuming default SF6 etch utilization efficiency of 70% and Heel 10% from expected purchase level (See IPCC Tier 2b emission factor) and, in the Project Emission calculation, $E_{SF6,out,y}$ is calculated using an estimated DRE of 90% which is the IPCC default.

During the Monitoring activities, actual measured data will be collected and exact values of $E_{SF6,in,y}$ and $E_{SF6,out,y}$ will be calculated by following equations as per AM0078 specified.

$$M_{d,in} = 1.460[SF_{6in}] + 0.44[CO_{2in}] + 0.399[Ar_{in}] + 0.320[O_{2in}] + 0.280[N_{2in}] \quad \textbf{(6)}$$

Where:

$M_{d,in}$	=	Total inlet stack gas dry molecular weight (gram/mole)
SF_{6in}, …. N_{2in}	=	Average relative concentration of the gases (mass fraction in percentage)

$$\begin{aligned} M_{d,out} = & 1.460[SF_{6out}] + 0.399[Ar_{out}] + 0.320[O_{2out}] + 0.280[N_{2out}] + 0.28[CO_{out}] \\ & + 0.44[CO_{2in}] + 0.380[F_{2out}] + 0.200[HF_{out}] + 0.641[SO_{2out}] + 0.861[SOF_{2out}] \\ & + 1.021[SO_2F_{2out}] \end{aligned} \quad \textbf{(7)}$$

Where:

$M_{d,out}$	=	Total outlet stack gas dry molecular weight (gram/mole)
SF_{6out}, …. SO_2F_{2out}	=	Average relative concentration of the gases (mass fraction in percentage)

$$M_{s,in} = M_{d,in} \cdot (100 - B_{ws,in}) \div 100 + 0.18 \cdot B_{ws,in} \quad \textbf{(8)}$$

$$M_{s,out} = M_{d,out} \cdot (100 - B_{ws,out}) \div 100 + 0.18 \cdot B_{ws,out} \quad \textbf{(9)}$$

Where:

$M_{d,in}$ and $M_{d,out}$	=	Total molecular weights of the inlet and outlet stack gases, dry basis (gram/mole)
$B_{ws,in}$ and $B_{ws,out}$	=	Water vapor in the inlet and outlet gas streams. (Percentage volume fraction)

$$v_{s,in} = K_p \cdot C_{p,in} \sqrt{p_{avg,in}} \sqrt{\frac{T_{s,in}}{P_{s,in} \cdot M_{s,in}}} \quad \textbf{(10)}$$

$$v_{s,out} = K_p \cdot C_{p,out} \sqrt{p_{avg,out}} \sqrt{\frac{T_{s,out}}{P_{s,out} \cdot M_{s,out}}} \quad \textbf{(11)}$$

Where:

$v_{s,in}$ and $v_{s,out}$	=	Average inlet and outlet stack gas velocities (m/sec)
K_p	=	Velocity equation constant (=34.97)
$C_{p,in}$ and $C_{p,out}$	=	Inlet and outlet annubar device coefficients
$p_{avg,in}$ and $.p_{avg,in}$	=	Average inlet and outlet velocity head measurements b, measured across the annubar device (mmH_2O)
$T_{s,in}$ and $T_{s,out}$	=	Absolute inlet and outlet stack temperatures (K)
$P_{s,in}$ and $P_{s,out}$	=	Absolute inlet and outlet stack pressures (mmHg)
$M_{s,in}$ and $M_{s,out}$	=	Stack gas molecular weights at the inlet and outlet of the abatement system

$$Q_{in} = \{(100 - B_{ws,in}) \div 100\} v_{s,in} A_{in} \left[\frac{T_{std} P_{s,in}}{T_{s,in} P_{std}} \right] \qquad \textbf{(12)}$$

$$Q_{out} = \{(100 - B_{ws,out}) \div 100\} v_{s,out} A_{out} \left[\frac{T_{std} P_{s,out}}{T_{s,out} P_{std}} \right] \qquad \textbf{(13)}$$

Where:

A_{in} and A_{out}	=	Cross-sectional areas of the inlet and outlet stacks (m^2)
T_{std}	=	Standard absolute temperature (293°K)
P_{std}	=	Standard absolute pressure (760 mm Hg)

$$E_{SF6in} = 65.18 Q_{in} [SF_{6in}] \qquad \textbf{(14)}$$

$$E_{SF6out} = 65.18 Q_{out} [SF_{6out}] \qquad \textbf{(15)}$$

Where:

SF_{6in} and SF_{6iout}	=	Concentration of SF_6 at the inlet and outlet (ppm)
Q_{in} and Q_{out}	=	Inlet and Outlet volumetric flow rate (m^3/sec)

Project Emissions

$$PE_y = BE_y (1 - DRE_y) + C_{CO2,y} \qquad \textbf{(17)}$$

Fab	BE_{2009} (1-.DRE_{2009}) (Tonnes CO2E) Estimated DRE of 90% which is the IPCC default	$C_{CO2,y}$ emission	PE
P2/3	10,949.99		

		12,853.93	23,803.92
P4/5	37,869.58	29,093.99	66,963.57
P6	55,698.01	7,195.53	62,893.54
P7	56,278.04	10,559.38	66,837.42
total or average	**160,795.62**	59,702.83	220,498.45

Where:
A combined margin (CM) has been calculated by referring "Tool to calculate the emission factor for an electricity system v.2" and the calculation is as follows (note all data referenced in this calculation is taken from the most recent (2003~2007) **annual electricity statistics issued by KEPCO. The official web site of KEPCO** (http://cyber.kepco.co.kr/kepco_new/eng/ir/resource/powerStatistics.jsp?gubun=K) **provides all data used hereunder**):

STEP 1. Identify the relevant electricity systems
The electricity from the project activities is connected to KEPCO grid, which is the only one in Korea and so relevant electric power system is KEPCO grid.

STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional)
As the host country, Republic of Korea, has an reliable and stable electricity grid, "option I: only grid power plants are included in the calculation" is applied.

STEP 3. Select a method to determine the Operating Margin (OM)
As described in "Tool to calculate the emission factor for an electricity system v.2", the OM emission factor is calculated as the generation-weighed emissions per electricity unit of all generating units serving the system, excluding low-operating cost and must-run power plants. Low-operating cost and must run power plants include hydro, nuclear, low cost biomass, geothermal and domestic coal.

Operating Margin emission factor ($EF_{grid,OM,simple,y}$) shall be calculated basis on one of the four following methods:

- *Option* (a) Simple OM
- *Option* (b) Simple adjusted OM
- *Option* (c) Dispatch Data Analysis OM
- *Option* (d) Average OM

If low-cost/must-run resources constitute less than 50% of total grid generation in average of the five most recent years, simple OM can be chosen. Referring to the net electricity generation rate by energy sources of the host country (Republic of Korea), the rate of low cost/must run power generation does not exceed 50% of the total grid. Actually, the most recent 5-year (2003~2007) average data shows that the rate of low cost/must run is 40.13%. (Source: KEPCO)

Therefore, for this project case, "Option (a) Simple OM" is available.

Table CM-1 The yearly proportion of the electricity generation based on the source of energy in Korea (Unit: million kWh)

Year	Low cost/must run				Total grid generation	Low cost/must run ratio
	Hydro	Nuclear	Alternative*	Subtotal		
2003	6,830,016	123,280,502	275,716	130,386,234	308,225,887	42.30%
2004	5,802,167	123,970,409	350,180	130,122,756	326,879,672	39.81%
2005	5,135,032	139,286,513	403,583	144,825,128	348,187,780	41.59%
2006	5,144,992	142,114,439	510,689	147,770,120	365,368,969	40.44%
2007	4 ,973,848	136,599,046	830,284	137,429,330	386,510,193	35.56%
Average of five recent years	5,728,052	133,050,182	474,090	139,252,324	347,034,500	40.13%

*Alternative - Geothermal, Wind, Low-cost biomass, Solar and LFG

STEP 4. Calculate the operating margin emission factor according to the selected method.
According to the "Tool to calculate the emission factor for an electricity system v.2", the Simple OM emission factor is calculated as the generation-weighted average emissions per electricity unit (tCO2/MWh) of all generating power plants serving the system, not including low-operating cost and must-run power plants based on the two following options:

- Option A: Based on the net electricity generation and a CO_2 emission factor of each power unit, or
- Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system

As the necessary data on the net electricity generation and a CO_2 emission factor of each power unit is available in Korea, the proposed project can employ Option A.

Where Option A is used, the simple OM emission factor is calculated as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (1)$$

$EF_{grid,OMsimple,y}$	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{,m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type i in year y (GJ / mass or volume unit)
$EF_{ELm,y}$	CO_2 emission factor of power unit m in year y (tCO_2/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

And $EF_{EL,m,y}$ is calculated based on the two following options:

• Option A1:

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

Where:

$EF_{ELm,y}$	CO_2 emission factor of power unit m in year y (tCO_2/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)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type i in year y (tCO_2/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 power units
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

• Option A2:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \cdot 3.6}{\eta_{m,y}}$$

Where:

$EF_{ELm,y}$	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
$EF_{CO2,m,,i,y}$	Average CO_2 emission factor of fuel type I used in power unit m in year y (tCO_2/GJ)
$\eta_{m,y}$	Average net energy conversion efficiency of power unit m in year y (ratio)
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

As the necessary data specified in opton A1 is available in Korea, the proposed project can employ Option A1.

In the case of this project, the applied values of $EF_{CO2,i,y}$ are based on using conversion factor suggested in the 2006 IPCC Guidelines, and those of $NCV_{i,y}$ and $FC_{i,m,y}$ are country-specific.
As a result, the OM emission factor ($EF_{grid,OM,simple,y}$) is 0.7256 (tCO_2/MWh).

STEP 5. Identify the group of power units to be included in the build margin
The sample group of power units m used to calculate the build margin consists of either;

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

Project participants should use the set of power units that comprises the larger annual generation. For this project case, the group (b) comprises the lager annual generation, and it is estimated as <Table CM-2> according to each

regulation to compose proper sample group(*m*), considering the electricity quantity of candidate sample groups and the ratio to total generation in Korea.

	2007 Net Generation (MWh)	Percentage of System
Grid total	386,510,193	100%
Sample Group m five plants	252,253	0.07%
Sample group m- 20% plants	85,176,017	22.04%

The annual generation of "the set of five power units that have been built most recently" was 252,253 MWh (0.07% of total generation of the grid system), and the annual generation of "the set of power capacity additions in the electricity system that comprise 22.04% of the system generation and that have been built most recently" was 85,176,017 MWh. Therefore, the latter was chosen for this project as a lager figure than the other one.

In terms of vintage of data, project participants can choose between one of the following tow options:

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.

For this project case, *Option* 1 is taken to calculate the Build Margin emission factor, $EF_{grid,BM,y}$ *ex-ante*.

STEP 6. Calculate the build margin emission factor

According to the "Tool to calculate the emission factors for electricity system (Version 02)", 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, calculate as follows:

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

where :

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in

	year y (MWh)
$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
m	Power units included in the build margin
y	Most recent historical year for which power generation data is available

According to the BM calculation formula and variables of above tables, $EF_{grid,BM,y}$ is 0.4161 tCO_2e/MWh

STEP 7. Calculate the combined margin emissions factor

Based on the results derived from Steps, $EF_{grid,CM,y}$ has been calculated using the following formula:

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

Where:

$EF_{grid,BM,y}$	Build margin CO2 emission factor in year y (tCO2/MWh)
$EF_{grid,OM,y}$	Operating margin CO2 emission factor in year y (tCO2/MWh)
w_{OM}	Weighting of operating margin emissions factor (50% default)
w_{BM}	Weighting of build margin emissions factor (50% default)

Therefore baseline emission factor ($EF_{grid,CM,y}$) for this project is = 0.5708 (tCO_2/MWh.) as follows :

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

= 0.5 · 0.7256(tCO_2/MWh) + 0.5 · 0.4161 (tCO_2/MWh)

= 0.5708 (tCO_2/MWh) of 0.0005708 (tCO2/kwh)

Fab	Average Electricity consumption in (kw)	hours per year	tCO2/kwh	$tCO2_y$(electricity)
P2/3	986.17	8760	0.0005708	4,931.05
P4/5	2,232.13	8760	0.0005708	11,161.10
P6	552.05	8760	0.0005708	2,760.36
P7	810.13	8760	0.0005708	4,050.81

Equation #1 and #3 From the 'Tool to calculate project or leakage CO2 emissions from fossil fuel combustion' Option A is selected and FC is measured as a volume (m3). The variable 'i' only corresponds to one fuel-LNG.

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y} \quad (1)$$

If $FC_{i,j,y}$ is measured in a volume unit: $COEF_{i,y} = w_{C,i,y} \times \rho_{i,y} \times 44/12 \quad (3)$

Fab	$w_{C,i,y}$ (tC/t LNG)	**$FC_{i,j,y}$** volume unit per year of LNG consumed by abatement device (m^3/yr)	$\rho_{i,y}$ (t LNG/ m3 LNG)	tCO_2/tC	$tCO2_y$(LNG)
P2/3	0.754	3,599,194	0.0007955	3.67	7,922.88

P4/5	0.754	8,146,529	0.0007955	3.67	17,932.89
P6	0.754	2,014,800	0.0007955	3.67	4,435.16
P7	0.754	2,956,703	0.0007955	3.67	6,508.57

(Source: Manufacturer's specification and Korea Gas Corporation)

Where $C_{CO2\ y}$, equals $tCO2_{electricity,y}$ + $tCO2_{LNG,y}$

Fab	$tCO2_y$(electricity)	$tCO2_y$(LNG)	Total $C_{CO2,y}$ emission
P2/3	4,931.05	7,922.88	12,853.93
P4/5	11,161.10	17,932.89	29,093.99
P6	2,760.36	4,435.16	7,195.53
P7	4,050.81	6,508.57	10,559.38

Year	**Total Baseline Emissions**	**Total Project Emissions TCO2**	**TCO2eq emissions Reductions**
Year 1 (April, 1, 2010 ~ March, 31, 2011)	556,980	62,893	**494,087**
Year 2 (April, 1, 2011 ~ March, 31, 2012)	1,607,956	220,498	**1,387,458**
Year 3 (April, 1, 2012 ~ March, 31, 2013)	1,607,956	220,498	**1,387,458**
Year 4 (April, 1, 2013 ~ March, 31, 2014)	1,607,956	220,498	**1,387,458**
Year 5 (April, 1, 2014 ~ March, 31, 2015)	1,607,956	220,498	**1,387,458**
Year 6 (April, 1, 2015 ~ March, 31, 2016)	1,607,956	220,498	**1,387,458**
Year 7 (April, 1, 2016 ~ March, 31, 2017)	1,607,956	220,498	**1,387,458**
Year 8 (April, 1, 2017 ~ March, 31, 2018)	1,607,956	220,498	**1,387,458**
Year 9 (April, 1, 2018 ~ March, 31, 2019)	1,607,956	220,498	**1,387,458**
Year 10 (April, 1, 2019 ~ March, 31, 2020)	1,607,956	220,498	**1,387,458**
Total	15,028,584	2,047,375	**12,981,209**

Values for year one are based on expected consumption and production patterns including market expectations and historical trends. Specifically, LGD set up a 2009 Business Plan of total production quantity based on clients' advanced order that forms the base of these projections. Years 2-10 are simply assuming similar values to year 1 for each additional year. According to the report issued by Display Search and LGD's Investors Relations Report, LGD has been keeping its production level steady even in the recent global financial crisis. Considering the fact that other LCD manufacturers in Japan and Taiwan have hard times because of global economy slump, increasing of LGD's market share is easily expected. But project participants did not consider aforementioned factors in the calculation to ensure a conservative approach. Although annual LCD production of LGD and market demand are continually increasing, (Source: Quarterly Worldwide Flat Panel Forecast Report issued by Display Search, www.displaysearch.com) project participants do not consider these factors for a more conservative approach. Considering market expectation and LGD's market share and production trend, it is more plausible that annual LCD production of LGD will be increased during the crediting period. However, for conservative approach, project participants simply assumed that the LCD production would not change. SF6 consumption is proportional to LCD production. Therefore, project participants assumed that the SF6 consumption also would not change during the crediting period. Project participants expected that the efficiency (DRE) and energy consumption of abatement system would not change during the crediting period as project participants have elaborated and periodic maintenance plans. And also all factors related to efficiency and energy use are included in

manufacturer's performance guarantee. In this regards, project participants assumed the annual project emission would not change during the crediting period.

For Year 1, the abatement system in P6 alone will be operational and the other facilities will be under construction. After Year 1, all systems will be fully operational.

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

Year	Estimation of project activity emission (tonnes of CO2e)	Estimation of baseline emission (tonnes of CO2 e)	Estimated Leakage (tonnes of CO2 e)	Estimation of emission reductions (tonnes of CO2 e)
Year 1 (April, 1, 2010 ~ March, 31, 2011)	62,893	**556,980**	0	**494,087**
Year 2 (April, 1, 2011 ~ March, 31, 2012)	220,498	**1,607,956**	0	**1,387,458**
Year 3 (April, 1, 2012 ~ March, 31, 2013)	220,498	**1,607,956**	0	**1,387,458**
Year 4 (April, 1, 2013 ~ March, 31, 2014)	220,498	**1,607,956**	0	**1,387,458**
Year 5 (April, 1, 2014 ~ March, 31, 2015)	220,498	**1,607,956**	0	**1,387,458**
Year 6 (April, 1, 2015 ~ March, 31, 2016)	220,498	**1,607,956**	0	**1,387,458**
Year 7 (April, 1, 2016 ~ March, 31, 2017)	220,498	**1,607,956**	0	**1,387,458**
Year 8 (April, 1, 2017 ~ March, 31, 2018)	220,498	**1,607,956**	0	**1,387,458**
Year 9 (April, 1, 2018 ~ March, 31, 2019)	220,498	**1,607,956**	0	**1,387,458**
Year 10 (April, 1, 2019 ~ March, 31, 2020)	220,498	**1,607,956**	0	**1,387,458**
Total (tones of CO2 e)	2,047,375	**15,028,584**	0	**12,981,209**

For Year 1, the abatement system in P6 alone will be operational and the other facilities will be under construction. After Year 1, all systems will be fully operational.

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$E_{SF6,in,y}$

Data unit:	tonnes
Description:	Mass of SF_6 gas entering the abatement device in year *y*
Source of data to be used:	From inlet FTIR and inlet Annubar devices
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Each of the ten project years is expected to be roughly the same **Plant** / ESF6,in,y (Assuming default SF6 etch utilization efficiency of 70% and Heel 10% from expected purchase level (See IPCC Tier 2b emission factor) P2/3: 4.58 P4/5: 15.85 P6: 23.30 P7: 23.55
Description of measurement methods and procedures to be applied:	To convert the concentration of SF_6 measured at the inlet of the abatement system into the mass of SF_6 entering the abatement system, the project developer will use the conservative measurement of the inlet gas molecular weight, and calculate the inlet gas flow from the measurement of the inlet gas velocity. This calculation will be done automatically by the control system and will provide the data unit as described above to be recorded on a continuous basis
QA/QC procedures to be applied:	All of the manufacturer's maintenance and calibration procedures and timetables will be followed
Any comment:	This data will be monitored annually.

Plant	ESF6,in,y (Assuming default SF6 etch utilization efficiency of 70% and Heel 10% from expected purchase level (See IPCC Tier 2b emission factor)
P2/3	4.58
P4/5	15.85
P6	23.30
P7	23.55

Data / Parameter:	$C_{SF6,y}$
Data unit:	Tonnes
Description:	Annual consumption of SF_6 during the project year *y*, defined as the total SF_6 purchased in a specific project year *y* taking into account the change in inventory in the same year.
Source of data to be used:	Records of purchases and inventory taking into account 10% heel value which is based on the IPCC default.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	(see table below)
Description of measurement methods and procedures to be applied:	Taken from purchase records and inventory records Annual consumption of SF6 in 2009 was calculated from production of LCD substrate in 2009 taking into account minimum ratio of $SF_{6\ ratio}$

Fab	C_{SF6}			
	'06 (-3)	'07 (-2)	'08 (-1)	09 (1)
P2/3	18,450	20,781	19,530	16,969
P4/5	45,090	56,610	61,155	58,685
P6	55,024	73,990	76,226	86,313
P7	24,371	70,092	98,453	87,212
total or average	142,935	221,473	255,364	**249,180**

QA/QC procedures to be applied:	Cross check with official purchase records. Inventory data is measured and recorded at the beginning and end of each year. Residual gas quantity (Heel value) is measured and recorded every replacement.
Any comment:	This data will be monitored annually.

Data / Parameter:	$SP_{project,y}$
Data unit:	m^2
Description:	Production of LCD substrate during the project year *y*
Source of data to be used:	Records of production
Value of data applied for the purpose of calculating expected emission reductions in section B.5	(see table below)
Description of measurement methods and procedures to be applied:	Calculate from production records. Production of LCD substrate in 2009 comes from LGD's Business Plan in 2009 based on clients' advanced order.
QA/QC procedures to be applied:	Cross check with LGD's mothly & annual production summary reports
Any comment:	This data will be monitored annually.

Fab	SP			
	'06 (-3)	'07 (-2)	'08 (-1)	'09 (1)
P2/3	1,248,918	1,388,752	1,354,599	1,176,957
P4/5	3,477,234	4,196,473	4,551,720	4,525,666
P6	4,078,800	5,252,354	5,680,338	6,432,045
P7	2,438,002	6,020,234	7,559,469	8,724,449
total or average	11,242,954	16,857,813	19,146,126	**20,859,117**

Data / Parameter:	$E_{SF6,in}$
Data unit:	Gram / second
Description:	Emissions of SF_6 gas measured at the inlet of the SF_6 abatement system
Source of data to be used:	From inlet QMS, FTIR and inlet Annubar devices
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**$E_{SF6,in}$** **(Assuming default SF6 etch utilization efficiency of 70% and Heel 10% from expected purchase level (See IPCC Tier 2b emission factor) and 365 days of operation per year) Note: These values are test results, these are not used in the ER calculation.** P2/3: 0.15 P4/5: 0.50 P6 : 0.74 P7 : 0.75
Description of	Calculated by multiplying the volumetric total flow rate by the concentration of

measurement methods and procedures to be applied:	SF_6 at the inlet (in %) and by the SF_6 molar mass to molar volume ratio (6,518 gram / standard cubic meter).
QA/QC procedures to be applied:	All of the manufacturer's maintenance and calibration procedures and timetables will be followed.
Any comment:	This data will be monitored continuously.

Data / Parameter:	$E_{SF6,out}$
Data unit:	gram/second
Description:	Emissions of SF_6 gas measured at the outlet of the SF_6 abatement system
Source of data to be used:	From outlet FTIR and outlet Annubar devices
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**$E_{SF6,out}$** Estimated DRE of 90% which is the IPCC default P2/3: 0.015 P4/5: 0.050 P6: 0.074 P7: 0.075
Description of measurement methods and procedures to be applied:	Calculated by multiplying the volumetric total flow rate by the concentration of SF_6 at the outlet (in %) and by the SF_6 molar mass to molar volume ratio (6,518 gram / standard cubic meter)
QA/QC procedures to be applied:	All of the manufacturer's maintenance and calibration procedures and timetables will be followed.
Any comment:	This data will be monitored continuously.

Data / Parameter:	**$M_{s.in}$**
Data unit:	g/mole
Description:	Maximum molecular weight of inlet stack gas, wet basis
Source of data to be used:	QMS
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not included in the estimate of $E_{SF6,in,y}$. Instead, $E_{SF6,in,y}$ was estimated by assuming default SF6 etch utilization efficiency of 70% and Heel 10% from expected purchase level (See IPCC Tier 2b emission factor).
Description of measurement methods and procedures to be applied:	Equation 8 in AM0078: $M_{s,in} = M_{d,in} \cdot (100 - B_{ws,in}) \div 100 + 0.18 B_{ws,in}$
QA/QC procedures to be applied:	The measured concentrations and the calibration curves of all substances detected at the inlet in concentration greater than 100ppmv will be documented and kept as part of the records for verification purposes. Note in case the variance of this parameter is greater than 5% then this methodology will not apply to the project. To be clear the minimum and maximum recorded value should not vary by more than 5% of the mean.
Any comment	This data will be monitored once per year.

Data / Parameter:	**$M_{s.out}$**
Data unit:	g/mole
Description:	Minimum molecular weight of outlet stack gas, wet basis
Source of data to be used:	QMS
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not included in the estimate of $E_{SF6,out,y}$. Instead, $E_{SF6,out,y}$ was estimated using an estimated DRE of 90% which is the IPCC default.
Description of measurement methods and procedures to be applied:	Equation 9 in AM0078: $M_{s,out} = M_{d,out} \cdot (100 - B_{ws,out}) \div 100 + 0.18 B_{ws,out}$
QA/QC procedures to be applied:	The measured concentrations and the calibration curves of all substances detected at the outlet in concentration greater than 100ppmv will be documented and kept as part of the records for verification purposes. Note in case the variance of this parameter is greater than 5% then this methodology will not apply to the project. To be clear the minimum and maximum recorded value should not vary by more than 5% of the mean.
Any comment	This data will be monitored once per year.

Data / Parameter:	$M_{d,in}$
Data unit:	Gram / mole
Description:	Molecular weight of inlet stack gas (dry basis)
Source of data to be used:	QMS data
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not included in the estimate of $E_{SF6,in,y}$. Instead, $E_{SF6,in,y}$ was estimated by assuming default SF6 etch utilization efficiency of 70% and Heel 10% from expected purchase level (See IPCC Tier 2b emission factor).
Description of measurement methods and procedures to be applied:	Quantifying the averaged relative concentrations of SF_6, Ar, O_2, CO_2 and N_2 measured by the QMS (as per US EPA Method 2 and 3 section 12.0) at the inlet of the abatement system during normal production conditions. $M_{d,in}$ shall be defined as the highest value of the gas mass density / molecular weight measured at the inlet during the 6 hours period, using equation 6 from AM0078.
QA/QC procedures to be applied:	Equipment must be calibrated according to manufacturer's specifications
Any comment:	Equation 6 $M_{d,in} = 1.460[SF_{6in}] + 0.44[CO_{2in}] + 0.399[Ar_{in}] + 0.320[O_{2in}] + 0.280[N_{2in}]$ This data will be monitored once per year.

Data / Parameter:	$M_{d,out}$
Data unit:	Gram / mole

Description:	Molecular weight of outlet stack gas (dry basis)
Source of data to be used:	QMS data
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not included in the estimate of $E_{SF6,out,y}$. Instead, $E_{SF6,out,y}$ was estimated using an estimated DRE of 90% which is the IPCC default.
Description of measurement methods and procedures to be applied:	Quantifying the averaged relative concentrations of SF_6, Ar, O_2, N_2, CO, CO_2, F_2, HF, SO_2, SOF_2, and SO_2F_2 measured by the QMS (as per US EPA Method 2 and 3 section 12.0) at the outlet of the abatement system during normal production conditions. $M_{d,out}$ shall be defined as the lowest value of the gas mass density / molecular weight measured at the inlet during the 6 hours period, using equation 7 from AM0078.
QA/QC procedures to be applied:	Equipment must be calibrated according to manufacturer's specifications
Any comment:	Equation 7 $M_{d,out} = 1.460[SF_{6out}] + 0.399[Ar_{out}] + 0.320[O_{2out}] + 0.280[N_{2out}] + 0.28[CO_{out}] + 0.44[CO_{2in}] + 0.380[F_{2out}] + 0.200[HF_{out}] + 0.641[SO_{2out}] + 0.861[SOF_{2out}] + 1.021[SO_2F_{2out}]$ This data will be monitored once per year.

Data / Parameter:	$B_{ws,in}$
Data unit:	dimensionless (percentage volume fraction)
Description:	The proportion of water in the inlet gas stream measured using EPA method 4, and used to calculate the inlet gas molecular weight.
Source of data to be used:	EPA Method 4, as determined by measurement of volume or mass.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not included in the estimate of $E_{SF6,in,y}$. Instead, $E_{SF6,in,y}$ was estimated by assuming default SF6 etch utilization efficiency of 70% and Heel 10% from expected purchase level (See IPCC Tier 2b emission factor).
Description of measurement methods and procedures to be applied:	This measurement will be done for a minimum of 6 hours during normal manufacturing conditions. The averaged proportion of water during the 6 hours period will be used to calculate the inlet gas stream density.
QA/QC procedures to be applied:	As per Annex 1.a. of methodology
Any comment:	This data will be monitored once per year.

Data / Parameter:	$B_{ws,out}$
Data unit:	dimensionless (percentage volume fraction)
Description:	The proportion of water in the outlet gas stream measured using EPA method 4, and used to calculate the outlet gas molecular weight.
Source of data to be used:	EPA Method 4, as determined by measurement of volume or mass.

Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not included in the estimate of $E_{SF6,out,y}$. Instead, $E_{SF6,out,y}$ was calculated using an estimated DRE of 90% which is the IPCC default.
Description of measurement methods and procedures to be applied:	This measurement will be done for a minimum of 6 hours during normal manufacturing conditions. The averaged proportion of water during the 6 hours period will be used to calculate the inlet gas stream density.
QA/QC procedures to be applied:	As per Annex 1.a. of methodology
Any comment:	This data will be monitored once per year.

Data / Parameter:	Absolute inlet stack pressure ($P_{s,in}$)
Data unit:	mmHg
Description:	The inlet stack pressure measured during manufacturing operations
Source of data to be used:	Pressure gauge
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not included in the estimate of $E_{SF6,in,y}$. Instead, $E_{SF6,in,y}$ was estimated by assuming default SF6 etch utilization efficiency of 70% and Heel 10% from expected purchase level (See IPCC Tier 2b emission factor). .
Description of measurement methods and procedures to be applied:	EPA method 2 or similar nationally- or internationally-recognized standard.
QA/QC procedures to be applied:	See EPA method 2 or similar nationally- or internationally-recognized standard; The inlet pressure gauge will be calibrated and maintained per the manufacturer's instructions.
Any comment:	This data will be monitored continuously.

Data / Parameter:	Absolute outlet stack pressure ($P_{s,out}$)
Data unit:	mmHg
Description:	The outlet stack pressure measured during manufacturing operations
Source of data to be used:	Pressure gauge
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not included in the estimate of $E_{SF6,out,y}$. Instead, $E_{SF6,out,y}$ was calculated using an estimated DRE of 90% which is the IPCC default.
Description of measurement methods and procedures to be applied:	See EPA method 2 or similar nationally- or internationally-recognized standard.
QA/QC procedures to be applied:	EPA method 2 or similar nationally- or internationally-recognized standard.; The inlet pressure gauge will be calibrated and maintained per the manufacturer's instructions.

Any comment:	This data will be monitored continuously.

Data / Parameter:	Absolute inlet stack temperature ($T_{s,in}$)
Data unit:	K
Description:	The inlet stack temperature measured during manufacturing operations
Source of data to be used:	Thermocouple
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not included in the estimate of $E_{SF6,in,y}$. Instead, $E_{SF6,in,y}$ was estimated by assuming default SF6 etch utilization efficiency of 70% and Heel 10% from expected purchase level (See IPCC Tier 2b emission factor). .
Description of measurement methods and procedures to be applied:	EPA method 2 or similar nationally- or internationally-recognized standard.
QA/QC procedures to be applied:	See EPA method 2; The inlet temperature gauge will be calibrated and maintained per the manufacturer's instructions.
Any comment:	This data will be monitored continuously.

Data / Parameter:	Absolute outlet stack temperature ($T_{s,out}$)
Data unit:	K
Description:	The outlet stack temperature measured during manufacturing operations
Source of data to be used:	Thermocouple
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not included in the estimate of $E_{SF6,out,y}$. Instead, $E_{SF6,out,y}$ was calculated using an estimated DRE of 90% which is the IPCC default.
Description of measurement methods and procedures to be applied:	See EPA method 2 or similar nationally- or internationally-recognized standard.
QA/QC procedures to be applied:	EPA method 2 or similar nationally- or internationally-recognized standard.; The outlet pressure gauge will be calibrated and maintained per the manufacturer's instructions.
Any comment:	This data will be monitored continuously.

Data / Parameter:	Velocity head measurement by inlet Annubar device (.$p_{avg,in}$)
Data unit:	mmH_2O
Description:	The averaged velocity head measurement used to calculate the inlet gas velocity
Source of data to be used:	Differential pressure gauge
Value of data applied for the purpose of calculating expected emission reductions in	Not included in the estimate of $E_{SF6,in,y}$. Instead, $E_{SF6,in,y}$ was estimated by assuming default SF6 etch utilization efficiency of 70% and Heel 10% from expected purchase level (See IPCC Tier 2b emission factor).

section B.5	
Description of measurement methods and procedures to be applied:	EPA method 2 or similar nationally- or internationally-recognized standard.
QA/QC procedures to be applied:	The project proponents will completely discount from the baseline any SF_6 emitted during periods of times where the gas velocity measured at the inlet decreases by more than 5%, compared to the averaged velocity. See also EPA method 2's QA/QC procedures.
Any comment:	This data will be monitored continuously.

Data / Parameter:	Velocity head measurement by outlet Annubar device (.$p_{avg,out}$)
Data unit:	mmH_2O
Description:	The averaged velocity head measurement used to calculate the outlet gas velocity
Source of data to be used:	Differential pressure gauge
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not included in the estimate of $E_{SF6,out,y}$. Instead, $E_{SF6,out,y}$ was calculated using an estimated DRE of 90% which is the IPCC default.
Description of measurement methods and procedures to be applied:	See EPA method 2 or similar nationally- or internationally-recognized standard.
QA/QC procedures to be applied:	The project proponents will completely discount from the baseline any SF_6 emitted during period of times where the gas velocity measured at the outlet increases by more than 5%, compared to the averaged velocity. See also EPA method 2's QA/QC procedures.
Any comment:	This data will be monitored continuously.

Data / Parameter:	Inlet gas velocity ($v_{s,in}$)
Data unit:	m/sec
Description:	Inlet gas velocity
Source of data to be used:	Measurement of inlet gas velocity corrected for pressure and temperature variations.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not included in the estimate of $E_{SF6,in,y}$. Instead, $E_{SF6,in,y}$ was estimated by assuming default SF6 etch utilization efficiency of 70% and Heel 10% from expected purchase level (See IPCC Tier 2b emission factor).
Description of measurement methods and procedures to be applied:	EPA method 2 or similar nationally- or internationally-recognized standard.
QA/QC procedures to be applied:	See EPA method 2

Any comment:	This data will be monitored continuously.

Data / Parameter:	Outlet gas velocity ($v_{s,out}$)
Data unit:	m/sec
Description:	Outlet gas velocity
Source of data to be used:	Measurement of outlet gas velocity corrected for pressure and temperature variations.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not included in the estimate of $E_{SF6,out,y}$. Instead, $E_{SF6,out,y}$ was calculated using an estimated DRE of 90% which is the IPCC default.
Description of measurement methods and procedures to be applied:	See EPA method 2 or similar nationally- or internationally-recognized standard.
QA/QC procedures to be applied:	See EPA method 2
Any comment:	This data will be monitored continuously.

Data / Parameter:	Inlet stack volumetric flow rate (Q_{in})
Data unit:	m^3/s
Description:	Inlet volumetric flow rate
Source of data to be used:	Measurement of inlet gas volumetric flow rate corrected for pressure and temperature variations.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not included in the estimate of $E_{SF6,in,y}$. Instead, $E_{SF6,in,y}$ was estimated by assuming default SF6 etch utilization efficiency of 70% and Heel 10% from expected purchase level (See IPCC Tier 2b emission factor). .
Description of measurement methods and procedures to be applied:	EPA method 2 or similar nationally- or internationally-recognized standard.
QA/QC procedures to be applied:	See EPA method 2
Any comment:	This data will be monitored continuously.

Data / Parameter:	Outlet stack volumetric flow rate (Q_{out})
Data unit:	m^3/sec
Description:	Outlet volumetric flow rate
Source of data to be used:	Measurement of outlet gas volumetric flow rate corrected for pressure and temperature variations.
Value of data applied for the purpose of calculating expected emission reductions in	Not included in the estimate of $E_{SF6,out,y}$. Instead, $E_{SF6,out,y}$ was calculated using an estimated DRE of 90% which is the IPCC default.

section B.5	
Description of measurement methods and procedures to be applied:	See EPA method 2 or similar nationally- or internationally-recognized standard.
QA/QC procedures to be applied:	See EPA method 2
Any comment:	This data will be monitored continuously.

Data / Parameter:	Inlet SF_6 concentration
Data unit:	ppm
Description:	Inlet SF_6 concentration measured by FTIR
Source of data to be used:	Inlet FTIR system
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not included in the estimate of $E_{SF6,in,y}$. Instead, $E_{SF6,in,y}$ was estimated by assuming default SF6 etch utilization efficiency of 70% and Heel 10% from expected purchase level (See IPCC Tier 2b emission factor). .
Description of measurement methods and procedures to be applied:	Conversion of FTIR absorbance measurement into concentration
QA/QC procedures to be applied:	See EPA method 2
Any comment:	See annex 1.a.; The inlet FTIR unit will be calibrated and maintained per the manufacturer's instructions. This data will be monitored continuously.

Data / Parameter:	Outlet SF_6 concentration
Data unit:	ppm
Description:	Outlet SF_6 concentration measured by FTIR
Source of data to be used:	Outlet FTIR system
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not included in the estimate of $E_{SF6,out,y}$. Instead, $E_{SF6,out,y}$ was calculated using an estimated DRE of 90% which is the IPCC default.
Description of measurement methods and procedures to be applied:	Conversion of FTIR absorbance measurement into concentration
QA/QC procedures to be applied:	See annex 1.a.; The outlet FTIR unit will be calibrated and maintained per the manufacturer's instructions.
Any comment:	This data will be monitored continuously.

Data / Parameter:	**$FC_{i,j,y}$** volume unit per year of natural gas consumed by abatement device at 0℃, 1ATM
Data unit:	(m^3/yr)
Description:	Quantity of natural gas combusted in abatement process during the year *y*
Source of data to be used:	Onsite measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**$FC_{i,j,y}$** volume unit per year of LNG consumed by abatement device (m^3/yr) P2/3 3,599,194 P4/5 8,146,529 P6 2,014,800 P7 2,956,703
Description of measurement methods and procedures to be applied:	Based on engineered expected values.Usage will be gauged by typical gas usage meter.
QA/QC procedures to be applied:	the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Any comment:	This data will be monitored continuously.

Data / Parameter:	$wc_{,i,y}$
Data unit:	(tC/t LNG)
Description:	Weighted average mass fraction of carbon in natural gas in year *y*
Source of data to be used:	Average Value provided by Korea Gas Corporation (a Public Enterprise)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	.754
Description of measurement methods and procedures to be applied:	requested from Korea Gas Corporation (www.kogas.or.kr)
QA/QC procedures to be applied:	This is a standard value
Any comment:	This data will be monitored once per year.

Data / Parameter:	$\rho_{i,y}$
Data unit:	(t natural gas/ m3 natural gas)
Description:	Weighted average density of natural gas in year *y*
Source of data to be used:	Average Value provided by Korea Gas Corporation
Value of data applied for the purpose of calculating expected emission reductions in	0.7955kg natural gas/1Nm3 natural gas at 0°C, 1 atm

section B.5	
Description of measurement methods and procedures to be applied:	requested from Korea Gas Corporation (www.kogas.or.kr)
QA/QC procedures to be applied:	This is a standard value
Any comment:	This data will be monitored once per year.

Data / Parameter:	$EC_{,y}$
Data unit:	kWh
Description:	Electricity Consumption in year y
Source of data to be used:	Metered from electricity consumption of the abatement unit.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**EC_y in kwh** P2/3 8,638,848 P4/5 19,553,440 P6 4,835,958 P7 7,096,731
Description of measurement methods and procedures to be applied:	Based on engineered expected values. Usage will be gauged by typical electricity usage meter.
QA/QC procedures to be applied:	The meters used measure electricity consumption will be maintained as per standard practices.
Any comment:	This data will be monitored continuously, for every minute.

B.7.2 Description of the monitoring plan:

The same Monitoring Methodology will be followed by each of the plants under consideration in the project activity. LG plans to hire a qualified independent third party to undertake the main monitoring functions. The independent third party will manage three key areas which are most critical for the ultimate accuracy and success of the monitoring portion of this activity. The three key areas are the design and operation of the metering system, the calibration of the metering system and data management. Each of these three functions will have a director responsible for ensuring the tasks are undertaken as per the methodological approach outline in AM0078 and those personnel undertaking each task are properly trained. Any irregularities will be documented and corrective measures will be undertaken that ensure a conservative outcome (that offering the fewest CERs of all the reasonable options) will be selective as the appropriate corrective actions.

All data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the last crediting period. All measurements will be conducted with calibrated measurement equipment according to relevant industry standards. In Annex 4 of this PDD, detailed monitoring plans are specified in accordance with following criteria

- The inventory, identification and the description of the measurement equipment used;
- The description of the QA/QC procedures for monitoring;
- The organizational structure and the responsibilities;

- The calibration and verification of the measurement equipment;
- The connecting of standard equipment to data logging devices;
- The process of recording data entries.

The steps required for the monitoring of the baseline and project emissions as well as the measures required to quantify uncertainties, ensure data quality, and conservativeness are as follows:

Step 1: Quality assurance, quality control, and conservativeness of the monitoring methodology
The applied methodology, AM0078, relies on direct and continuous monitoring of all key parameters necessary to quantify the baseline and project emissions. As such, the method does not require projection of the baseline or of the project emissions and does not lead to an overestimation of emission reductions attributable to the project activity. In addition to following the QA/QC and uncertainty assessment procedures highlighted in the baseline section for the measurement of SF_6 concentration, and to following the QA/QC procedures of the US EPA Methods for measuring the flow, the project developer will ensure conformance to the following steps, throughout the entire monitoring period.

Step 1a: QA/QC procedure and conservativeness for monitoring of the inlet flow
The project developer will ensure that maintenance of the inlet annubar device is performed at least as frequently as the manufacturer recommended. By continuously monitoring the flow at the inlet of the abatement system ($Q_{,in}$), the project developer will ensure that the flow conditions at the inlet of the abatement system do not drift, compared to the measurement performed during determination of the baseline. The method provides a conservative measure to estimate the baseline emissions by taking the highest value of the gas molecular weight measured at the inlet to calculate the inlet flow. As an additional conservative measure, the project developer will discount from the crediting period any SF_6 emissions measured when the value of the gas flow measured at the inlet of the abatement system during the monitoring period decreases by more than 5%, compared to the baseline flow rate measured (i.e. if $.Q_{in,monitoring} < 0.95\ .Q_{in,\ baseline}$). Indeed, a decrease of the total inlet flow would result in an increase in the SF_6 concentration, which could artificially increase the baseline if no flow compensation is accounted for. Should the gas flow measured at the inlet of the SF_6 abatement system drop below 0.95 $.Q_{in,\ baseline}$, the project developer will identify the source of the issue (annubar device clogging or real decrease in inlet flow) and restore the nominal flow condition prior to resuming normal operation and measurements for emission reductions.

Step 1b: QA/QC procedure and conservativeness for monitoring of the outlet flow
The project developer will ensure that maintenance of the outlet annubar device is performed at least as frequently as the manufacturer recommended. By continuously monitoring the gas flow at the outlet of the abatement system ($Q_{,out}$), the project developer will ensure that the flow conditions at the outlet of the abatement system do not drift, compared to the measurement performed during determination of the baseline. The method provides a conservative measure to estimate the project emissions by taking the lowest value of the gas molecular weight measured at the outlet to calculate the outlet flow. As an additional conservative measure, the project developer will discount from the crediting period any SF_6 emissions measured when the value of the gas flow measured at the outlet of the abatement system during the monitoring period increases by more than 5%, compared to the averaged velocity measured (i.e. if $Q_{out,monitoring} > 1.05\ .,Q_{out,\ baseline}$). Indeed, an increase in the total outlet flow would result in a decrease in the SF_6 concentration measured at the outlet, which could artificially increase the measurement of the DRE if no flow compensation is accounted for. Should the gas flow measured at the outlet of the SF_6 abatement system increase above 1.05 $Q_{out,\ baseline}$, the project developer will identify the source of the issue (Annubar device clogging or real increase in inlet flow) and restore the nominal flow condition prior to resuming normal operation and measurements for emission reductions.

Step 1.c: QA/QC procedure for maintenance and calibration of the FTIR systems
The project developer will ensure that the maintenance procedures of the FTIR systems are followed at least as often as the manufacturer's recommendation. The project developer has documented very clearly to the DOE what the

maintenance requirements of the FTIR devices are and ensures that the project participant will follow in at least as rigorous a manner as required. The project developer will also ensure that the FTIR systems windows are maintained in conformance with the maintenance procedure determined by the applied methodology, AM0078. Recalibration of the FTIR devices will be required every time the abatement device is brought offline for maintenance or every time the FTIR devices themselves are brought offline for maintenance, following the calibration procedure. Obviously, the project developer will discount from the crediting period any emissions of SF_6 that could occur while any FTIR system is being maintained or calibrated.

Step 1.d: QA/QC procedure for the maintenance of the abatement system
The project developer ensures that the maintenance procedures of the SF_6 abatement system are followed at least as often as the manufacturer's recommendation. The project developer has documented very clearly to the DOE what the maintenance requirements of the abatement device are and ensures that the project participant will follow in at least as rigorous a manner as required.

See Annex 4 for a more detailed description of the monitoring plan which includes monitoring frequency of each parameter.

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

Kevin James,
Climate Change Capital
3 More London Riverside
London, SE1 2AQ
UK

Young Suk Seo,
LG International Corp.
LG Twin Towers, 20, Yoido-dong, Youngdungpo-gu
Seoul, 150-606
Korea

Initial baseline study and monitoring methodology complete April 1, 2009

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

June, 1, 2009

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

10 years

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

C.2.1. Renewable crediting period

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

Option Not Selected

C.2.1.2. Length of the first crediting period:

Option Not Selected

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

April, 1, 2010 (or date of registration, whichever is later)

C.2.2.2. Length:

10 years

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

Environmental impacts of this project are expected to be small. The abatement device uses a small amount of electricity and natural gas. There will be no other significant environmental impact.

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

The environmental impacts of this project are expected to be small. And, According to the Environment Impact Assessment law in Korea, this project is not object to environmental impact assessment. The environmental impact assessment act in South Korea regulates the type of projects requiring an environmental impact assessment. Below is an exhaustive list of the types of facilities covered under the act requiring EIA assessments to be done. The act does not include abatement units being added on to LCD production facilities.

Taken from Annex1 of the South Korean Enforcement ordinance Article 3 Clause 2 in Environmental impact assessment act

Annex 1. Target Project of environmental impact assessment

1. City development
2. Industrial complex development
3. Energy development
4. Harbour construction
5. Expressway construction
6. Water resource development
7. Railroad construction
8. Airport construction
9. River development
10. Cultivation and Landfill
11. Sightseeing complex development
12. Forest development
13. Special region development (US army, etc.)
14. Sports complex installation
15. Installation of waste treatment, night soil treatment, livestock wastewater treatment
16. Installation of national defence and military facility
17. Soil, stone, sand, gravel, mineral gathering

SECTION E. Stakeholders' comments

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

Local stakeholders including local business leaders, government officials, and key implementation staff were invited to two stakeholders meetings in the cities of Gumi and Paju. The meetings were also advertised on local government websites in the two cities. The public advertisements have been provided to the DOE. The agenda for the meeting includes a presentation on the project by project engineers to describe the project and its benefits. Stakeholder comments and questions follow this presentation. The two stakeholders meeting were held at 8th of June 2009 in Paju and 9th of June 2009 in Gumi respectively. A full list of participants has been provided to the DOE.

E.2. Summary of the comments received:

To date all the comments concerning the project concern the technical details of the abatement device and how CDM is being used to implement the activity. A full list of comments , answers and any actions taken has been provided to the DOE and is included below:

Paju:

Q. As I know, there is a possibility that we can not obtain any CER generated from this project after 2012. In that case, do you have any contingency plan to recover the invested capital?
A. According to someone with international law expertise, any projects registered before 2012 are probably able to get CER after 2012 as international laws practically do not apply on retroactive manner. Of course, Korea will not be able to host any CDM project if Korea is included in Annex 1 countries after 2012. Therefore, we are trying to identify and develop new CDM projects as many and soon as possible.
ACTION- LG is seeking not only CDM projects but also other projects to protect the environment.
Q. Is it impossible to install the abatement facilities in other plants after 2012 if Korea is included in Annex1 in post Kyoto system?
A. We can install the equipments even after 2012 no matter what status of Korea in UNFCCC is. But, of course, we can not ask CERs if Korea becomes one of annex1 countries.
Q. Is installation of the equipment on progress? What if you fail to register the project as CDM?

A. Equipment manufacturing is now on progress. The first installation in P6 will be completed at the end of this year. We are taking some risk related to registration fail but we are quite sure that the project will be registered as we developed the methodology applied to the project.
ACTION- LG in investing in abatement system at P6 even before the CDM registration to maximize carbon emission reduction.
Q. LG developed the methodology for this project. Is there any possibility that the project is rejected?
A. If new laws regulating SF6 emission is legislated, the project can not satisfy additionality defined in the methodology. And there is another risk that the project registration is delayed.
Q. As I know, SF6 is used in power transmission equipments most. How do electricity companies respond to cut their GHG emission?
A. There is another methodology for reducing SF6 emission in Grid. The electricity company is developing CDM project based on that methodology.
A. Electricity companies and steel manufacturers are biggest emitters in Korea so they are very active to reduce GHG emission. They are developing many CDM projects such as forestation CDM
Q. Is the methodology developed by LG applicable to only LGD?
A. In principle, any LCD factory which can satisfy all applicability conditions in the methodology can use it. However, in practice, major LCD manufacturers are located in Japan, Taiwan or Korea and Korea is only one able to host CDM projects among these countries.
A. CDM pursues the public good so anyone who wants use methodology can use it for free.
Q. Frankly speaking, I don't understand why I become a stakeholder of this project. What kind of concerns do we hold in common?
A. The Interest includes not just economical concerns but also regional concerns. And the facility will emit some pollutants such as SOx and NOx so we want to collect neighbors' opinions and concerns although the quantity of those pollutants is very small.
A. Regarding the emission of SOx and NOx, we will keep emission levels much lower than statutory limit. The equipment is designed to emit only 50~60% of regulation. And economically, Daesung industrial gas has been providing SF6 gas to LGD, however LGD is looking for substitutes for SF6 and developing SF6-less process. These LGD's actions will affect profits Daesung industrial gas, thus Daesung industrial gas could be a stakeholder of LGD's mitigation actions.
ACTION- The initial design was to install one scrubber to reduce SOx and NOx emission but we will additionally install one more scrubber to secure the emission level of SOx and NOx under 60% of statutory regulation

Q. Is there any noise issue caused by the equipment operation?
A. The abatement equipment do not make any noise by itself. Some fans may make small noises but it does not affect neighbors' daily life.
Q. But some of us are annoyed by loud noises from LGD plant.
A. The noises come from air compressors of other facilities. LGD, however, are improving the air compression process to mitigate noise problems. Regarding the fan, we limits its maximum noise level before order it.
ACTION- The abatement system design firm will be asked to ensure the fan system is as quiet as possible to reduce noise
Q. How big is the incinerator?
A. The capacity of incinerator is 40 cubic meter per minute, it is relatively small than other industrial incinerators.
Q. Please convert it in terms of LNG consumption.
A. approximately 200 normal cubic meters per hour
Q. It must generate lots of heat. Do you have any plan to recover the wasted heat?
A. To prevent SF6 re-composition after incineration, the gas heated more than 1200°C should be quenched rapidly. Therefore recovering the wasted heat is not applicable, but LGD has utilized all other wasted heat from other facilities in the plant.
ACTION- Although the wasted heat from the abatement system can not be recovered, LG will utilize other wasted heat to save energy and to protect the environment
Q. I think N2O may be formed as one of by-products.
A. If we use plasma type system, N2O may be generated. However, the system to be used is burn-wet type, so it can not form N2O because N2O is a triple bond. To compose N2O, huge amount of energy is required.
ACTION- Technically N2O formation is impossible. LG will monitor all components of effluent gas and respond if any hazardous gas or GHG is generated.

Q. The burn-wet system consumes huge energy. So I think it is much better to develop an alternative gas than install abatement system in long-term.
A. We are developing more advanced technology such as concentration & heat decomposition, recycling, alternative gas. Final goal is developing new etching process which does not use any gas. But we are very early stage and it needs time. We will do our best to develop more environmental friendly technology.
ACTION LG will keep supporting internal technical innovation for carbon emission mitigation.

Gumi

Q. Is there any standard for SOx and NOx emission regulation?
A. Atmospheric environment law will be applied. We will reduce SOx and NOx emission to 50~60% of that standard.
ACTION- The initial design was to install one scrubber to reduce SOx and NOx emission but we will additionally install one more scrubber to secure the emission level of SOx and NOx under 60% of statutory regulation
Q. is any hazardous by-product formed from SF6 while it is used in the etching process?
A. SF6 is decomposed into fluorine and sulphur. Some dust, even not hazardous, may be made but it will be captured by a pretreatment system to be installed.
ACTION- We will install a pretreatment equipment to capture dust whose diameter is smaller than 1 um
A. The total emission reduction of P2~P6 which are located in Gumi is 1 million CO2t and 0.55 million CO2t for P6 solely. 0.55 million is substantial amount and it is same to 10% of carbon emission from energy use in Gumi. If this project is completed, Gumi will achieve outstanding outcome in terms of emission reduction. We hope LG expands its investment on other plants soon.
Q. Is there any other GHG gas being used in LGD except SF6?
A. Some processes utilize CO2 but the quantity is very small. It is less than 10% of carbon emission from LNG consumption in LGD.
ACTION- LG will keep supporting internal technical innovation for carbon emission mitigation.

Q. Is it possible to apply for a patent for the methodology?
A. Methodologies are one of public property so we can not claim any right regarding the methodology though we developed it.
Q. What is LGI's role in this project?
A. LGI is responsible for CDM proceeding and investment. LGI, also, will be in charge of CER trading on behalf of LG group thorough its global network. Save technology is in charge of EPC.
Q. What if Korea would belong to annex 1 group after 2012?
A. We can not predict what will happen to CDM rules after 2012 especially for projects being hosted in countries which are newly joined to the annex 1 group.
Q. I wonder whether other companies, such as Samsung, are developing similar projects. We hope other companies also to participate GHG emission reduction projects to the extent not to infringe of other's patent.
A. The methodology is available to every one, so foreign companies, as well as domestic companies, can use the methodology and develop similar projects.
ACTION- LG is advertising this project through mass media to encourage other companies' carbon mitigating implementation.
Q. Gumi municipal government is also considering diverse ways such as bicycle road building program to reduce GHG emission. Companies' efforts to reduce GHG emission also belong in activities of municipal government in a broad sense, we hope not only LG but also other neighboring companies to be more aggressive in activities for mitigating global warming.
A. We will support this project on the municipal level and advertise your project thorough local newspaper and broadcasting.
A. For seeking other GHG emission reduction project, we will arrange a meeting between Save Tech and companies which are consuming huge energy and causing GHG emission increase in Gumi.
ACTION- Gumi municipal government will arrange a meeting and LG/Save will actively participate in the meeting and their activities

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

To date no comments have been critical of the installation of the abatement system as proposed. Instead, the project developer has provided information on the project and general information concerning the CDM to interested parties. The list of action taken in response to the comments is included in the table above.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	LG International Corp.	LG Display Co.,Ltd.	Climate Change Capital Carbon Fund II s.à r.l.
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State/Region:			
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Represented by:	Jin-hyeon Kim	Seok-hyun Seong	Climate Change Capital Limited
Title:	Senior Manager	Senior Manager	Investment Manager for Climate Change Capital Carbon Fund II s.à r.l
Salutation:			Mr
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

NO PUBLIC FUNDING IS USED FOR THIS PROJECT ACTIVITY

Annex 3

Estimated Annual Baseline Emissions

$$BE_{in,y} = k \cdot E_{SF6,y} \cdot GWP_{SF6}$$ **EQ1**

This would yield the following baseline emissions:

Facility	SF6 Entering Abatement Device tonnes in year y - $E_{SF6.y}$	k	TSF6 GWP Tonnes CO2 /Tonne SF6	TCO2eq emissions tonnes $BE_{in,y}$
P2/3	4.58	1.000	23,900	109,499.91
P4/5	15.85	1.000	23,900	378,695.79
P6	23.30	1.000	23,900	556,980.12
P7	23.55	1.000	23,900	562,780.40
Total Baseline Emissions	**80.39**			1,607,956.22

where

$$E_{SF6,y} = \min\{E_{SF6,in,y}; 0.48 \times C_{SF6,y}; 0.48 \times C_{SF6,hist}\}$$ **EQ2**

Facility (2006)	$E_{SF6,in,y}$ (Assuming default SF6 etch utilization efficiency of 70% and Heel 10% from expected purchase level (See IPCC Tier 2b emission factor)	0.48 x $C_{SF6,y}$	$C_{SF6,y}$	0.48 x $C_{SF6,hist}$	$C_{SF6,hist}$	$E_{SF6,y}$
P2/3	4.58	8.15	16.97	9.97	20.78	4.58
P4/5	15.85	28.17	58.69	29.35	61.16	15.85
P6	23.30	41.43	86.31	36.59	76.23	23.30
P7	23.55	41.86	87.21	47.26	98.45	23.55

Where

$$k = \begin{cases} 1 & ; SF_{6,ratio} \geq C_{SF6,y} \div SP_{project\cdot y} \\ \dfrac{SF_{6,ratio}}{C_{SF6,y} \div SP_{project\cdot y}} & ; SF_{6,ratio} < C_{SF6,y} \div SP_{project\cdot y} \end{cases} \quad (4)$$

And

$$SF_{6,ratio} = \min\left(C_{SF6,-1} \div SP_{-1}; C_{SF6,-2} \div SP_{-2}; C_{SF6,-3} \div SP_{-3}\right) \quad (3)$$

Fab	C_{SF6}				SP			
	'06 (-3)	'07 (-2)	'08 (-1)	'09 (1)	'06 (-3)	'07 (-2)	'08 (-1)	'09 (1)
P2/3	18,450	20,781	19,530	16,969	1,248,918	1,388,752	1,354,599	1,176,957
P4/5	45,090	56,610	61,155	58,685	3,477,234	4,196,473	4,551,720	4,525,666
P6	55,024	73,990	76,226	86,313	4,078,800	5,252,354	5,680,338	6,432,045
P7	24,371	70,092	98,453	87,212	2,438,002	6,020,234	7,559,469	8,724,449
total or average	142,935	221,473	255,364	**249,180**	11,242,954	16,857,813	19,146,126	**20,859,117**

Fab	$SF_{6,ratio}$ (Tonnes/m2) -3	$SF_{6,ratio}$ (Tonnes/m2) -2	$SF_{6,ratio}$ (Tonnes/m2) -1	$C_{sf6,y}$ ÷, $SP_{project,y}$ (Tonnes/m2) y	$SF_{6,ratio}$ (Tonnes/m2) minimum (-3,-2,-1)	k
P2/3	0.0000148	0.0000150	0.0000144	0.0000144	0.0000144	1.00000
P4/5	0.0000130	0.0000135	0.0000134	0.0000130	0.0000130	1.00000
P6	0.0000135	0.0000141	0.0000134	0.0000134	0.0000134	1.00000
P7	0.0000100	0.0000116	0.0000130	0.0000100	0.0000100	1.00000

Project Emissions

$$PE_y = BE_y\left(1 - DRE_y\right) + C_{CO2,y} \quad (17)$$

Fab	BE_{2009} (1-.DRE_{2009}) (Tonnes CO2E) Estimated DRE of 90% which is the IPCC default	$C_{CO2,y}$ emission	PE
P2/3	10,949.99	12,853.93	23,803.92
P4/5	37,869.58	29,093.99	66,963.57
P6	55,698.01	7,195.53	62,893.54
P7	56,278.04	10,559.38	66,837.42
total or average	**160,795.62**	59,702.83	220,498.45

Fab	Average Electricity consumption in (kw)	hours per year	tCO2/kwh	$tCO2_y$(electricity)
P2/3	986.17	8760	0.0005708	4,931.05
P4/5	2,232.13	8760	0.0005708	11,161.10
P6	552.05	8760	0.0005708	2,760.36
P7	810.13	8760	0.0005708	4,050.81

Equation #1 and #3 From the 'Tool to calculate project or leakage CO2 emissions from fossil fuel combustion' Option A is selected and FC is measured as a volume (m3). The variable 'i' only corresponds to one fuel-LNG.

$$PE_{FC,j,y} = \sum_i FC_{i,j,y} \times COEF_{i,y} \quad (1)$$

If $FC_{i,j,y}$ is measured in a volume unit: $COEF_{i,y} = w_{C,i,y} \times \rho_{i,y} \times 44/12$ (3)

Fab	$w_{C,i,y}$ (tC/t LNG)	$FC_{i,j,y}$ volume unit per year of LNG consumed by abatement device (m3/yr)	$\rho_{i,y}$ (t LNG/ m3 LNG)	tCO_2/tC	$tCO2_y$(LNG)
P2/3	0.754	3,599,194	0.0007955	3.67	7,922.88
P4/5	0.754	8,146,529	0.0007955	3.67	17,932.89
P6	0.754	2,014,800	0.0007955	3.67	4,435.16
P7	0.754	2,956,703	0.0007955	3.67	6,508.57

(Source: Manufacturer's specification and Korea Gas Corporation)

Where $C_{CO2\ y}$, equals $tCO2_{electricity,y} + tCO2_{LNG,y}$

Fab	$tCO2_y$(electricity)	$tCO2_y$(LNG)	Total $C_{CO2,y}$ emission
P2/3	4,931.05	7,922.88	12,853.93
P4/5	11,161.10	17,932.89	29,093.99
P6	2,760.36	4,435.16	7,195.53
P7	4,050.81	6,508.57	10,559.38

Year	Total Baseline Emissions	Total Project Emissions TCO2	TCO2eq emissions Reductions
Year 1 (April, 1, 2010 ~ March, 31, 2011)	556,980	62,893	**494,087**
Year 2 (April, 1, 2011 ~ March, 31, 2012)	1,607,956	220,498	**1,387,458**
Year 3 (April, 1, 2012 ~ March, 31, 2013)	1,607,956	220,498	**1,387,458**
Year 4 (April, 1, 2013 ~ March, 31, 2014)	1,607,956	220,498	**1,387,458**
Year 5 (April, 1, 2014 ~ March, 31, 2015)	1,607,956	220,498	**1,387,458**
Year 6 (April, 1, 2015 ~ March, 31, 2016)	1,607,956	220,498	**1,387,458**
Year 7 (April, 1, 2016 ~ March, 31, 2017)	1,607,956	220,498	**1,387,458**

Year 8 (April, 1, 2017 ~ March, 31, 2018)	1,607,956	220,498	**1,387,458**
Year 9 (April, 1, 2018 ~ March, 31, 2019)	1,607,956	220,498	**1,387,458**
Year 10 (April, 1, 2019 ~ March, 31, 2020)	1,607,956	220,498	**1,387,458**
Total	15,028,584	2,047,375	**12,981,209**

Values for year one are based on expected consumption and production patterns including market expectations and historical trends. Years 2-10 are simply assuming similar values to year 1 for each additional year. For Year 1, the abatement system in P6 alone will be operational and the other facilities will be under construction. After Year 1, all systems will be fully operational.

Calculation of EFgrid (note all data referenced in this calculation is taken from the most recent **annual electricity statistics issued by KEPCO**):

Summary Calculation Electricity Grid Factor

EFgrid, CM, $_y$ = EFgrid, OM, $_y$ * wOM + EFgrid, BM, $_y$ * wBM

Where:

	EFgrid, CM, $_y$ = EFgrid, OM, $_y$ * wOM + EFgrid, BM, $_y$ * wBM
	Where:
0.4161	EFgrid,BM,y = Build margin CO2 emission factor in year y (t CO2/MWh)
0.7256	EFgrid,OM,y = Operating margin CO2 emission factor in year y (t CO2/MWh)
0.5	wOM = Weighting of operating margin emissions factor (50% default)
0.5	wBM = Weighting of build margin emissions factor (50% default)
	EFgrid,CM,y=
	0.5708 (tCO2e/MWh)

Low Cost Must Run Ratio

Year	Low cost/must run				Total grid generation	Low cost/must run ratio
	Hydro	Nuclear	Alternative*	Subtotal		
2003	6,830,016	123,280,502	275,716	130,386,234	308,225,887	42.30%
2004	5,802,167	123,970,409	350,180	130,122,756	326,879,672	39.81%
2005	5,135,032	139,286,513	403,583	144,825,128	348,187,780	41.59%
2006	5,144,992	142,114,439	510,689	147,770,120	365,368,969	40.44%
2007	4 ,973,848	136,599,046	830,284	137,429,330	386,510,193	35.56%
Average of five recent years	5,728,052	133,050,182	474,090	139,252,324	347,034,500	40.13%

Simple OM for the proposed project activity			
	Net Generation (∑EGm,y) (MWh)	CO_2 emission (∑EGm,y*$EF_{EL,m,y}$) (tCO_2)	Operating Margin
2007	236,141,712	167,461,006	0.7092
2006	211,789,276	154,579,989	0.7299
2005	200,163,028	148,222,723	0.7405
Average (2005-2007)			**0.7256**

Build Margin Calculation -Sample Group Selection

For the calculation of the Build Margin emission factor (BM y EF ,), the sample group m is selected according to Option 1.

	2007 Net Generation (MWh)	Percentage	Remark
Grid total	386,510,193	100.00%	
Sample group m 3 five plants	252,253	0.07%	
Sample group m - 20% plants	85,176,017	22.04%	**Selected**

BM Calculation Summary

$EF_{grid,BM,y} = \Sigma_m EG_{m,y} * EF_{EL,m,y} / \Sigma_m EG_{m,y}$	=	0.416084
$\Sigma_m EG_{m,y}$	=	85,176,017
$\sum_m EG_{m,y} * EF_{EL,m,y}$	=	35,440,419

Plant Unit Information Most Recent 20%

Plant (m)				
	Commissioning	Capacity (MW)	Plant factor(%)	Fuel (i) type
Hanbit Sungsan the second solar	2007.12			Solar
Taein gangjin solar	2007.12			Solar
Suni gangjin solar	2007.12			Solar
Korea yeongcheon solar	2007.12			Solar
Solar yungam solar	2007.12			Solar
Changwhan yeongduk solar	2007.12			Solar
Samsung jindo	2007.12			Solar
Hwaseong heat & power	2007.12			combined
Dangjin#8	2007.12	500.0	0.00	Coal-thermal
SP solar yonggwang	2007.11			solar
Dongyang energy sinan	2007.11			solar
EF yungam solar	2007.11			solar
Dongwon gangjin solar	2007.11			solar
Solec yonggwang solar	2007.11			solar
Solar junggeub solar	2007.11			solar
Sinbuk yungam solar	2007.11			solar
Hyein haenam solar	2007.11			solar
Samlangjin solar	2007.11			solar
Hyosung daegi-wind power	2007.11			Wind
Nonhyuon heat & power	2007.08			Combine
Wuriyungam solar	2007.08			Solar
Hwasung solar	2007.08			Solar
Yeongju the first solar	2007.08			Solar
Muan solar	2007.08			Solar
Jangheung solar	2007.08			Solar
Gomun	2007.08			small hydro
Taean#8	2007.08	500.0	95.85	Coal-thermal
Dangjin#7	2007.06	500.0	87.79	Coal-thermal
Munkyung solar	2007.06			Solar

Younggwang solar park	2007.06			Solar
Yungam solar	2007.06			Solar
Wonjungsu	2007.05			small hydro
Baegok	2007.05			small hydro
Damyangho	2007.05			small hydro
Juam	2007.05			small hydro
Namjeju#4	2007.03	100.0	58.31	Heavy oil thermal
Eco energy	2007.03			Solar
Hapcheon	2007.02			small hydro
Jeonju resource recovery facility	2007.02			waste
Seoul Marin	2007.02			Solar
Mirae energy	2007.02			Solar
Seomjingang	2007.02			small hydro
Samcheonpo	2007.02			small hydro
Dalbang	2007.02			small hydro
Taean#7	2007.02	500.0	90.63	Coal-thermal
Yeongju the second solar	2007.01			Solar
Hyungdae daesan	2007.01			combined
Cheongsong pumping#2	2006.12	300.0	5.52	pumping
S&P solar	2006.10			Solar
Bundang fuel cell	2006.10			Solar
Yongwang solar park	2006.10			Solar
Namhae solar	2006.10			Solar
Hanla jeunggong solar	2006.10			Solar
Yungam solar	2006.09			Solar
enepark	2006.09			Solar
Yongheng solar	2006.09			Solar
Cheongsong pumping#1	2006.09	300.0	6.24	pumping
Namjeju#3	2006.09	100.0	60.83	Heavy oil thermal
Yangyang#4	2006.08	250.0	4.17	pumping
Donghae solar	2006.08			Solar
Kangwon wind power	2006.07			Wind
yangyang pump wind	2006.06			Wind
hadongho	2006.06			small hydro
Yangyang#3	2006.06	250.0	2.58	pumping
Cogeung solar	2006.06			Solar
Jangseong	2006.05			small hydro
Yangyang#2	2006.04	250.0	4.74	pumping
Dangjin#6	2006.04	500.0	83.41	Coal-thermal
Sinchang wind	2006.03			Wind
Yangyang#1	2006.02	250.0	4.92	pumping
Janghengdam	2005.12			small hydro
Suncheon solar	2005.12			Solar
Samcheonpo solar	2005.12			Solar
Dangjin#5	2005.10	500.0	82.77	Coal-thermal
Yangyang pump small hydro	2005.10			small hydro
Taean solar	2005.10			Solar
Jeju DP	2005.07	40.0	71.56	internal combustion

Wunjeong LFG	2005.07			internal combustion
Yulchon	2005.07	525.5	46.38	combined
Incheon	2005.07	503.5	85.73	combined
Daegok	2005.07	0.3	49.26	small hydro
Donghwa	2005.07	1.0	28.33	small hydro
Ulchin#6	2005.04	1000.0	91.00	nuclear
Hanrye	2005.04	0.9		LFG
Busan Biogas	2005.03	2.1		internal combustion
Sungnam	2004.12	0.3	60.35	small hydro
Yungduk wind	2004.12	39.6		Wind
Yongdam	2004.12	22.1	91.29	small hydro
Maebongsan wind	2004.12	4.3		Wind
Daegwanryung wind	2004.12	2.6		Wind
Yongheng#2	2004.11	800.0	75.53	Coal-thermal
New solar energy	2004.11			Solar
Yongheng#1	2004.07	800.0	75.53	Coal-thermal
Ulchin#5	2004.07	1000.0	92.17	nuclear
Busan	2004.03	1800.0	75.28	combined
Chunsang	2004.02	0.3	10.96	small hydro
Cheongju LFG	2004.02	1.0		internal combustion
Andong	2003.09	90.0	13.54	small hydro
Gunsan Wind	2003.09	7.9		Wind
Daejon Geumgodong	2003.06	3.5		internal combustion
Hoicheon ENC	2003.05	1.0		internal combustion
Sangwon ENC	2003.06	9.9		internal combustion
Muju	2003.04	0.4	18.19	small hydro
Yonggwang#6	2002.12	1000.0	90.56	nuclear
Taean#6	2002.05	500.0	96.96	Steam
Yonggwang#5	2002.05	1000.0	99.51	nuclear

Annex 4

Monitoring Plan

The objective of the monitoring plan is to ensure the consistent, clear, and accurate monitoring and calculation of the emissions reductions during the whole crediting period consistent with the approved methodology. The project owner will be ultimately responsible for the implementation of the monitoring plan but expects to hire a third party to manage the day-to-day monitoring activity. Monitoring procedures may be adjusted from time to time but will not deviate from the principles described in the monitoring plan below.

Operational procedures:

The approved methodology utilized for this project is highly prescriptive on how to design and undertake monitoring activities. The parameters that need to be actively monitored, the frequency of monitoring, and the methods required for monitoring are described in detail in the methodology. The following monitoring plan will seek to ensure the monitoring equipment is designed and measurements are taken in accordance with the methodology.

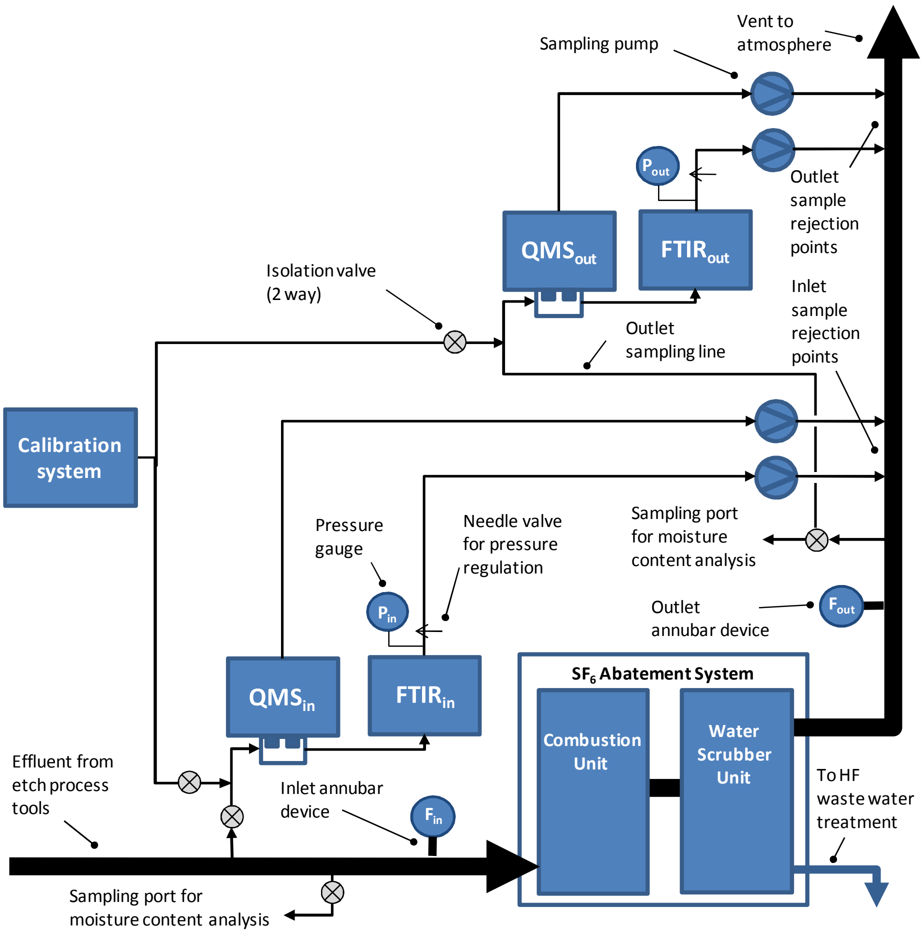


Figure A4-1

An indicative diagram taken from the approved methodology in figure A4-1 provides a clear roadmap for the design of critical metering instruments that will be used in the monitoring of emission reductions. The abatement device monitoring system in the LG project is based on these specifications. The first component of the monitoring plan will to be to ensure compliance of the design of the abatement monitoring system with the methodology.

Management and Operational Systems

LG plans to hire a qualified independent third party to undertake the main monitoring functions. Staff of the independent third party will implement the monitoring activities by performing Quality Control Measures throughout the crediting period. The independent firm will be responsible for A) the design and operation of the metering system, B) the calibration of the metering system and C) data management.

The monitoring of the emission reductions will be carried out according to the scheme shown in Fig A4-2. The day-to-day responsibility for the monitoring process will be held by the manager appointed by the 3rd party monitoring entity.

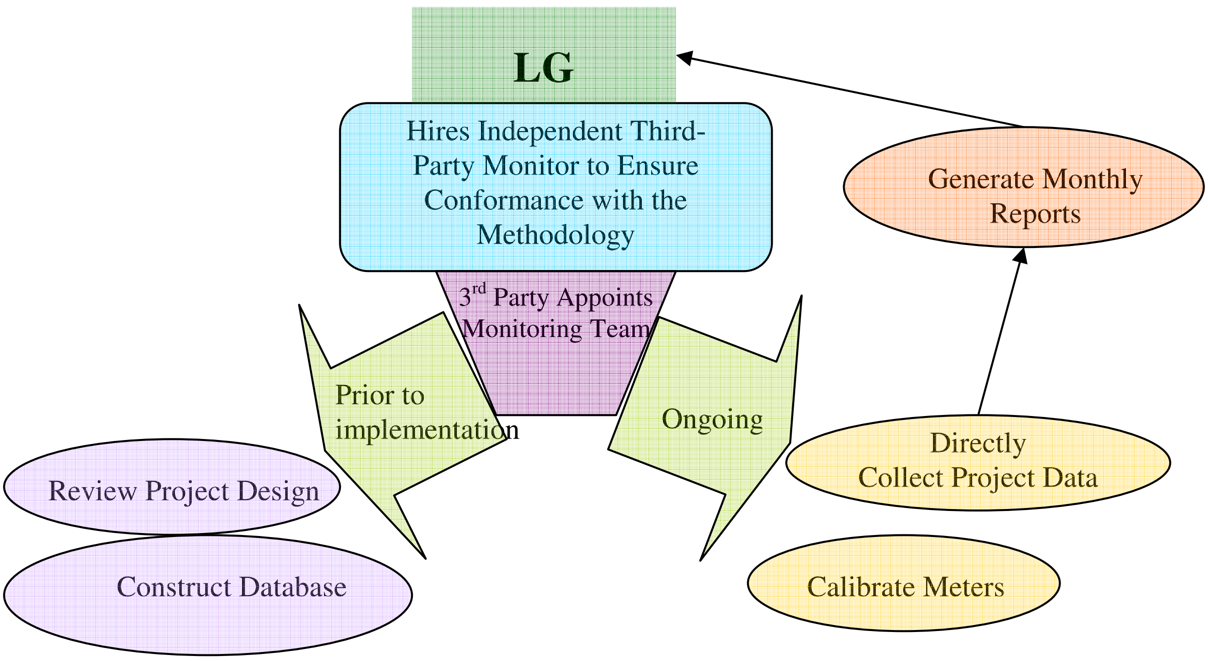


Figure A4-2

The Project Team organized by the 3rd party entity will be composed of a Project Management Team and a number of sub-teams, which will likely be organized as follows:

Project Management Team - The Project Management team will be responsible for coordinating the overall monitoring plan implementation. They will oversee the Engineering and Design Teams, Monitoring Management Team and Database Management Team, and will also be responsible for coordinating all other logistics, including for example:

- ensuring compliance with CDM methodology,
- ensuring staffing needs for all teams are met,
- evaluating training needs and carrying out training programs,
- liaising with LG senior management to ensure a smooth implementation of the monitoring function.
- auditing calibration procedures of each metering device implemented by suppliers
    - This will include ensuring the operators are trained and capable of performing the required calibration and
    - checking the calibration records to ensure the time intervals between calibrations match the manufacturer's requirements.

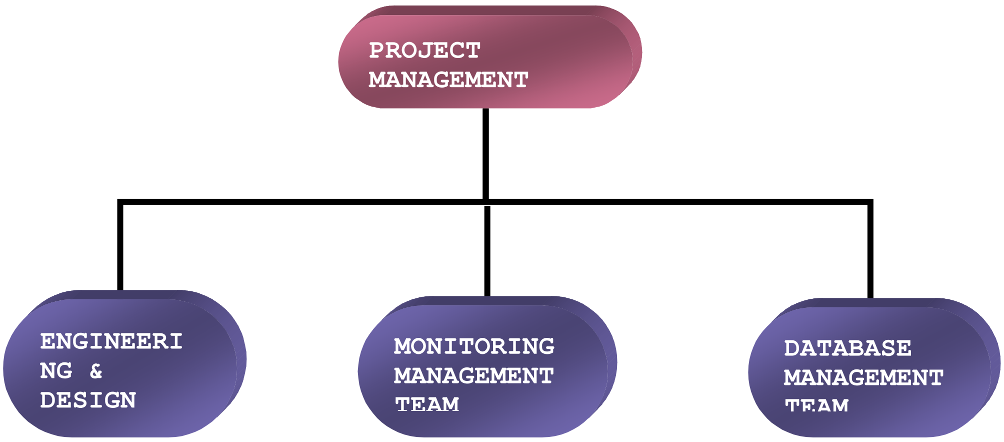
This team will be headed by an experienced manager appointed by the 3rd party monitoring company, who will also be the first line of responsibility for implementing monitoring operations on a day-to-day basis and the Monitoring Plan overall. Ultimate authority will lie with LG for overall project implementation but the third party will be responsible for the day-to-day monitoring activity.

Engineering and Design Team– This team will review the equipment and design of the abatement system including the monitoring instruments. The design team will document the expected abatement system design conforms to the methodological requirements.

Monitoring Management Team- As data collection and monitoring is one of the most critical components of the methodology, the independent third party will establish a team to gather the data in the manner detailed in the approved methodology. This team will ensure the monitoring system is operating properly and the meters are calibrated as per the methodology. This team also has the responsibility to manage and record utility consumption. This team is the focal point for the data gathering. The team will use the raw data collected to make monthly reports of the results including any irregularities and remedies.

Database Management Team- The 3rd party monitoring entity will establish a team responsible for documenting the data, and ensuring that it is correctly entered into a database. The team will prepare an appropriate database format prior to the start of the project implementation phase. Once the project commences, the required data will be entered on a daily basis.

O&M TEAM STRUCTURE



Team structure and roles/activities are as below;

PROJECT MANAGEMENT TEAM

Members :

General officer and Process engineers.

ROLE & ACTION

1. General responsibility for SF6 Abatement System

2. Controlling Engineering team, Monitoring Management team & Database Management team

3. Ensuring compliance with CDM methodology

4. Ensuring staffing needs for all teams are met

5. Evaluating training needs and carrying out training programs

6. Liaising with LG senior management to ensure a smooth implementation of the monitoring function

7. Directing & checking up operating Condition of the SF6 Abatement System

8. Being in charge of Calibration procedures and Controlling of Vendor that Supplied meter/Device.

9. Responsible for Calibration procedures and supervises measurement device supplier.

ENGINEERING & DESIGN TEAM

Members :

professional Proecss Engineer and chief operator

ROLE & ACTIVITIES

1. Maintain performance and proper operating condition of SF6 Abatement System.

2. Operating with the management of risk.

3. Ensuring performance of Monitoring System.

4. Design conforming to methodology.

5. Optimizing utility consumption and operation cost.

6. Analyzing result of measurements.

7. Designing for improving an equipment or whole system.

MONITORING MANAGEMENT TEAM

Members :

6 Operators of 3 group of 2, operating in 3 shifts.

ROLE & ACTION

1. Operating of SF6 Abatement System

2. Monitoring and recording data required in methodology

3. Monitoring and recording data for operation.

4. Checking for Alarm setting Value.

5. Checking for SF6 Abatement System every from one to six hours.

Checking Point :

1) FUEL GAS FLOWRATE (LNG CONSUMPTION)
2) SF6 GAS FLOWRATE
3) SF6 GAS PRESSURE
4) COMBUSTION AIR PRESSURE
5) COMBUSTION AIR TERPERATURE FROM ELECTRIC AIR HEATER
6) SEAL AIR FLOWRATE
7) DECOMPOSITION REACTOR REMPERATURE
8) PILOT/MAIN BURNER FLAME

9) MAIN BURNER FLAME

10) QUENCHER LEVEL

11) CHILLER WATER TEMPERATURE(IN/OUT)

12) PURE WATER FLOW TO DOWNCOMER

13) CHILLER WATER FLOWRATE

14) DECOMPOSITION REACTOR PRESSURE

15) CHECK FOR WATT-HOUR METER

16) ELETRIC POWER METER

6. Daily operation report on equipments and system.

7. Assist Maintenance Work for equipment and instruments.

8. Protecting system immediately by Interlock and proper activities.

9. Data of LNG and electricity consumption should be archived and kept electronically and be kept.

DATABASE MANAGEMENT TEAM

Members :

Professional analyzing agent and operator

ROLE & ACTION

1. Saving measurement data required in methodology. (Attachment 24)

2. Saving and backup the measurement data for 2 years after the end of the last crediting period

3. Calibration of measuring device/Meter and reporting.

4. Maintenance of measuring device and reporting.

5. Checking accuracy of measurement results and reporting.

6. Checking and solving problems when measuring device alarms.

7. Checking and maintaining measuring device and filtering system.

8. Monthly report on measuring result.

9. Audits of calibration process.

Calibration of Equipment

The methodology required for gaining CERs rests on numerous measurements being undertaken on a continuous basis on a variety of parameters. The measurement tools required for this process need to be calibrated using a variety of different methods. The independent third party will establish a single person responsible for overseeing the calibration process. This person will ensure that the calibrations take place as scheduled under the conditions required in the methodology.

The Monitoring Management Team will maintain a calibration schedule and log for each meter to be used as part of the program. A master schedule will establish the responsible personnel for each meter and provide the required dates for each calibration activity. As the calibration is undertaken, the responsible person for that meter will sign the log attesting to the accurate completion of the calibration and date the calibration.

Any irregularities are to be reported in the log and an explanation for the steps undertaken to rectify the problem documented in the log.

Quality Assurance and Corrective Action

The Project Participants have taken a number of steps to ensure that the Project data is of a high quality.

The third party will undertake an assessment of the project design to confirm the expected results outlined by the PDD are reasonable given the pre-project circumstances and the engineering design for the new abatement system. The responsibilities of the third party include the following:

- Conduct study of the current situation and the engineering plans of the new abatement system to ensure the LG projections are in line with those found by an independent third party.
- Provide formal training requirements analysis to ensure the teams in charge of the monitoring functions listed above are properly trained to use the equipment and fulfill the requirements of the methodology.

<u>Corrective Actions and Emergencies</u>

- At the end of each yearly monitoring period, a draft monitoring report will be developed by the Project management team leader for verifier review and approval. Those documents will be circulated to the entire project team for comments and to check for irregularities. In the event that such irregularities are observed:
    - An analysis of the irregularities and their causes will be carried out immediately.
    - The management of independent third party will make a decision on appropriate corrective actions to eliminate the non-conformity and its causes in a way that maintains the conservativeness of the results. The corrective measure will err on the side of conservativeness.
    - Corrective actions will be executed under the supervision of project leader, and any necessary amendments will be made to ensure a conservative outcome.
    - Corrective actions could involve
        - Re-measurements where possible,

- Reduction in time of use of equipment in question
- Elimination of data set where no other corrective action would offer a plausible conservative result.
- Using the most conservative data and calculating the most conservative result in the case of redundant data.

Data Flow, Storage and Management

Quality Control, Discrepancies, and Data Security
After the monthly data collection, the independent third party reviews the data and checks that it has been recorded correctly.

- Any discrepancies between the purchase records and actual inventories will be recorded.
- A description of cause of deviation will be recorded.
- Any clear errors will be documented and corrected. With evidence backing up the correction.
- For any discrepancy that is not cured, the more conservative (resulting in fewer CERs being generated) will be chosen as the actual data.

The data is backed up on a weekly basis and the collated data placed on an excel spreadsheet on a monthly basis, where it will be retained as well to ensure long-tem electronic storage in several separate locations. All electronic and hard copy records of the metering devices, relevant documentation and the results of calibration will be collected in a central place by the project entity. Data record will be archived for a period of 2 years after the crediting period to which the records pertain.

Maintenance Actions for Abatement Device

MAINTENANCE WORK

Equipment	Work	Cycle	Remark
Decomposition Reactor	Refractories replacing	1/3~5years	
	Refractories cleaning	1/ year	
	Burner cleaning	1/ year	
	Burner replacing	1 / 3~5years	
	Sight glass cleaning	1 / year	
Quencher	Flake Lining	1 / 3years	
Pre-treatment system	Discharge plate cleaning	4 / year	
	Packing Cleaning	2 / year	
	ionizer Collecting Electrode replacing	1 / 5years	
	ionizer Discharge Electrode replacing	1 / 2years	

	Insulation Air Filter	1 / year	
	Spray nozzle replacing	1 / 2years	
Emergency Water Tank	Internal cleaning	1 / year	
Quencher Cooler	Internal cleaning	1 / year	
Air Heater	Internal cleaning	1 / year	
Scrubber	Packing cleaning	2 / year	
	Tank cleaning	4 / year	
Rotary Equipment	Bearing replacing	1 / 2years	Prepare spare parts
	Mechanical Seal Replacing	1 / year	stand-by needed
Instrument	pH meter Replacing	1 / year	
	UV tube Replacing	1 / year	
	Thermocouple(for high temperature) Replacing	1 / year	
	Pilot lamp & fuse Replacing	1 / year	

This data are general figures of normal operation and is subjected to change given specific operation conditions.

Equipment to be Used for Monitoring

The Equipment to be used for monitoring is expected to include annubar devices supplied by the South Korean Company Taehung M&C Corp, FTIR provided by the South Korean Company Joowon Industrial Co. Ltd., and the QMS purchased from the South Korean Company Bongil Inc. Detailed descriptions of the equipment has been provided to the Validator including copies of operational manuals.

ANNUBAR DEVICE SPECIFICATIONS

FLOWER METER
(annubar device)

NO	ITEM	CONTENT
1	Measuring Pricipal	Muli-points Pitot -Fechheimer flow element.

2	Measuring Range	1.5 to 50 m/s velocity.
3	Materal of sensor & station	All 316 SS construction.
4	Accuracy	Within 2% (AMCA 610 Certified)
5	Sensor Coefficient	1 (No need correction factor)
6	Temperature sensor/transmitter	0 to 100 deg.C. 4-20mA output , 3-wire
7	Auto Calibration	Aut0-Zero Cal. By Internally. Auto-Span Cal. By internal or external
8	Auto-Purge	Stainless steel material. Adjust.- time & Duration.
9	Flow computer(Mass-tron/CEM)	Mass flow calcuation, output, AUTO-purge & Auto- cal. Management.
10	Sensing parameter in Masstron/CEM	D/P, Tmeteraure, and Barometic pressure with duct static pressure.
11	Power supply	120vac
12	Instrument Air requirement	100 Psi. for both AUTO-Purge & Cal.

Maintenance Schedule (FLOWMETER)

	Maintenance Contents / Month (After start-up)	1	2	3	4	5	6	7	8	9	10	11	12
1	Phygical & Fuction test												
2	Zero verification												
3	Auto-Span Verfication												

<Calibration procedure of FLOWMETER>

1. All equiments are calibrated in factory by order information.
2. Field engineer perform span calibration according to reference test data by K-factor and Bias-factor correction if the engineer finds an error.
3. AUTO-Purge performance check.

Calibration

1. Zero calibration : Autamatically performing by integral circuit.
2. Span calibration : configured and mounted airpressure source and calibration logics in the system

Training Schedule (FLOWMETER)

	Training Contents	D-10	D-9	D-8	D-7	D-6	D-5	D-4	D-3	D-2	D-1	REMARK
1	Installtion											
2	Operation											1/2 day
3	Test method											1/2 day
4	Maintinence.											1/2 day

(1) This schedule can be shorten by the request of trainee.

(2) Every content is two to three hours training course.

(3) Some training courses can be combined by the request of trainee.

(4) Trainer or Trainee can discuss or choose the place of training.

FTIR SPECIFICATIONS

FTIR

NO	ITEM	CONTENT
1	Spectral range	5000-650 cm-1
2	Wavenumber accuracy	0.01cm-1
3	Resolution	0.5cm-1 to 32cm-1 (step selectable)
4	Ordinate precision	0.1%T

5	Interferometer	Michelson type with dual mechanical
6	Beam splitter	Ge/ZnSe
7	Detector	DTGS Detector
8	Source	1650K, high energy SiC, air cooled
9	Mirror control	HeNe Laser with quadrature phase detectors
10	Reflector	gold coated, diamond turned
11	Gas cells	1 cm for Inlet gas and 10 cm for Outlet gas
12	CPU	Pentium iV
13	HDD	160 GB
14	RAM	2 GB
15	ODD	Combo
16	Monitor	19" LCD
17	CPU for Server	INTEL DUAL CORE 945 (3.4GHz)
18	HDD for Server	300G SATA
19	RAM for Server	4GHz
20	VGA for Server	8600GT
21	ODD for Server	MULTI1
22	CASE for Server	MIDDLE SEVER CASE
23	Monitor for Server	19" LCD

FTIR Maintenance Schedule

	Maintenance Contents / Month (After start-up)	1	2	3	4	5	6	7	8	9	10	11	12
1	Check FTIR Performance	■	■	■									
2	Standard Calibration	■		■		■			■			■	
3	Check the Clogging of Sampling line	■	■	■		■		■			■		
4	Check / Clean the filtration unit	■	■		■		■		■		■		■
5	Check / Clean the Cell windows	■	■		■		■		■		■		■
6	Check Fittings / Valbes / Unions	■			■		■		■		■		■

FT-IR Training Schedule

	Training Contents	D-10	D-9	D-8	D-7	D-6	D-5	D-4	D-3	D-2	D-1
1	What is IR Spectroscopy	DH Yoon									
2	Principle of FTIR(□)	DH Yoon								DH Yoon	
3	Principle of FTIR(□)							DH Yoon			
4	Principle of FTIR(□)				DH Yoon						
5	Qualitative Analysis								KC Kim		
6	Qualitative Analysis									DH Yoon	
7	FTIR Operation		KC Kim			KC Kim					DH Yoon
8	How to make the method						DH Yoon		DH Yoon		
9	Calibration			DH Yoon				DH Yoon			
10	Sampling , Valving , Fitting									KC Kim	
11	Softwares				DH Yoon		DH Yoon				
12	Maintenance								KC Kim		DH Yoon

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(4) Trainer or Trainee can discuss or choose the place of training.

QMS SPECIFICATIONS

QMS

NO	ITEM	CONTENT
1	Monitoring and Analysis	Fast Continuous Real-time Gas Analysis
2	Analyte	Unlimited Number of Components
3	Detection Limits	Detection Limits of 100% to 10ppb
4	Software	Q5 Process Analysis Software Package
5	Filament	6~8W,0.178mm Dual Filament, Yttria-Iridium
6	Resolution	1 AMU
7	Electron Multiplier	Faraday Cup ,Dual Detector
8	CPU	Pentium IV
9	HDD	160 GB
10	RAM	2 GB
11	Monitor	19 inch LCD

QMS Maintenance Schedule

	Maintenance Contents / Month (After start-up)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	Check Qms Performance												
2	Standard Calibration												
3	Check the Clogging of Sampling line												
4	Check the Sample Injection Valve unit												
5	Check Rotary Pump/ Turbo Pump												
6	Check Electronics Modules												

QMS Training Schedule

	Training Contents	**D-10**	**D-9**	**D-8**	**D-7**	**D-6**	**D-5**	**D-4**	**D-3**	**D-2**	**D-1**
1	Basic Theory Mass Spec.	YT Chae									
2	Qualitative Analysis								YT Chae		
3	Quantitative Analysis									YT Chae	
4	QMS Operation		YT Chae			YT Chae					YT Chae
5	How to back up data								YT Chae		
6	Calibration			YT Chae				YT Chae			
7	Sampling , Valving , Fitting									K.C. Kim	

8	Software				YT Chae		YT Chae				
9	Maintenance								YT Chae		YT Chae

(1) This schedule can be shorten by the request of trainee.

(2) Every content is two to three hours training course.

(3) Some training courses can be combined by the request of trainee.

(4) Trainer or Trainee can discuss or choose the place of training.

NO.	Data/ Parameter	Data Unit	Description	Monitoring &Recording frequency
1)	$E_{SF6,in,y}$	tonnes	Mass of SF6 gas entering the abatement device in yearly	Annual
2)	$C_{SF6,y}$	tonnes	Annual consumption of SF6 during the project yearly, defined as the total SF6 purchased in a specific project yearly taking into account the change in inventory in the same year	Annual
3)	$SP_{project,\ y}$	m^2	Production of LCD substrate during the project yearly	Annual
4)	$E_{SF6,in}$	g/sec	Emission of SF6 gas measured at the inlet of the SF6 abatement system	Continuous (once per min.)
5)	$E_{SF6,out}$	g/sec	Emission of SF6 gas measured at the outlet of the SF6 abatement system	Continuous (once per min.)
6)	Ms, in	g/mole	Maximum molecular weight of inlet stack gas, wet basis	once per year
7)	Ms,out	g/mole	Minimum molecular weight of outlet stack gas, wet basis	once per year
8)	$M_{d,\ in}$	g/mole	Total dry molecular weight of inlet stack gas	once per year
9)	$M_{d,\ out}$	g/mole	Total dry molecular weight of outlet stack gas	once per year
10)	$B_{ws,\ in}$	N.A	The proportion of water in the inlet gas stream measured using EPA Method 4, and used to calculate the inlet gas molecular weight	once per year

11)	$B_{ws,\ out}$	N.A	The proportion of water in the outlet gas stream measured using EPA Method 4, and used to calculate the outlet gas molecular weight	once per year
12)	$P_{S,in}$	mmHg	The inlet stack pressure measured during manufacturing operations	Continuous (once per min.)
13)	$P_{S,out}$	mmHg	The outlet stack pressure measured during manufacturing operations	Continuous (once per min.)
14)	$T_{S,in}$	K	The inlet stack temperature measured during manufacturing operations	Continuous (once per min.)
15)	$T_{S,out}$	K	The outlet stack temperature measured during manufacturing operations	Continuous (once per min.)
16)	$p_{avg,in}$	mmH_2O	The averaged velocity head measurement used to calculate the inlet gas velocity in equation 10	Continuous (once per min.)
17)	$p_{avg,out}$	mmH_2O	The averaged velocity head measurement used to calculate the outlet gas velocity in equation 11	Continuous (once per min.)
18)	$v_{S,in}$	m/sec	Inlet gas velocity calculated using equation 10	Continuous (once per min.)
19)	$v_{S,out}$	m/sec	Outlet gas velocity	Continuous (once per min.)
20)	Q_{in}	m^3/s	Inlet volumetric flow rate	Continuous (once per min.)
21)	Q_{out}	m^3/s	Outlet volumetric flow rate	Continuous (once per min.)
22)	Inlet SF_6 Conc.	ppm	Inlet SF6 concentration measured by FTIR	Continuous (once per min.)
23)	Outlet SF_6 Conc.	ppm	Outlet SF6 concentration measured by FTIR	Continuous (once per min.)
24)	FCi,j,y	m^3/yr	volume unit per year of natural gas consumed by abatement device	Continuous (once per min.)
25)	WC,i,y	tC/t LNG	Weighted average mass fraction of carbon in natural gas in year y	once per year
26)	ρi,y	t/ m3	Weighted average density of natural gas in year y	once per year
27)	EC,y	kWh	Electricity Consumption in year y	Continuous (once per min.)

1. The proportion of moisture in the inlet/Outlet gas is measured by the professional measurement company which has a certification. The measurement should be done based on US EPA Method 4.