MONITORING REPORT FORM (CDM-MR) *
Version 01 - in effect as of: 28/09/2010

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* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

MONITORING REPORT
Version 01, 04/10/2010

Point of Use Abatement Device to Reduce SF6 emissions in LCD Manufacturing Operations in the Republic of Korea (South Korea)
Reference number 3440
The 1st monitoring period, 01/08/2010 – 30/09/2010

SECTION A. General description of the project activity

A.1. Brief description of the project activity: >>

>>
LG Display (LGD) currently uses SF6 in its LCD manufacturing process in Plant 2/3, Plant 4/5, Plant 6 in Gumi, South Korea and Plant 7 in Paju, South Korea. To destroy much of the SF6 vented from the dry etching process, LG International (LGI) and LGD installed an abatement device at the stack of the dry etching chambers in Plant 6. And additional abatement devices which will have similar technical specification with the existing system will be installed in the other plants as soon as the first issuance of CER from the project is approved by the UN CDM Executive Board.

The project activities during this monitoring period includes only Plant 6 and the other Plants mentioned in the registered Project Designed Document will be included from the subsequent monitoring period or thereafter depending on the investment timeline of each abatement system. The emission reductions achieved during this monitoring period comes from the abatement system in Plant 6 and, therefore, all information provided in this report is limited only to that of the existing system in Plant 6.

To decompose SF6 gas, high temperature, around 1,200℃, is necessary and diverse continuous measurements on both inlet and outlet are required to ensure accurate and reliable monitoring outcomes of emission reductions. For this purpose, an end-of-pipe abatement device was selected. And, In order to capture the actual amount of SF6 entering and subsequently leaving the abatement device, the project participants have been undertaking an extensive ongoing monitoring operation. This monitoring operation includes installing and maintaining Fourier Transform Infrared (FTIR) devices on both the inlet and the outlet of the abatement device to continuously monitor the concentration of SF6 and calculate the mass of SF6 destroyed. In addition, two sets of Quadrupole Mass Spectrometer (QMS) were installed to calculate accurate values of dry molecular weights of both the inlet and the oulet gases as the applied methodology requires. This result has been converted into a carbon equivalent value and any emissions resulting from electricity and/or fuel consumption of the abatement device has been subtracted to arrive at the emission reduction value for the project activity.

The following information contains dates of key events of the project

Date	Progress
February 13, 2009	The applied methodology, developed by the project participants, was approved by the CDM EB.
June 1, 2009	An EPC contract was signed and construction was commenced.
July 10, 2010	The project was approved by the CDM EB
July 23, 2010	The commissioning of the abatement system was completed.
August 1, 2010 ~	The crediting period of the project was started and operation was commenced.
September 30, 2010	The 1st monitoring period was over and the emission reduction data for the period was confirmed.

The total emission reduction achieved for the 1st monitoring period, starting from August 1, 2010 and ending on September 30 of the same year, is 144,274 tons of CO2 equivalent.

A.2. Project Participants

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LG International Corp.
LG Display Co., Ltd.
Climate Change Capital Carbon Fund II s.a.r.l.

A.3. Location of the project activity:

>>

Plant 6, having the GPS coordinates of (36.0944, 128.4111), is located at Gumi, Gyeongsangbuk-do, Republic of Korea.

Plant 6,
Gumi, Gyeongsanbuk-do

Plant 6
Gumi, Gyeonsangbuk-

A.4. Technical description of the project

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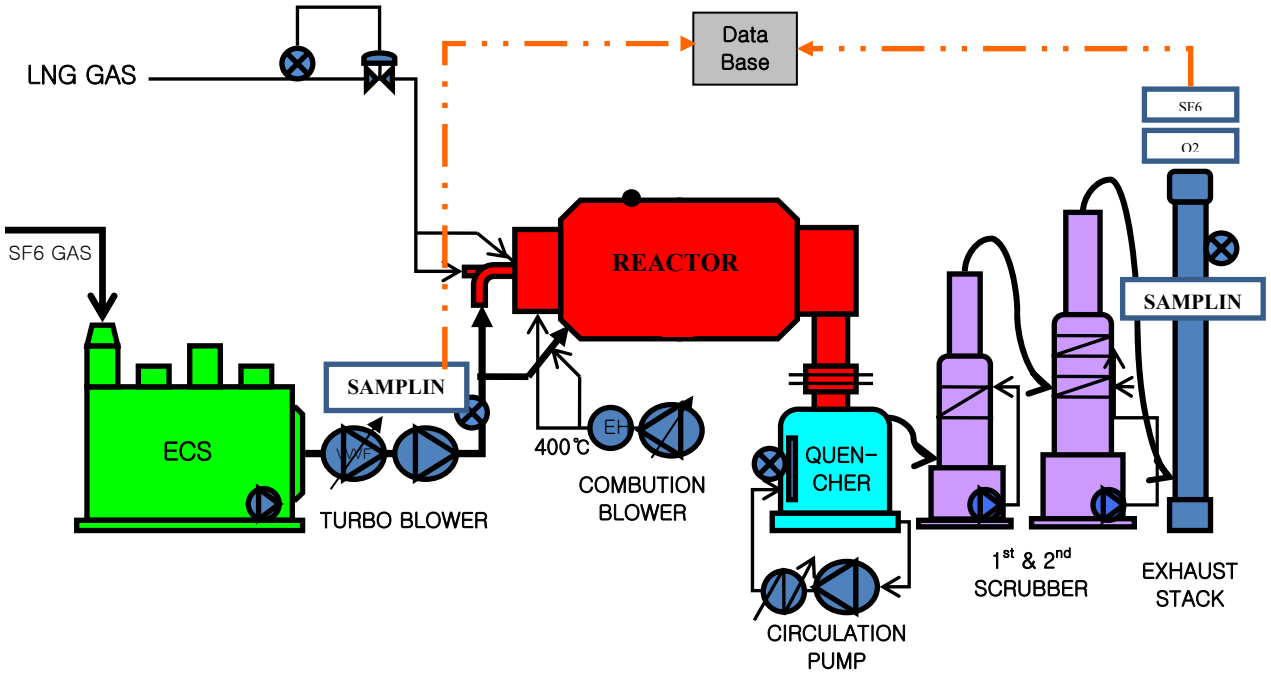
This project installed the necessary abatement equipments required to destroy SF6 that is vented from the Dry Etching processes in the manufacture of LCD panels. Specifically, the abatement technology requires temperature around 1,200℃ to break down and destroy the SF6. The specifications of the abatement device installed in Plant 6 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

And the following figure shows the configuration of the whole abatement system. The abatement system consists of 4 main devices; ECS, reactor, quencher and scrubbers.



1) ECS (Pre-treatment system)
This Device removes F-compounds such as HF(SF6 is not excluded), water soluble acidic/toxic components and dusts with 1~0.1μ m diameters from inlet gas before the gas enters into the reactor. NaOH is used as a reaction material with HF and HCl and dusts being charged by an ionizer are gathered in a packing bed located at the end of the ionizer.

2) Reactor
The reactor is a core technology of this system. This reactor is operated at 1200℃ and secures the removal efficiency higher than 95%.

3) Quencher
To avoid SF6 recombination, the gas exiting from the reactor should be cooled rapidly to below 70℃. The quencher is made of carbon graphite to stand extreme heat stress and to efficiently cool down the exiting gas.

4) 1st&2nd Scrubber
Two sets of scrubbers were installed to remove hazardous gas components such as HF, SOx and NOx from the treated gas. Each scrubber has 85% removal efficiency, the two sets of scrubbers installed in series, therefore, guarantee 97.7% removal efficiency and ensure that any regulated air pollutants of the ventilated gas are well within legally accepted limit.

A.5. Title, reference and version of the 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

A.6. Registration date of the project activity:

>>
July 10, 2010

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

>>
August 1, 2010 – July 31, 2020 (Fixed)

The starting date of the crediting period has been changed from July 10, 2010 to August 1, 2010 following the project participants' request made on July 22, 2010. The request was sent to the UNFCCC secretariat and subsequently accepted.

A.8. Name of responsible person(s)/entity(ies):

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

Tel: +82-2-3773-5298
E-mail: ysseoa@lgi.co.kr

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

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The commissioning of the abatement device installed in Plant 6 was completed on July 23, 2010 and has been operational since August 1, 2010. Any commercial orders for additional sets of abatement devices to be installed in the other plants are yet to be made at the time of writing. As the project participants described in the registered PDD, the other plants will be invested after the performance of the existing abatement system has been confirmed. The project participants expect the expansion will be able to be commenced early 2011.

And the followings are information on special events including overhaul times, downtimes of the system and exchange of any equipment. (Any replacement works of consumables are excluded.)

Events	Date	Duration	Effects on emission reduction
Data processing program correction	Aug 4, 2010	15 minutes	According to the methodology, mass of any SF6 entering into or exiting from the abatement device shall be excluded from the emission reductions calculation where gas velocity or flow rate decreases more than 5% at inlet or increases more than 5% at outlet, compared to the baseline values of each parameter. The former version of the program deducted mass of SF6 from the calculation if those values varied more than ± 5% from the baseline values and this was excessive regulation. The latest version was modified according to the firstly mentioned guidelines and it is perfectly in compliance with the methodology.
Inlet FTIR probe change	Aug 5, 2010	15 minutes	The probe of the inlet FTIR was substituted for a new one as the old one was contaminated by the inlet gas. The mass entering into the system during the replacement work was completely deducted from the baseline calculation.
Emergency Shut-down of the system	Aug 9, 2010	19 minutes	Inlet flow rate rapidly increased more than 40% in a second because of auto-damper replacement work done by LG Display. This rapid flow rate increase led to an instant extinguishment of flame inside the reactor. The reactor was ignited again in 20 minutes.
Communication error between MMI and the data processing program	Aug 11, 2010	3 hours	Due to the communication error between MMI and the data processing program, the program failed to gather real-time data but only recorded constant values of each parameter which had been recorded lastly before the error occurred. After rebooting the system, the problem was solved. The mass of SF6 removed during this period was completely deducted from the emission reduction calculation.
Outlet annubar error	Aug 17, 2010	9 minutes	After auto purging, the outlet annubar failed to detect accurate values of flow rate. The outlet annubar was re-booted and the problem was solved. The mass of SF6 removed during this period was completely deducted from the emission reduction calculation.
FTIR Maintenance	Aug 19, 2010	2 hours	FTIR maintenance was done and meaning less values of inlet SF6 concentration was recorded during that period. Hence, any reduction calculated during this period was completely deducted from the emission reductions calculation.
M_s value change	Aug 20, 2010	Not Applicable	The second measurement of M_d and B_{ws} was done on the previous day and the new values were applied from August 20, 2010.
Data recording frequency change	Sep 1, 2010	40 minutes	As a step of database setting-up processes, data recording frequency of the program was changed from once per 10 seconds to once per second to make them harmonized with other parameters of MMI which are being recorded at once second frequency. .

Communication error between MMI and the data processing program	Sep 1, 2010	80 minutes	Due to the communication error between MMI and the data processing program, the program failed to gather real-time data but only recorded constant values of each parameter which had been recorded for the last time before the error occurred. After rebooting the system, the problem was solved. The mass of SF6 removed during this period was completely deducted from the emission reduction calculation.
Emergency Shut-down of the system	Sep 3, 2010	11 minutes	The emergency shut down occurred by an operator who clicked the emergency shutdown button on the MMI screen by mistake. The re-ignition work took 11 minutes.
Data arrangement	Sep 5, 2010	28 minutes	To set up a database system, re-arrangement of data was necessary. It took 28 minutes and SF6 removal during this period was not included in the emission reduction calculation.
Data recording error	Sep 5, 2010	30 minutes	Data monitored during this period was not recorded as an operator accessed a CLD file by mistake. The data processing program records all data of the day in one (1) CLD file on real time basis so data is unable to be recorded if the CLD file is accessed before the recording is completed.
Flow meter error	Sep 12, 2010	40 minutes	The outlet annubar failed to detect correct level of flow following the daily auto calibration. The problem was solved through re-booting the annubar and any reductions during this period were completely deducted from the emission reductions calculation.
Communication error	Sep 17, 2010	15 minutes	Due to the communication error between MMI and the data processing program, the program failed to gather real-time data but only recorded constant values of each parameter which had been recorded lastly before the error occurred. After rebooting the system, the problem was solved. The mass of SF6 removed during this period was completely deducted from the emission reduction calculation.
Database establishment	Sep 29, 2010	17 minutes	While connecting database system to the existing data processing program, data was not gathered appropriately. The reduction during this work was completely deducted from the emission reduction calculation.

The above events have not had any adverse effects on the applicability of the applied methodology and no other event which may impact the applicability of the methodology has occurred during the monitoring period.

1. The starting date of operation of the project activity. For project activities that consist of more than one site, the report shall clearly describe the status of implementation and starting date of operation for each site. For CDM project activities with phased implementation, the report shall indicate the progress of the proposed CDM project activity achieved in each phase.

2. The information regarding the actual operation of the project activity during this monitoring period, including information on special events, for example overhaul times, downtimes of equipment, exchange of equipment, etc.
3. A brief description of: (i) events or situations that occurred during the monitoring period, which may impact the applicability of the methodology, and (ii) how the issues resulting from these events or situations are being addressed.

B.2. Revision of the monitoring plan

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No revision on the approved monitoring plan has been made.

B.3. Request for deviation applied to this monitoring period

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No deviation has been made.

B.4. Notification or request of approval of changes

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No notification or request of approval of changes on the project activity has been made.

SECTION C. Description of the monitoring system

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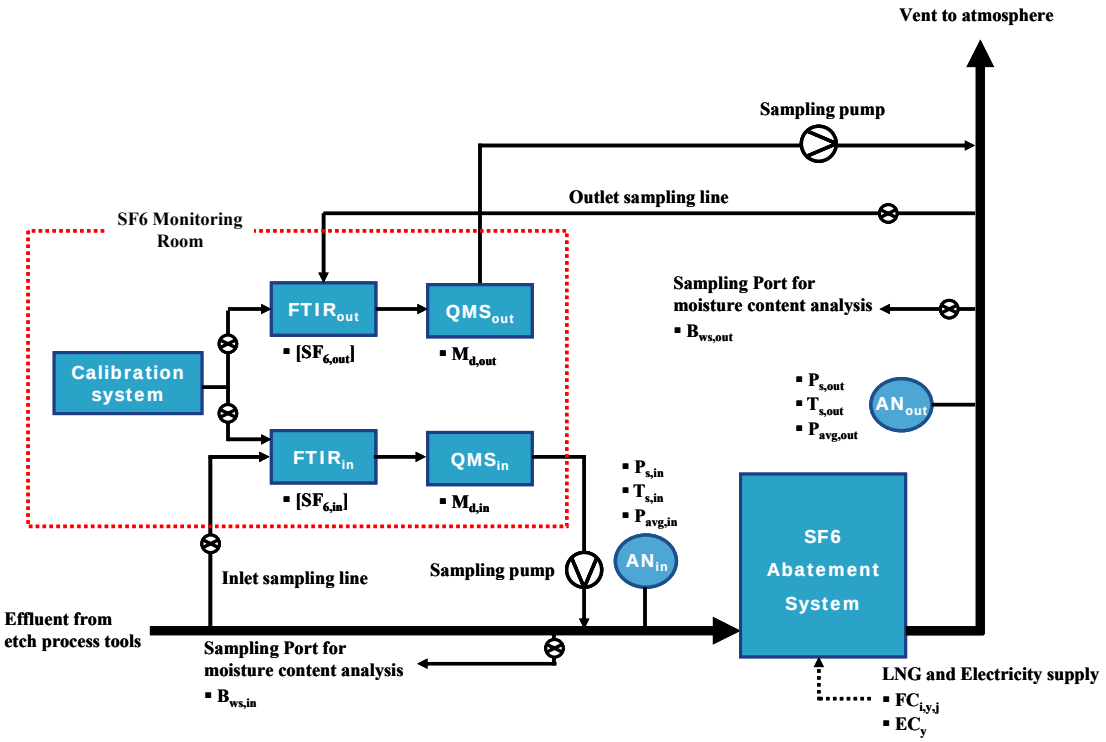
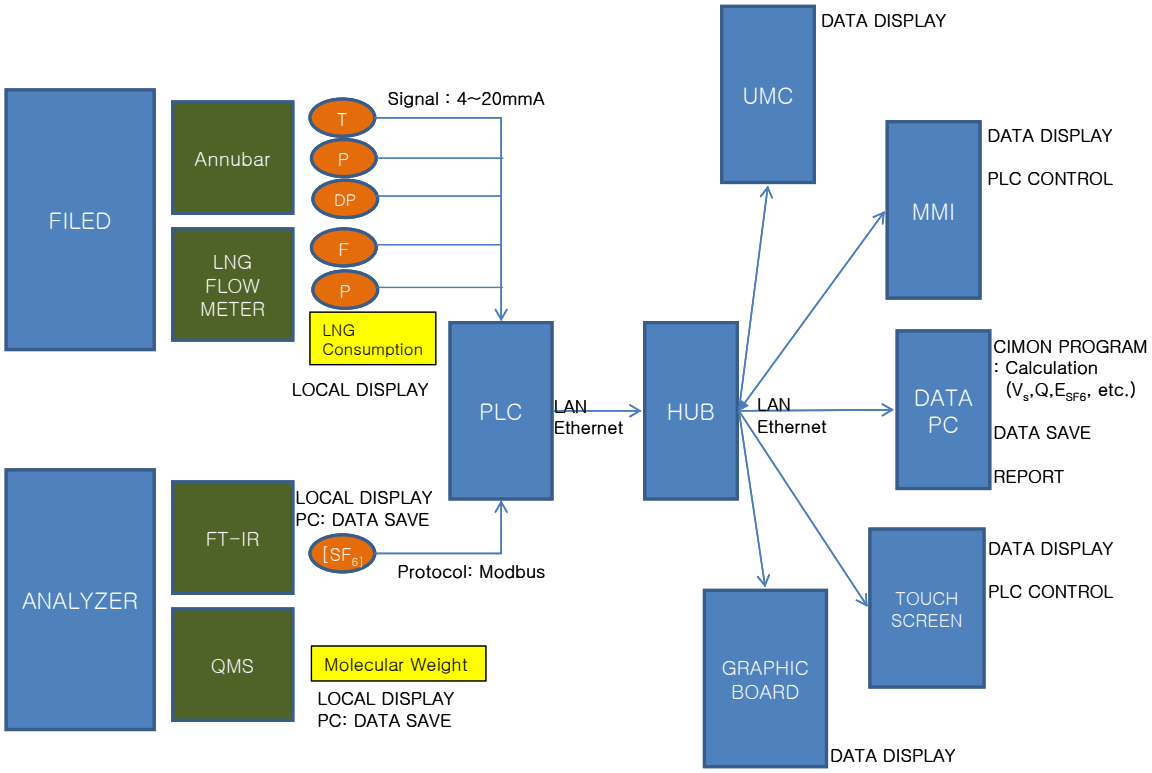
Parameters used in the emission reductions calculation can be classified into 4 groups – continuously monitored group, frequently monitored group, calculated group and externally provided group. The following diagrams show all relevant monitoring points and how the continuously monitored factors and frequently monitored factors are gathered, processed, calculated, recorded and reported.



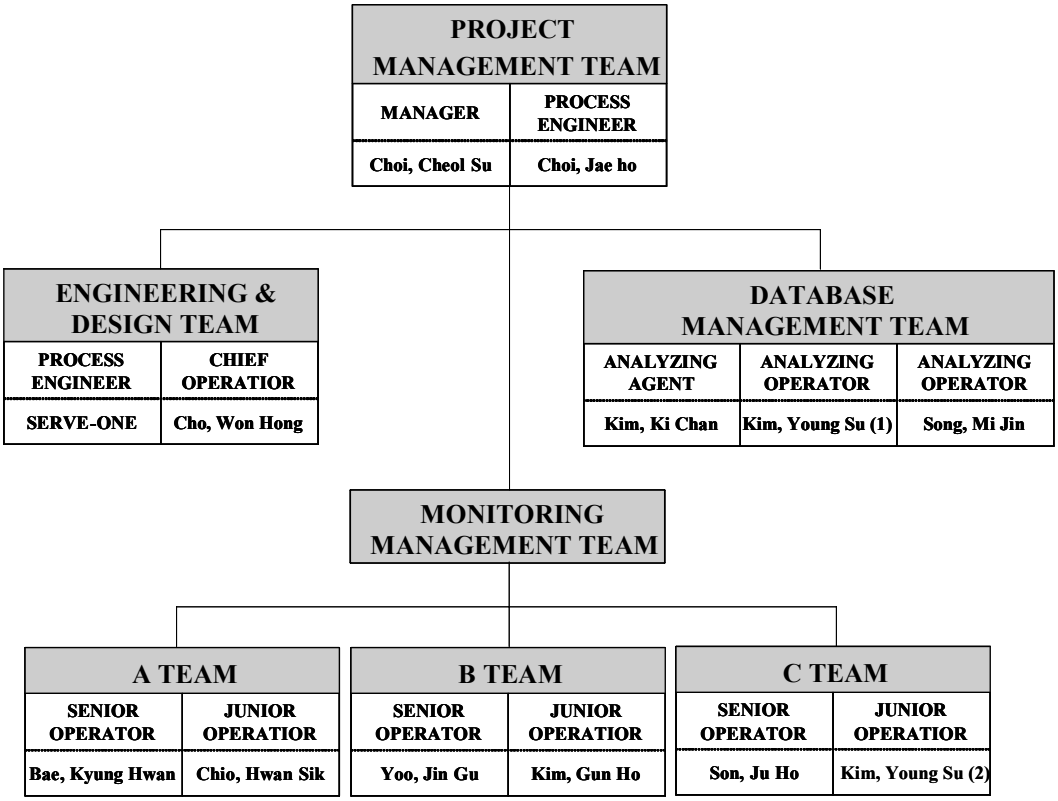
<Monitoring points>



<Data Processing Flow>

The continuously monitored parameters including temperature, pressure, velocity head and concentration of SF6 in both inlet and outlet gases are measured by each metering device described in Section D.2. The data is transmitted to PLC through electrical signal and subsequently distributed to other devices such as MMI, UMC and computers to control the whole system and to calculate emission reductions. The emission reduction is calculated by the data processing program and the results are recorded along with other raw data on server computers. The result is reported to the project participant by the operation team on daily, weekly and monthly bases. In case of the externally provided group, the project participants secured accuracy and transparency of data through diverse QA/QC activities. The activities include crosschecking with logbook/SAP data, invoice/letter from suppliers and other reliable measures.

The operation team consists of several sub-teams namely Project Management team, Engineering & Design team, Database Management team and Operation Management team. The following is an organizational structure of the operation team.



Each sub team has following roles and responsibilities;

1) Project Management team's roles and responsibilities
- Responsible for the overall legal affairs for SF6 decomposition facilities
- Secure operations of the SF6 decomposition facilities in accordance with the CDM methodology
- Secure and manage human resources necessary for operations of SF6 decomposition facilities
- Training practice and evaluation of each team member necessary for operations
- Amicable performance over operations of the facilities in cooperation with managers of LG
- Check and supervision over operating conditions for SF6 decomposition facilities
- Responsible supervision for calibrations of metering devices and supervision for suppliers

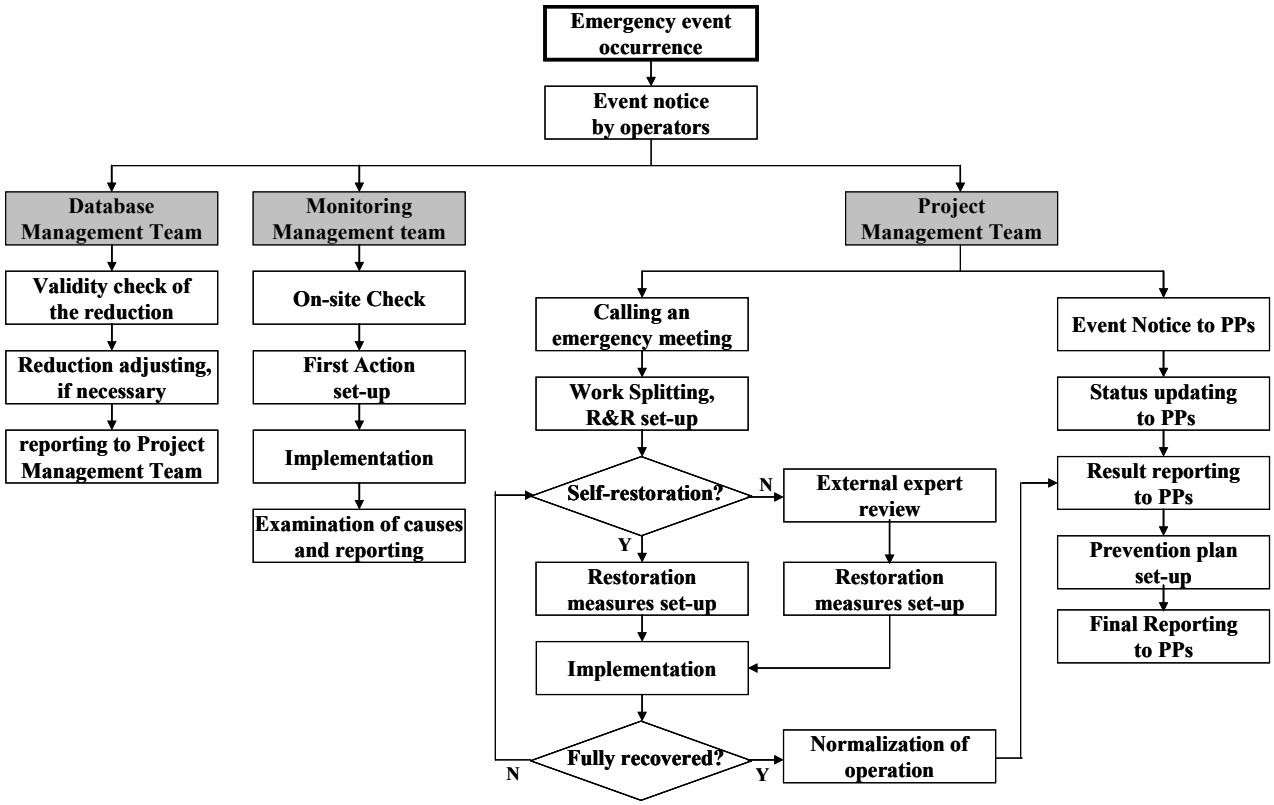
2) Engineering & Design team's roles and responsibilities
- Designer for the overall operations for SF6 decomposition facilities
- Maintain the proper operating conditions and performance for SF6 decomposition facilities
- Risk management for operations of SF6 decomposition facilities
- System design in accordance with the methodology
- Improvements on equipments for SF6 decomposition facilities and system

3) Database Management team's roles and responsibilities
- Actual operator of SF6 decomposition facilities
- Data monitoring and record required in the methodology
- Establish alarm values and monitor them
- Regular check on SF6 decomposition facilities

4) Monitoring Management team's roles and responsibilities
- Data measurement and storage necessary for the methodology
- Store measurement data for 2 years after the last credit period
- Calibration of metering device and reporting of calibration results
- Maintenance/repair and report of metering devices
- Accuracy check and result report for measurements
- Check and troubleshooting on any alarm from metering devices
- Daily/weekly/monthly report for measurement data

- Auditing for calibration works on metering devices

The operation team has set up emergency plans for the main system and metering devices. When emergency events occur, the following emergency procedure will be applied.



More detailed information on monitoring system is included in a Data Management Manual which has been provided to DOE for verification purpose.

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors	
(Copy this table for each data and parameter. To report multiple values, a table may be used)	
Data / Parameter:	**GWP of** SF_6
Data unit:	$tCO2eq/tSF_6$
Description:	Global Warming Potential of SF_6
Source of data used:	IPCC default value
Value(s) :	23,900
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the baseline calculation.
Additional comment:	Provided by the IPCC to calculate the global warming potential of SF_6

Data / Parameter:	**Design capacity for existing Abatement Device (*CAP* $_{SF\ 6,\ ex}$)**
Data unit:	Tonnes/year
Description:	Design capacity should be based on 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(s) :	None- Not applicable
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the baseline calculation.
Additional comment:	There is no abatement device on the existing lines of production or plants included in this project.

Data / Parameter:	**Historical SF_6 consumption ($CSF6,hist$)**
Data unit:	Tonnes
Description:	Historical SF_6 consumption of Plant 6, 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(s) :	12.704 tonnes This value is the maximum consumption of SF6 in Plant 6 over the three year historic period.

Fab	Yearly SF6 consumption (kg)		
	'06	'07	'08
P6 (in the PDD)	55,024	73,990	76,226
P6 (adjusted)	9,171	12,332	12,704

	For this monitoring purpose, only 2 months of $C_{SF6,hist}$ is necessary. Therefore, the values presented in the PDD are re-calculated on a pro-rata basis.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the baseline calculation.
Additional comment:	For this monitoring period, only Plant 6 is operational. Therefore, only the data for Plant 6 is included.

Data / Parameter:	Historical production of LCD substrate **(SP_{-i})**
Data unit:	m2
Description:	Historical production of LCD substrate (m^2) of Plant 6 during year i (where i =-1, -2, -3) prior to the implementation of the project activity before January, 31, 2009 (values of 2 months, for this monitoring purpose)
Source of data used:	Production record
Value(s) :	

Fab	Glass input(m2)		
	'06	'07	'08
P6 (in the PDD)	4,078,800	5,252,354	5,680,338
P6 (adjusted)	679,800	875,392	946,723

For this monitoring purpose, only 2 months of SP_{-i} is necessary. Therefore, the values presented in the PDD are re-calculated on a pro-rata basis.

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the baseline calculation.
Additional comment:	For this monitoring period, only Plant 6 is operational. Therefore, only the data for Plant 6 is included.

Data / Parameter:	**Maintenance schedule for abatement device**
Data unit:	List of maintenance requirements and checking frequency
Description:	Complete maintenance schedule for the device
Source of data used:	Yearly plan of Operation & Maintenance team
Value(s) :	A summary of this information is described in Section C.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Not applicable
Additional comment:	This data is not used for calculating emission reduction. However, reporting this data is required by the applied methodology.

Data / Parameter:	**Maintenance schedule for FTIR measurement devices**
Data unit:	List of maintenance requirements and checking frequency
Description:	Complete maintenance schedule for the device
Source of data used:	Yearly plan of Operation & Maintenance team
Value(s) :	A summary of this information is described in Section C.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Not applicable
Additional comment:	This data is not used for calculating emission reduction. However, reporting this data is required by the applied methodology.

Data / Parameter:	**Maintenance schedule for QMS measurement devices**
Data unit:	List of maintenance requirements and checking frequency
Description:	Complete maintenance schedule for the device
Source of data used:	Yearly plan of Operation & Maintenance team
Value(s) :	A summary of this information is described in Section C.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Not applicable
Additional comment:	This data is not used for calculating emission reduction. However, reporting this data is required by the applied methodology.

Data / Parameter:	**Maintenance schedule for Annubar devices**
Data unit:	List of maintenance requirements and checking frequency
Description:	Complete maintenance schedule for the device
Source of data used:	Yearly plan of Operation & Maintenance team
Value(s) :	A summary of this information is described in Section C.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Not applicable
Additional comment:	This data is not used for calculating emission reduction. However, reporting this data is required by the applied methodology.

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"
Value(s) :	0.5708 TCO2/MWh
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project calculation.
Additional comment:	This data has been verified by the DOE which validated the project and will be used for the whole crediting period of the project.

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(s) :	1
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project calculation.
Additional comment:	As specified in the registered PDD, This data is applicable only to Plant 6 and values applicable to the other plants will be verified at the following verification or thereafter when each plant becomes operational and included in the monitoring period thereof.

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(s) :	1
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project calculation.
Additional comment:	As specified in the registered PDD, This data is applicable only to Plant 6 and values applicable to the other plants will be verified at the following verification or thereafter when each plant becomes operational and included in monitoring period thereof.

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:	Supplier's specification
Value(s) :	0.0961625
Indicate what the data are used for (Baseline/ Project/ Leakage emission	This data is used for the project calculation.

calculations)	
Additional comment:	0.175m * 0.175m*3.14 (Diameter of the inlet stack is 0.35m) As specified in the registered PDD, This data is applicable only to Plant 6 and values applicable to the other plants will be verified at the following verification or thereafter when each plant becomes operational and included in monitoring period thereof.

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:	Supplier's specification
Value(s) :	0.2826
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project calculation.
Additional comment:	0.3m * 0.3m*3.14 (Diameter of the outlet stack is 0.6m) As specified in the registered PDD, This data is applicable only to Plant 6 and values applicable to the other plants will be verified at the following verification or thereafter when each plant becomes operational and included in monitoring period thereof.

D.2. Data and parameters monitored	
(Copy this table for each data and parameter. To report multiple values, a table may be used)	
Data / Parameter:	$E_{SF6,in,y}$
Data unit:	tonnes
Description:	Mass of SF_6 gas entering the abatement device in year *y* (From August 1, 2010 to September 30, 2010, for this monitoring purpose)
Measured /Calculated /Default:	Calculated
Source of data:	Data processing program and Daily/weekly/monthly logs
Value(s) of monitored parameter:	6.3886 tonnes
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for both the Baseline and Project emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	This value is a sum of daily $E_{SF6,\ in}$ values for the monitoring period. For the monitoring equipment information of $E_{SF6,\ in}$, please refer to the $E_{SF6,in}$ table in this section.
Measuring/ Reading/ Recording frequency:	Once per year or a monitoring period, whichever is shorter.
Calculation method (if applicable):	Sum of daily $E_{SF6,in}$
QA/QC procedures applied:	Daily sum of $E_{SF6,in}$ value is automatically calculated by a data processing program and recorded in a daily log by operators. The log is double- checked by the head of O&M team and sum of weekly and monthly data are reported to the project participants periodically. More detailed information on QA/QC procedure is included in the

	Data Management Manual which has been provided to DOE for verification purpose.

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. (From August 1, 2010 to September 30, 2010, for this monitoring purpose)
Measured /Calculated /Default:	Calculated
Source of data:	Purchase records, monthly records on SF6 inventory change and cylinder replacement records.
Value(s) of monitored parameter:	14.459 Tonnes
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the baseline emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable
Measuring/ Reading/ Recording frequency:	Once per year or a monitoring period, whichever is shorter.
Calculation method (if applicable):	(Total SF6 purchase Amount – Inventory change) * 10% of heel value
QA/QC procedures applied:	This data is cross-checked with official purchase records and inventory data is measured and recorded at the beginning and end of each month. Residual gas quantity (Heel value), which is smaller than 10%, is measured and recorded every replacement. However, for more conservative calculation, 10% of heal value is applied in the emission reduction calculation.

Data / Parameter:	$SP_{project,y}$
Data unit:	m^2
Description:	Production of LCD substrate during the project year *y* (From August 1, 2010 to September 30, 2010, for this monitoring purpose)
Measured /Calculated /Default:	Measured
Source of data:	Data management system of LG Display
Value(s) of monitored parameter:	1,085,574 m^2
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the baseline emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	This data comes from the Manufacturing Execution System of LG Display, which is a computerized system commonly used in the manufacturing industry.
Measuring/ Reading/	Once per year or a monitoring period, whichever is shorter.

Recording frequency:	
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	Cross check with LGD's monthly & annual production summary reports

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
Measured /Calculated /Default:	Calculated
Source of data:	From inlet QMS, FTIR and inlet Annubar devices
Value(s) of monitored parameter:	Sums of the daily, weekly and monthly data of $E_{SF6,\ in}$ are recorded and reported.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the baseline emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable This is a calculated data.
Measuring/ Reading/ Recording frequency:	Once per second
Calculation method (if applicable):	Equation 14 in the applied methodology $E_{SF6in} = 65.18 Q_{in} [SF_{6in}]$
QA/QC procedures applied:	Daily sum of $E_{SF6,in}$ value is automatically calculated by a data processing program and recorded in a daily log by operators. The log is double- checked by the head of O&M team and sum of weekly and monthly data are reported to the project participants periodically. More detailed information on QA/QC procedure is included in the Data Management Manual which has been provided to DOE for verification purpose.

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
Measured /Calculated /Default:	Calculated
Source of data:	Data processing program
Value(s) of monitored parameter:	Sums of the daily, weekly and monthly data of $E_{SF6,\ out}$ are recorded and reported.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable This is a calculated data.
Measuring/ Reading/ Recording frequency:	Once per second
Calculation method (if	Equation 15 in the applied methodology

applicable):	$E_{SF6out} = 65.18 Q_{out} [SF_{6out}]$
QA/QC procedures applied:	Daily sum of $E_{SF6,out}$ value is automatically calculated by a data processing program and recorded in a daily log by operators. The log is double- checked by the head of O&M team and sum of weekly and monthly data are reported to the project participants periodically. More detailed information on QA/QC procedure is included in the Data Management Manual which has been provided to DOE for verification purpose.

Data / Parameter:	**$M_{s.in}$**
Data unit:	g/mole
Description:	Maximum molecular weight of inlet stack gas, wet basis
Measured /Calculated /Default:	Calculated
Source of data:	Data processing program, inlet QMS and water vapour measurement report
Value(s) of monitored parameter:	28.270 g/mole (for the period from Aug 1, 2010 to Aug 19, 2010) 28.175 g/mole (for the period from Aug 20, 2010 to Sep 30, 2010)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the baseline emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable This is a calculated data.
Measuring/ Reading/ Recording frequency:	Once per year, at least
Calculation method (if applicable):	Equation 8 in the applied methodology $M_{s,in} = M_{d,in} \cdot (100 - B_{ws,in}) \div 100 + 0.18 B_{ws,in}$
QA/QC procedures applied:	This is a calculated data through measured $M_{d,in}$ and $B_{ws,in}$. Therefore, QA/QC procedures for $M_{s,in}$ follow those of $M_{d,in}$ and $B_{ws,in}$.

Data / Parameter:	**$M_{s.out}$**
Data unit:	g/mole
Description:	Minimum molecular weight of outlet stack gas, wet basis
Measured /Calculated /Default:	Calculated
Source of data:	Data processing program, outlet QMS and a water vapour measurement report
Value(s) of monitored parameter:	27.792 g/mole (for the period from Aug 1, 2010 to Aug 19, 2010) 27.889 g/mole (for the period from Aug 20, 2010 to Sep 30, 2010)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the Project emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable This is a calculated data.
Measuring/ Reading/ Recording frequency:	Once per year, at least

Calculation method (if applicable):	Equation 9 in the applied methodology $M_{s,out} = M_{d,out} \cdot (100 - B_{ws,out}) \div 100 + 0.18 B_{ws,out}$
QA/QC procedures applied:	This is a calculated data through measured $M_{d,out}$ and $B_{ws,out}$. Therefore, QA/QC procedures for $M_{s,out}$ follow those of $M_{d,out}$ and $B_{ws,out}$.

Data / Parameter:	$M_{d,in}$
Data unit:	g/mole
Description:	Molecular weight of inlet stack gas (dry basis)
Measured /Calculated /Default:	calculated
Source of data:	From inlet QMS and an analyzing result report
Value(s) of monitored parameter:	28.853 g/mole (for the period from Aug 1, 2010 to Aug 19, 2010) 28.850 g/mole (for the period from Aug 20, 2010 to Sep 30, 2010)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the baseline emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	inlet QMS Type: Quadruple Mass spectrometry Accuracy class: 97% Serial number: 2X31131 Calibration frequency: Once per year Date of last Calibration: August 19, 2010 Validity: August 18, 2011
Measuring/ Reading/ Recording frequency:	Once per year, at least
Calculation method (if applicable):	Equation 6 in the applied methodology and relevant clauses thereof. $M_{d,in} = 1.460[SF_{6in}] + 0.440[CO_{2in}] + 0.320[O_{2in}] + 0.280[N_{2in}] + 0.399[Ar_{in}] + 1.021[SO_2F_{2in}] + 0.040[He_{in}]$
QA/QC procedures applied:	QMS was calibrated with all components having more than 100 ppmv concentrations in inlet gas, which include SF_6, CO_2, O_2, N_2, Ar, SO_2F_2 and He. And the applied value of $M_{d,in}$ is higher than the actual maximum value of $M_{d,in}$(rounded up) during the 6 hours measuring period and this makes the emission reduction result more conservative. More detailed information on QA/QC procedure is included in the Data Management Manual which has been provided to DOE for verification purpose.

Data / Parameter:	$M_{d,out}$
Data unit:	g/mole
Description:	Molecular weight of outlet stack gas (dry basis)
Measured /Calculated /Default:	calculated
Source of data:	From outlet QMS and an analyzing result report
Value(s) of monitored parameter:	28.810 g/mole (for the period from Aug 1, 2010 to Aug 19, 2010) 29.249 g/mole (for the period from Aug 20, 2010 to Sep 30, 2010)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	outlet QMS Type: Quadruple Mass spectrometry Accuracy class: 97% Serial number: 2X31132

	Calibration frequency: Once per year Date of last Calibration: August 19, 2010 Validity: August 18, 2011
Measuring/ Reading/ Recording frequency:	Once per year, at least
Calculation method (if applicable):	Equation 7 in the applied methodology and relevant clauses thereof. $M_{d,out} = 0.440[CO_{2out}] + 0.320[O_{2out}] + 0.280[N_{2out}] + 0.399[Ar_{out}] + 0.040[He_{out}]$
QA/QC procedures applied:	QMS was calibrated with all components having more than 100 ppmv concentrations in outlet gas, which include CO_2, O_2, N_2, Ar and He. And the applied value of $M_{d,out}$, 28.810 g/mole, is lower than the actual maximum value of $M_{d,out}$(rounded down) during the 6 hours measuring period and this makes the emission reduction result more conservative More detailed information on QA/QC procedure is included in the Data Management Manual which has been provided to DOE for verification purpose..

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.
Measured /Calculated /Default:	Measured
Source of data:	a measurement report
Value(s) of monitored parameter:	5.376 % (for the period from Aug 1, 2010 to Aug 19, 2010) 6.220 % (for the period from Aug 20, 2010 to Sep 30, 2010)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the baseline emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	This data was measured by an independent measurement company in accordance with the EPA method. Inlet water proportion analyzer Type: Gas Sampling Analyzer Accuracy class: 95% Serial number: 80-091100-1 Calibration frequency: Once per 2 years Date of last Calibration: November 24, 2008 Validity: November 24, 2010
Measuring/ Reading/ Recording frequency:	Once per year, at least
Calculation method (if applicable):	This value was measured by an independent measuring and analyzing company and the entire measurement procedure followed EPA method 4.
QA/QC procedures applied:	This measurement was done for 6 hours during normal manufacturing conditions. The averaged proportion of water during the 6 hours period is used to calculate the inlet gas stream density. More detailed information on QA/QC procedure is included in the Data Management Manual which has been provided to DOE for verification purpose.

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.
Measured /Calculated /Default:	Measured
Source of data:	a measurement report
Value(s) of monitored parameter:	9.414 % (for the period from Aug 1, 2010 to Aug 19, 2010) 12.090 % (for the period from Aug 20, 2010 to Sep 30, 2010)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	This data was measured by an independent measurement company in accordance with the EPA method. outlet water proportion analyzer

Type	Gas Sampling Analyzer
Accuracy class	95%
Serial number	601023
Calibration frequency	Once per 2 years
Date of last Calibration	April 12, 2010
Validity	Aril 12, 2012

Measuring/ Reading/ Recording frequency:	Once per year, at least
Calculation method (if applicable):	This value was measured by an independent measuring and analyzing company and the entire measurement procedure followed EPA method 4.
QA/QC procedures applied:	This measurement was done for 6 hours during normal manufacturing conditions. The averaged proportion of water during the 6 hours period is used to calculate the inlet gas stream density. More detailed information on QA/QC procedure is included in the Data Management Manual which has been provided to DOE for verification purpose.

Data / Parameter:	Absolute inlet stack pressure ($P_{s,in}$)
Data unit:	mmHg
Description:	The inlet stack pressure measured during manufacturing operations
Measured /Calculated /Default:	measured
Source of data:	From inlet annubar
Value(s) of monitored parameter:	Not applicable (This parameter is monitored on a continuous basis)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the baseline emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	(inlet annubar device)

Type	Differential Pressure-Pitot tube
Accuracy class	97~98%
Serial number	69453A
Calibration frequency	Once per day (auto calibration)
Date of last Calibration	Not applicable (every day)
Validity	Not applicable

Measuring/ Reading/ Recording frequency:	This value is monitored for every second and used to calculate $E_{SF6,in.}$
Calculation method (if applicable):	Not applicable

QA/QC procedures applied:	This value is measured in accordance with the EPA guideline.

Data / Parameter:	Absolute outlet stack pressure ($P_{s,out}$)
Data unit:	mmHg
Description:	The outlet stack pressure measured during manufacturing operations
Measured /Calculated /Default:	measured
Source of data:	From outlet annubar
Value(s) of monitored parameter:	Not applicable (This parameter is monitored on a continuous basis)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	(outlet annubar device) Type: Differential Pressure-Pitot tube Accuracy class: 97~98% Serial number: 69453B Calibration frequency: Once per day (auto calibration) Date of last Calibration: Not applicable (every day) Validity: Not applicable
Measuring/ Reading/ Recording frequency:	This value is monitored for every second and used to calculate $E_{SF6,out.}$
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	This value is measured in accordance with the EPA guideline.

Data / Parameter:	Absolute inlet stack temperature ($T_{s,in}$)
Data unit:	K
Description:	The inlet stack temperature measured during manufacturing operations
Measured /Calculated /Default:	Measured
Source of data:	From inlet annubar
Value(s) of monitored parameter:	Not applicable (This parameter is monitored on a continuous basis)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the baseline emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	(inlet annubar device) Type: Differential Pressure-Pitot tube Accuracy class: 97~98% Serial number: 69453A Calibration frequency: Once per day (auto calibration) Date of last Calibration: Not applicable (every day) Validity: Not applicable
Measuring/ Reading/ Recording frequency:	This value is monitored for every second and used to calculate $E_{SF6,in.}$
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	This value is measured in accordance with the EPA guideline.

Data / Parameter:	Absolute outlet stack temperature ($T_{s,out}$)
Data unit:	K
Description:	The outlet stack temperature measured during manufacturing

	operations
Measured /Calculated /Default:	Measured
Source of data:	From outlet annubar
Value(s) of monitored parameter:	Not applicable (This parameter is monitored on a continuous basis)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	(outlet annubar device) Type: Differential Pressure-Pitot tube Accuracy class: 97~98% Serial number: 69453B Calibration frequency: Once per day (auto calibration) Date of last Calibration: Not applicable (every day) Validity: Not applicable
Measuring/ Reading/ Recording frequency:	This value is monitored for every second and used to calculate $E_{SF6,out.}$
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	This value is measured in accordance with the EPA guideline.

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
Measured /Calculated /Default:	Measured
Source of data:	From inlet annubar
Value(s) of monitored parameter:	Not applicable (This parameter is monitored on a continuous basis)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the baseline emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	(inlet annubar device) Type: Differential Pressure-Pitot tube Accuracy class: 97~98% Serial number: 69453A Calibration frequency: Once per day (auto calibration) Date of last Calibration: Not applicable (every day) Validity: Not applicable
Measuring/ Reading/ Recording frequency:	This value is monitored for every second and used to calculate $E_{SF6,in.}$
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	This value is measured in accordance with the EPA guideline.

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
Measured /Calculated /Default:	Measured

Source of data:	From outlet annubar
Value(s) of monitored parameter:	Not applicable (This parameter is monitored on a continuous basis)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	(outlet annubar device) Type: Differential Pressure-Pitot tube Accuracy class: 97~98% Serial number: 69453B Calibration frequency: Once per day (auto calibration) Date of last Calibration: Not applicable (every day) Validity: Not applicable
Measuring/ Reading/ Recording frequency:	This value is monitored for every second and used to calculate $E_{SF6,out.}$
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	This value is measured in accordance with the EPA guideline.

Data / Parameter:	Inlet gas velocity ($v_{s,in}$)
Data unit:	m/sec
Description:	Inlet gas velocity
Measured /Calculated /Default:	Calculated
Source of data:	Data processing program
Value(s) of monitored parameter:	Not applicable (This parameter is monitored on a continuous basis)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the baseline emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable This is a calculated data
Measuring/ Reading/ Recording frequency:	This value is calculated for every second and used to calculate $E_{SF6,in.}$
Calculation method (if applicable):	Equation 10 in the applied methodology $v_{s,in} = K_p \cdot C_{p,in} \sqrt{P_{avg,in}} \sqrt{\frac{T_{s,in}}{P_{s,in} \cdot M_{s,in}}}$
QA/QC procedures applied:	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, is completely discounted from the baseline emission. More detailed information on QA/QC procedure is included in the Data Management Manual which has been provided to DOE for verification purpose.

Data / Parameter:	Outlet gas velocity ($v_{s,out}$)
Data unit:	m/sec
Description:	Outlet gas velocity
Measured /Calculated	Calculated

/Default:	
Source of data:	Data processing program
Value(s) of monitored parameter:	Not applicable (This parameter is monitored on a continuous basis)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable This is a calculated data.
Measuring/ Reading/ Recording frequency:	This value is calculated for every second and used to calculate $E_{SF6,out.}$
Calculation method (if applicable):	Equation 11 in the applied methodology $v_{s,out} = K_p \cdot C_{p,out} \sqrt{P_{avg,out}} \sqrt{\frac{T_{s,out}}{P_{s,out} \cdot M_{s,out}}}$
QA/QC procedures applied:	Any SF_6 emitted during periods of times where the gas velocity measured at the outlet increases by more than 5%, compared to the averaged velocity, is completely discounted from the baseline emission. More detailed information on QA/QC procedure is included in the Data Management Manual which has been provided to DOE for verification purpose.

Data / Parameter:	Inlet stack volumetric flow rate (Q_{in})
Data unit:	m^3/s
Description:	Inlet volumetric flow rate
Measured /Calculated /Default:	Calculated
Source of data:	Data processing program
Value(s) of monitored parameter:	Not applicable (This parameter is monitored on a continuous basis)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the baseline emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable This is a calculated data.
Measuring/ Reading/ Recording frequency:	This value is calculated for every second and used to calculate $E_{SF6,in.}$
Calculation method (if applicable):	Equation 12 in the applied methodology $Q_{in} = \{(100 - B_{ws,in}) \div 100\} V_{s,in} \cdot A_{in} \left[\frac{T_{std} \cdot P_{s,in}}{T_{s,in} \cdot P_{std}} \right]$
QA/QC procedures applied:	Any SF6 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, is discounted from the baseline emission. More detailed information on QA/QC procedure is included in the

	Data Management Manual which has been provided to DOE for verification purpose.

Data / Parameter:	Outlet stack volumetric flow rate (Q_{out})
Data unit:	m^3/sec
Description:	Outlet volumetric flow rate
Measured /Calculated /Default:	Calculated
Source of data:	Data processing program
Value(s) of monitored parameter:	Not applicable (This parameter is monitored on a continuous basis)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable This is a calculated data
Measuring/ Reading/ Recording frequency:	This value is calculated for every second and used to calculate $E_{SF6,out.}$
Calculation method (if applicable):	Equation 13 in the applied methodology $Q_{out} = \{(100 - B_{ws,out}) \div 100\} V_{s,out} \cdot A_{out} \left[\frac{T_{std} \cdot P_{s,out}}{T_{s,out} \cdot P_{std}} \right]$
QA/QC procedures applied:	Any SF6 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 baseline flow rate measured, is discounted from the baseline emission. More detailed information on QA/QC procedure is included in the Data Management Manual which has been provided to DOE for verification purpose.

Data / Parameter:	Inlet SF_6 concentration
Data unit:	ppm
Description:	Inlet SF_6 concentration measured by FTIR
Measured /Calculated /Default:	Measured
Source of data:	From inlet FTIR
Value(s) of monitored parameter:	Not applicable (This parameter is monitored on a continuous basis)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the baseline emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Inlet FTIR

Type	FT-IR spectrometry
Accuracy class	98%
Serial number	580
Calibration frequency	3 months
Date of last Calibration	July 29, 2010
Validity	October 30, 2010

Measuring/ Reading/ Recording frequency:	Once per 40 seconds

Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	FTIR shall be calibrated in accordance with the Methodology requirement. More detailed information on QA/QC procedure is included in the Data Management Manual which has been provided to DOE for verification purpose.

Data / Parameter:	Outlet SF_6 concentration
Data unit:	ppm
Description:	Outlet SF_6 concentration measured by FTIR
Measured /Calculated /Default:	Measured
Source of data:	From outlet FTIR
Value(s) of monitored parameter:	Not applicable (This parameter is monitored on a continuous basis)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	outlet FTIR Type: FT-IR spectrometry Accuracy class: 98% Serial number: 581 Calibration frequency: 3 months Date of last Calibration: July 29, 2010 Validity: October 30, 2010
Measuring/ Reading/ Recording frequency:	Once per 40 seconds
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	FTIR shall be calibrated in accordance with the Methodology requirement. The average SF_6 concentration in the outlet of the abatement system is lower than 0.1 ppm which is confirmed by sampling & analyzing result implemented through more sensitive FTIR that can detect 0.1ppm of SF_6. However, considering that the SF_6 detection range of the installed outlet FTIR is 2 ppm, any values below 2 ppm in outlet is counted as 2 ppm for more conservative calculation. More detailed information on QA/QC procedure is included in the Data Management Manual which has been provided to DOE for verification purpose.

Data / Parameter:	**FCi,j,y** volume unit per year of natural gas consumed by the abatement device.
Data unit:	Nm^3
Description:	Quantity of natural gas combusted in the abatement process during the year *y* (From August 1, 2010 to September 30, 2010, for this monitoring purpose)
Measured /Calculated /Default:	Measured
Source of data:	a LNG flow-meter
Value(s) of monitored parameter:	194,806 Nm^3

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	LNG flow meter Type: LNG flow meter Accuracy class: Grade 2 (certified by Youngnam Energy Service) Serial number: 606920 Calibration frequency: Once per 8 years Date of last Calibration: July 21, 2010 Validity: July 20, 2018
Measuring/ Reading/ Recording frequency:	Once per second
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	The flow meter will be maintained by Korea Gas Corporation (a public enterprise).

Data / Parameter:	$W_{C,i,y}$
Data unit:	tC/tLNG
Description:	Weighted average mass fraction of carbon in natural gas in year *y*
Measured /Calculated /Default:	Default
Source of data:	Information provided by Korea Gas Corporation
Value(s) of monitored parameter:	0.752 tC/tLNG
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable This is an externally provided data.
Measuring/ Reading/ Recording frequency:	Once per year
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	This is a standard value provided by Korea Gas Corporation and an official letter from Korean Gas Corporation regarding the above value has been provided to the DOE for verification purpose.

Data / Parameter:	$\rho_{i,y}$
Data unit:	t natural gas/ m3 natural gas
Description:	Weighted average density of natural gas in year *y*
Measured /Calculated /Default:	Default
Source of data:	Korea Gas Corporation
Value(s) of monitored parameter:	0.7976 * 10^-3 t natural gas/ m3 natural gas
Indicate what the data are used for (Baseline/ Project/	This data is used for the project emission calculation.

Leakage emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable This is an externally provided data.
Measuring/ Reading/ Recording frequency:	Once per year
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	This is a standard value provided by Korea Gas Corporation and an official letter from Korean Gas Corporation regarding the above value has been provided to the DOE for verification purpose.

Data / Parameter:	$EC_{,y}$
Data unit:	MWh
Description:	Electricity Consumption in year y (From August 1, 2010 to September 30, 2010, for this monitoring purpose)
Measured /Calculated /Default:	Measured
Source of data:	Logbooks and 6 electricity meters
Value(s) of monitored parameter:	208.330 MWh
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project emission calculation.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Meter #1 Type: Electric meter Accuracy class: Grade 2 (Certified by KEPCO) Serial number: 97001891 Calibration frequency: Once per 10 years Date of last Calibration: December, 2009 (Purchase date) Validity: December, 2019 Meter #2 Type: Electric meter Accuracy class: Grade 2 (Certified by KEPCO) Serial number: 90064842 Calibration frequency: Once per 10 years Date of last Calibration: December, 2009 (Purchase date) Validity: December, 2019 Meter #3 Type: Electric meter Accuracy class: Grade 2 (Certified by KEPCO) Serial number: 98001026 Calibration frequency: Once per 10 years Date of last Calibration: December, 2009 (Purchase date) Validity: December, 2019

Meter #4

Type	Electric meter
Accuracy class	Grade 2 (Certified by KEPCO)
Serial number	9084449
Calibration frequency	Once per 10 years
Date of last Calibration	December, 2009 (Purchase date)
Validity	December, 2019

Meter #5

Type	Electric meter
Accuracy class	Grade 2 (Certified by KEPCO)
Serial number	90064836
Calibration frequency	Once per 10 years
Date of last Calibration	December, 2009 (Purchase date)
Validity	December, 2019

Meter #6

Type	Electric meter
Accuracy class	Grade 2 (Certified by KEPCO)
Serial number	90004868
Calibration frequency	Once per 10 years
Date of last Calibration	December, 2009 (Purchase date)
Validity	December, 2019

Measuring/ Reading/ Recording frequency:	Once per second
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	Data from logbooks and electrically gathered data from each electricity meter may be different from each other due to communication noise or transmission errors. If both data do not perfectly match, higher value shall be applied for more conservative outcome.

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

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The Baseline emissions calculation is as follows;

$$BE_{in,y} = k \cdot E_{SF6,y} \cdot GWP_{SF6}$$;Equation (1) in the methodology

Facility	$E_{SF6.v}$ (Aug 1, 2010~Sep 30, 2010)	k	GWP_{SF6}	$BE_{in,v}$ (Aug 1, 2010~Sep 30, 2010)
P6	6.0981	1.0000	23,900	145,744

where ;Equation (4) in the methodology

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

Facility	$SF_{6,ratio}$	$C_{SF6,y}$	$SP_{project,y}$	k
P6	0.0000134902	14.459	1,085,574	1.0000

where

$SF_{6,ratio} = \min(C_{SF6,-1} \div SP_{-1}; C_{SF6,-2} \div SP_{-2}; C_{SF6,-3} \div SP_{-3})$;Equation (3) in the methodology

Facility	$C_{SF6,-3}$	$C_{SF6,-2}$	$C_{SF6,-1}$	SP_{-3}	SP_{-2}	SP_{-1}	$SF_{6,ratio}$
P6	9.171	12.332	12.704	679,800	875,392	946,723	0.0000134902

And

$E_{SF6,y} = \min\{E_{SF6in,y}; 0.48 \times C_{SF6,y}; 0.48 \times C_{SF6,hist}\}$;Equation (2) in the methodology

Facility	$E_{SF6,in,y}$ (Aug 1, 2010~ Sep 30, 2010)	0.48 x $C_{SF6,y}$	$C_{SF6,y}$ (Aug 1, 2010~ Sep 30, 2010)	0.48 x $C_{SF6,hist}$	$C_{SF6,hist}$	$E_{SF6,y}$ (Aug 1, 2010~ Sep 30, 2010)
P6	6.3886	6.9401	14.4585	6.0981	12.7043	6.0981

where

$E_{SF6in,y} = annual(periodic)\ sum\ of\ E_{SF6,in}$

$E_{SF6,in}$ is automatically calculated for every second by the data processing program in accordance with the methodology and daily sum of $E_{SF6,in}$ is also recorded in a form of electric files along with other values of key parameters used in the $E_{SF6,in}$ calculation. The O&M team records the daily sum in a logbook and periodically reports a weekly and a monthly sums of $E_{SF6,in}$ to the project participants. The followings are the formulas used in the calculation.

$M_{d,in} = 1.460[SF_{6in}] + 0.440[CO_{2in}] + 0.320[O_{2in}] + 0.280[N_{2in}] + 0.399[Ar_{in}] + 1.021[SO_2F_{2in}] + 0.040[He_{in}]$

;Equation (6) in the methodology modified in accordance with the relevant clauses thereof

$M_{s,in} = M_{d,in} \cdot (100 - B_{ws,in}) \div 100 + 0.18 B_{ws,in}$;Equation (8) in the methodology

$$v_{s,in} = K_p \cdot C_{p,in} \sqrt{P_{avg,in}} \sqrt{\frac{T_{s,in}}{P_{s,in} \cdot M_{s,in}}}$$;Equation (10) in the methodology

$$Q_{in} = \{(100 - B_{ws,in}) \div 100\} V_{s,in} \cdot A_{in} \left[\frac{T_{std} \cdot P_{s,in}}{T_{s,in} \cdot P_{std}} \right]$$;Equation (12) in the methodology

$E_{SF6in} = 65.18 Q_{in}[SF_{6in}]$;Equation (14) in the methodology

E.2. Project emissions calculation

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The Project emissions calculation is as follows;

$$PE_y = BE_y(1 - DRE_y) + C_{CO2,y}$$;Equation (17) in the methodology

Facility	BE_y (Aug 1, 2010 ~ Sep 30, 2010)	DRE_y (Aug 1, 2010 ~ Sep 30, 2010)	$C_{CO2,y}$ (Aug 1, 2010 ~ Sep 30, 2010)	PE_y (Aug 1, 2010 ~ Sep 30, 2010)
P6	145,744	0.9915	236	1,470

Where

$$DRE_y = 1 - \frac{E_{SF6,out,y}}{E_{SF6,in,y}}$$;Equation (16) in the methodology

Facility	$E_{SF6,in,y}$ (Aug 1, 2010~ Sep 30, 2010)	$E_{SF6,out,y}$ (Aug 1, 2010~ Sep 30, 2010)	DRE_y (Aug 1, 2010~ Sep 30, 2010)
P6	6.3886	0.0541	0.9915

where

$$E_{SF6out,y} = annual(periodic)\, sum\, of\ E_{SF6,out}$$

As well as $E_{SF6,in,y}$, $E_{SF6,in}$ is automatically calculated for every second by the data processing program in accordance with the methodology and daily sum of $E_{SF6,out}$ is also recorded in a form of electric files along with other values of key parameters used in the $E_{SF6,out}$ calculation. The O&M team records the daily sum in a logbook and periodically reports a weekly and a monthly sum of $E_{SF6,out}$ to the project participants. The followings are the formulas used in the calculation.

$M_{d,out} = 0.440[CO_{2out}] + 0.320[O_{2out}] + 0.280[N_{2out}] + 0.399[Ar_{out}] + 0.040[He_{out}]$
;Equation (7) in the methodology modified in accordance with the relevant clauses thereof

$$M_{s,out} = M_{d,out} \cdot (100 - B_{ws,out}) \div 100 + 0.18 B_{ws,out}$$;Equation (9) in the methodology

$$v_{s,out} = K_p \cdot C_{p,out} \sqrt{P_{avg,out}} \sqrt{\frac{T_{s,out}}{P_{s,out} \cdot M_{s,out}}}$$;Equation (11) in the methodology

$$Q_{out} = \{(100 - B_{ws,out}) \div 100\} V_{s,out} \cdot A_{out} \left[\frac{T_{std} \cdot P_{s,out}}{T_{s,out} \cdot P_{std}} \right]$$;Equation (13) in the methodology

$$E_{SF6out} = 65.18 Q_{out} [SF_{6out}]$$;Equation (15) in the methodology

And $C_{CO2,y}$ (for the period beginning from Aug,1,2010 and ending at Sep 30,2010) is calculated as follows;

$$C_{CO2,y} = tCO2_{electricity,y} + tCO2_{LNG,y}$$

Where,
$tCO2_{electricity,y}$: GHG emission from electricity consumption by the abatement system during the monitoring period (tCO2)
$tCO2_{LNG,y}$: GHG emission from LNG consumption by the abatement system during the monitoring period (tCO2)

Facility	$tCO2_{electricity,y}$ (Aug 1, 2010~ Sep 30, 2010)	$tCO2_{LNG,y}$ (Aug 1, 2010~ Sep 30, 2010)	$C_{CO2,y}$ (Aug 1, 2010~ Sep 30, 2010)
P6	119	117	236

where

$$tCO2_{electricity,y} = EC_y \cdot EF_{grid,CM,y}$$

Facility	EC_y (Aug 1, 2010~ Sep 30, 2010)	$EF_{grid,CM,y}$	$tCO2_{electricity,y}$ (Aug 1, 2010~ Sep 30, 2010)
P6	208.330	0.5708	119

And where

$$tCO2_{LNG,y} = FC_{i,j,y} \cdot wc_{i,y} \cdot \rho_{i,y}$$

Facility	$FC_{i,j,y}$ (Aug 1, 2010~ Sep 30, 2010)	$wc_{i,y}$	$\rho_{i,y}$	$tCO2_{LNG,y}$ (Aug 1, 2010~ Sep 30, 2010)
P6	194,806	0.752	0.0007976	117

E.3. Leakage calculation

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According to the methodology applied, there is no leakage from the project activity.

E.4. Emission reductions calculation / table

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The Emission reductions calculation is as follows;

$$ER_y = BE_y - PE_y$$;Equation (18) in the methodology

Facility	BE_y (Aug 1, 2010~ Sep 30, 2010)	PE_y (Aug 1, 2010~ Sep 30, 2010)	ER_y (Aug 1, 2010~ Sep 30, 2010)
P6	145,744	1,470	144,274

*No leakage occurs from the project activity.

Therefore, the total emission reductions achieved during the monitoring period is 144,274 tCO_2e.

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

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Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period

Emission reductions (tCO_2e)	**82,348 (equivalent to one sixth of 494,087 tCO2e which is the reduction estimated for the Year 1.)**	**144,274**

E.6. Remarks on difference from estimated value in the PDD

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According to the methodology applied, actually measured data should be used for calculation emission reductions. However, at the time of requesting registration for the PDD of this project activity, the abatement system in Plant 6 was under construction so there was no way to obtain reliable data necessary to calculate emission reductions to be achieved by this project. Instead, to estimate emission reductions acceptable to the CDM Executive Board and satisfactory to its criteria, the project participants used IPCC default values. In the registered PDD, SF6 etch utilization efficiency of 70% and heel value of 10% is applied for estimating emission reductions, particularly calculations of $E_{SF6,in}$ and $E_{SF6,out}$,. IPCC default values, including aforementioned values, are generally more conservative than reasonably expected values; therefore, it is not an unexpected result that the actually measured emission reduction is higher than the estimated figures in the PDD.

As none of the parameters necessary to calculate mass of SF6 removed are used in the emission reductions calculation of the PDD, comparing the values herein with those of the PDD is impossible and meaningless.

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History of the document

Version	Date	Nature of revision
01	EB 54, Annex 34 28 May 2010	Initial adoption.
Decision Class: Regulatory **Document Type**: Guideline, Form **Business Function**: Issuance		