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, 11/05/2011

Point of Use Abatement Device to Reduce SF6 emissions in LCD Manufacturing Operations in the Republic of Korea (South Korea)
Reference number 3440
The 3rd monitoring period, 01/01/2011[1] – 30/04/2011

SECTION A. General description of the project activity

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

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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 in the very near future.

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 outlet 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

[1] The SF6 abatement system was shutdown from 01/01/2011 to 19/01/2011 due to the maintenance on the pre-treatment system, i.e. no ER generated during this period. And thus, CERs calculation is done based on the monitored data measured or determined for the period from 20/01/2011 to 30/04/2011, which is more conservative as a longer monitoring period may lead to increase of the baseline emissions according to AM0078.

	commenced.
April 30, 2011	The 3rd monitoring period was over and the emission reduction data for the period was confirmed.

The total emission reduction achieved for the 3rd monitoring period, starting from January 01, 2011 and ending on April 30 of the same year, is 202,165 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:

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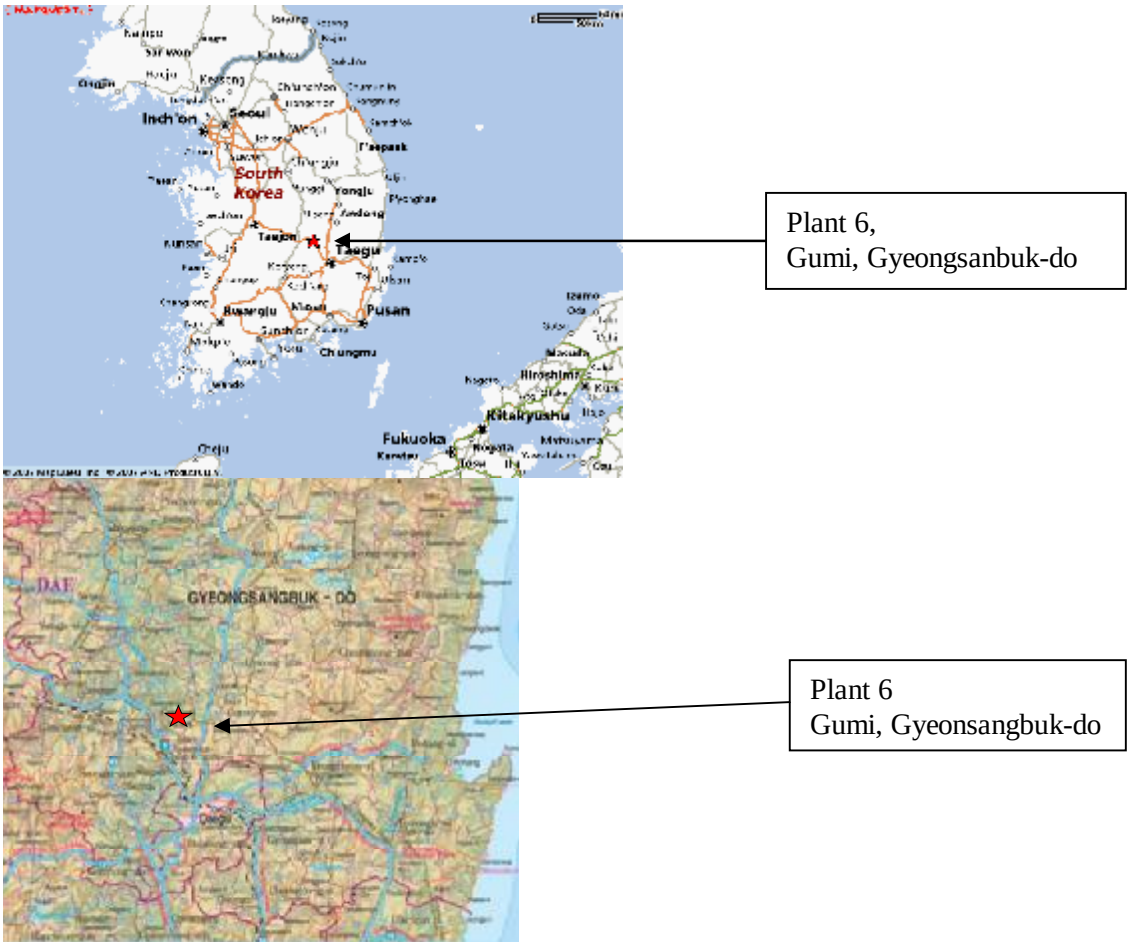
Plant 6, having the GPS coordinates of (36.0944°, 128.4111°), is located at Gumi, Gyeongsangbuk-do, Republic of Korea.



A.4. Technical description of the project

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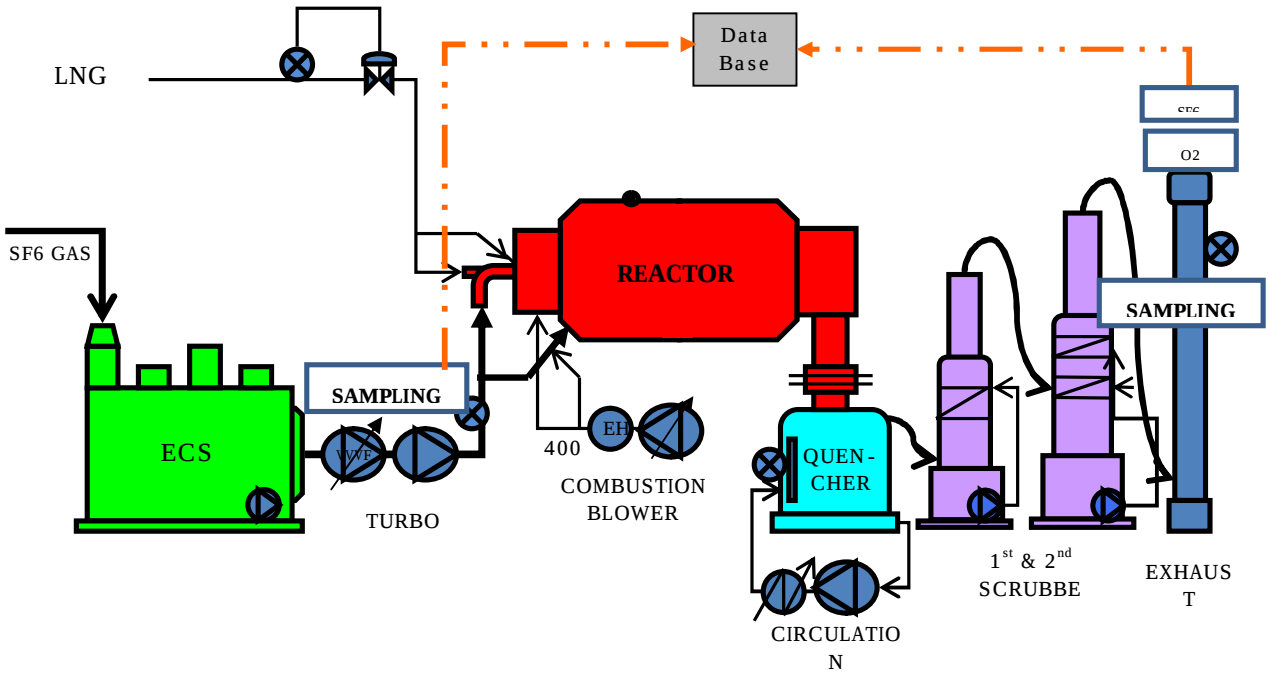
This project installed the necessary abatement equipments required to destroy SF6 that is vented from the Dry Etching processes in the manufacture of LCD panels. Specifically, the abatement technology requires temperature around 1,200℃ to break down and destroy the SF6. The specifications of the abatement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

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"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:

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July 10, 2010

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

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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):

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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. The second investment for a new SF6 abatement system to be installed in Plant 7 was approved by the executives in March, 2011 and the construction is planned to be commenced in the first half of 2011. Commercial orders for additional sets of abatement devices to be installed in other than plant 6/7 are yet to be made at the time of writing. As the project participants described in the registered PDD, the other plants will be successively invested after the performance of the existing abatement system has been confirmed.

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
Pre-treatment system maintenance	Jan 1~19, 2011	19 days	The SF6 abatement system was shutdown from 01/01/2011 to 19/01/2011 due to the maintenance on the pre-treatment system, i.e. no ER generated during this period. And thus, CERs calculation is done based on the monitored data measured or determined for the period from 20/01/2011 to 30/04/2011, which is more conservative as a longer monitoring period may lead to increase of the baseline emissions. According to AM0078, the baseline emissions should be determined as the minimum value among 1)$E_{SF6,in,y}$, 2)0.48*$C_{SF6,y}$ and 3)0.48*$C_{SF6,hist}$ and a longer monitoring period leads to increase of $C_{SF6,y}$ and $C_{SF6,hist}$ values which may cause increase of the baseline emissions.
Data analyzing Computer error	Feb 2, 2011	3 minutes	The data analyzing computer failed to read real-time data due to communication error. The problem was solved after re-booting the computer. All reductions during this event were manually deleted from the daily emission reductions calculation.
Program Interface Upgrade	Mar 3~4, 2011	3 minutes for each day	Interface of the data analyzing program was upgraded during this period. While applying the new version of the program, temporary loss of data occurred. Those data was eliminated from the daily emission reductions calculation.
outlet FTIR maintenance & zero-span check	Mar 29, 2011	49 minutes	Zero-span check on the outlet FTIR was implemented after regular cleaning of the outlet FTIR. In case of the inlet FTIR, cleaning was unnecessary as its absorbance level was stable. All data during this work was deducted from the emission calculation.
Outlet Annubar fuse shorting out	Mar 31, 2011	21 minutes	Outlet annubar was powered off due to fuse shorting out. The fuse was immediately replaced with a new one and the annubar was consequently recovered. All data during this event was completely removed from the emission reductions calculation.

Outlet Annubar fuse shorting out	Apr 11, 2011	40 minutes	Outlet annubar was powered off due to fuse shorting out. The fuse was immediately replaced with a new one but shorting out occurred again. The operation team substitute the fuse with a higher current fuse and the problem was solved. Fuse of the inlet annubar was also replaced with a higher current fuse as a preventive action.

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.

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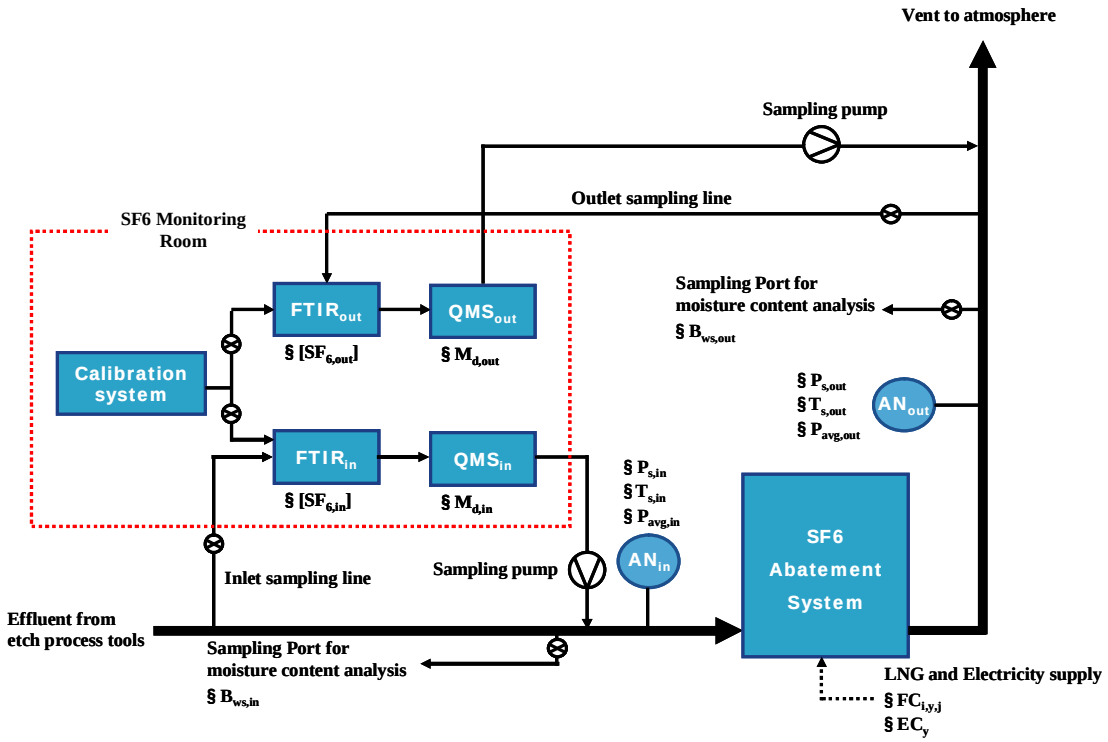
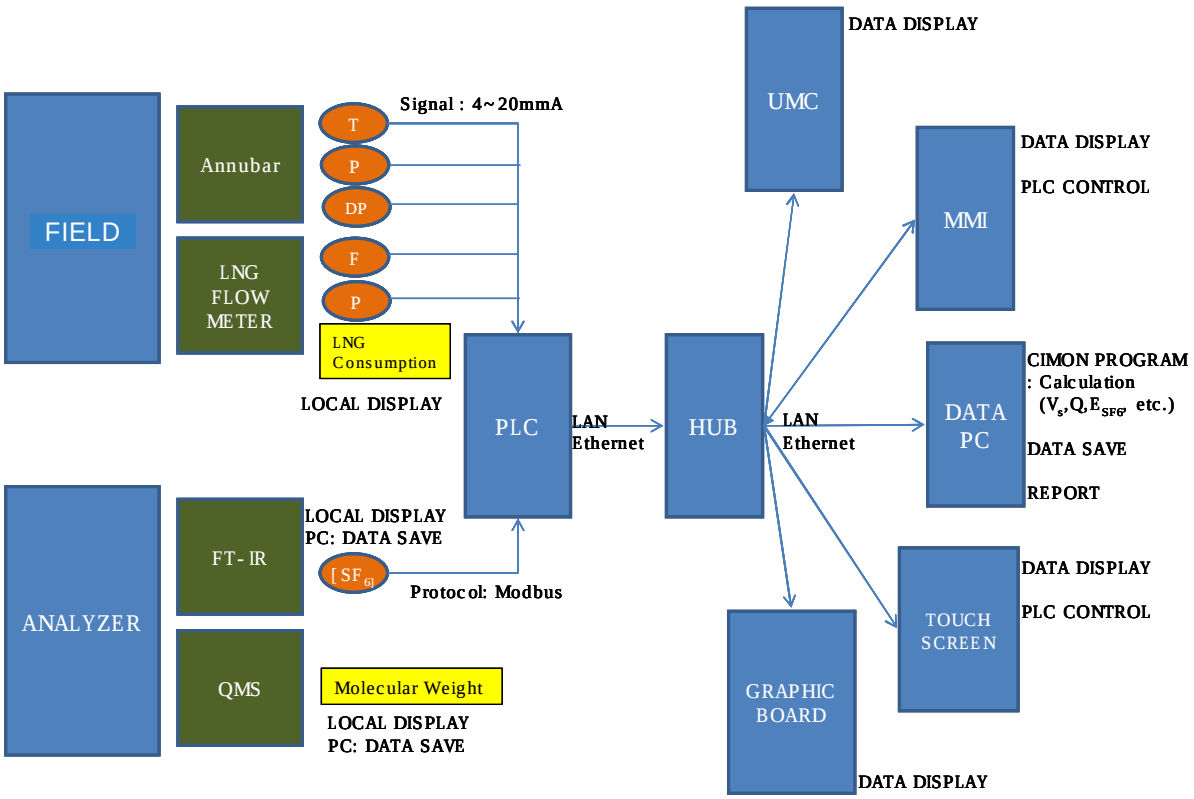
Parameters used in the emission reductions calculation can be classified into 4 groups – continuously monitored group, frequently monitored group, calculated group and externally provided group. The following diagrams show all relevant monitoring points and how the continuously monitored factors and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



<Monitoring points>

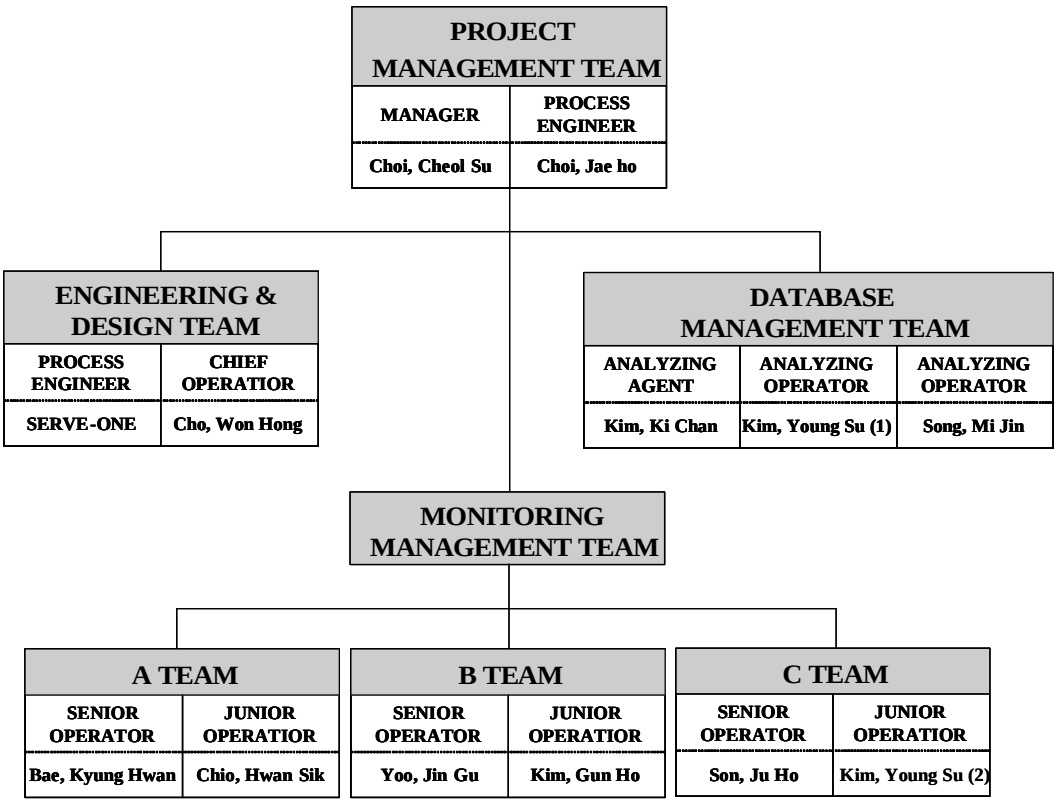


<Data Processing Flow>

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 Main Monitoring Interface (MMI), Utility Monitoring Center (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

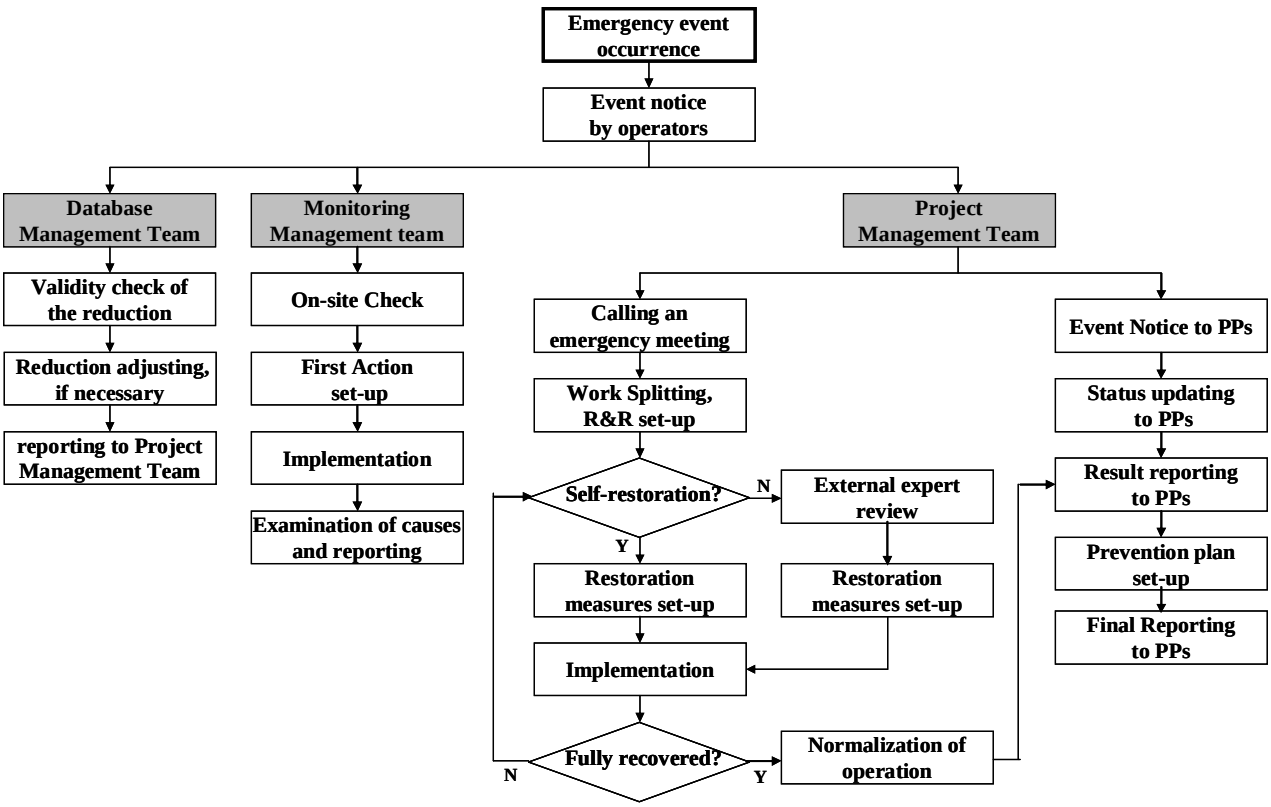
3) Database Management team's roles and responsibilities

- 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 ($CAP_{SF6,ex}$)**
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) :	21.035 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)	15,226	20,474	21,035

	For this monitoring purpose, only 101 days of $C_{SF6,hist}$ is necessary. (The monitoring period, 01/01/2011 – 30/04/11, is 120 days but 19 days of pre-treatment maintenance period, 01/01/2011 – 19/01/2011, was excluded for a conservativeness purpose.) 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 101 days, for this monitoring purpose)
Source of data used:	Production record
Value(s) :	<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>P6 (in the PDD)</td><td>4,078,800</td><td>5,252,354</td><td>5,680,338</td></tr><tr><td>P6 (adjusted)</td><td>1,128,654</td><td>1,453,391</td><td>1,567,525</td></tr></table> For this monitoring purpose, only 101 days of SP_{-i} is necessary. (The monitoring period, 01/01/2011 – 30/04/2011, is 120 days but 19 days of pre-treatment maintenance period, 01/01/2011 – 19/01/2011, was excluded for a conservativeness purpose.) 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 has been submitted to the DOE for verification purpose.
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 has been submitted to the DOE for verification purpose.
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 has been submitted to the DOE for verification purpose.
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 has been submitted to the DOE for verification purpose.
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:	**$C_{p.out}$**
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 calculations)	This data is used for the project calculation.
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 January 20, 2011 to April 30, 2011, for this monitoring purpose. The pre-treatment maintenance period, from January 1, 2011 to January 19, 2011 is excluded from the emission reductions calculation for conservativeness.)
Measured /Calculated /Default:	Calculated
Source of data:	Data processing program and Daily/weekly/monthly logs
Value(s) of monitored parameter:	8.8087 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)	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:	$\mathbf{C}_{SF6,y}$
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 January 20, 2011 to April 30, 2011, for this monitoring purpose. The pre-treatment maintenance period, from January 1, 2011 to January 19, 2011 is excluded from the emission reductions calculation for conservativeness.)
Measured /Calculated /Default:	Calculated
Source of data:	Purchase records, monthly records on SF6 inventory change and cylinder replacement records.
Value(s) of monitored parameter:	23.017 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,	Not applicable

accuracy class, serial number, calibration frequency, date of last calibration, validity)	
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. The average value of the residual gas quantity during the monitoring period is 6.0%. However, for more conservative calculation, 10% of heel 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 January 20, 2011 to April 30, 2011, for this monitoring purpose. The pre-treatment maintenance period, from January 1, 2011 to January 19, 2011 is excluded from the emission reductions calculation for conservativeness.)
Measured /Calculated /Default:	Measured
Source of data:	Manufacturing Execution system of LG Display
Value(s) of monitored parameter:	1,668,635 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/ Recording frequency:	Once per year or a monitoring period, whichever is shorter.
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/	This data is used for the baseline emission calculation.

Leakage emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	1.03 gram / second This is the average value during the monitoring period. To comply precisely with US EPA Methods required in both AM0078 and registered PDD and also to monitor "continuously", actual monitoring was done every second and monitored values were immediately converted by the algorithm in the program of the monitoring system for real-time determination of $V_{s,in}$, $V_{s,out}$, Q_{in}, Q_{out}, $E_{SF6,in}$ and $E_{SF6,out}$ using each real-time value of $P_{s,in}$, $P_{s,out}$, $T_{s,in}$, $T_{s,out}$, $P_{avg,in}$, $P_{avg,out}$ and SF_6 concentration and fixed values of $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ which were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
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)	0.01 gram / second This is the average value during the monitoring period. To comply precisely with US EPA Methods required in both AM0078 and registered PDD and also to monitor "continuously", actual monitoring was done every second and monitored values were immediately converted by the algorithm in the program of the monitoring system for real-time determination of $V_{s,in}$, $V_{s,out}$, Q_{in}, Q_{out}, $E_{SF6,in}$ and $E_{SF6,out}$ using each real-time value of $P_{s,in}$, $P_{s,out}$, $T_{s,in}$, $T_{s,out}$, $P_{avg,in}$, $P_{avg,out}$ and SF_6 concentration and fixed values of $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ which were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
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:	28.474 g/mole $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
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:	27.810 g/mole $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
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	Not applicable This is a calculated data.

number, calibration frequency, date of last calibration, validity)	
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:	28.910 g/mole $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
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: ±3% Serial number: 2X31131 Calibration frequency: Once per year Date of last Calibration: 19/08/2010 Validity: 18/08/2011
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:	29.060 g/mole $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ were determined with

	separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
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: ±3% Serial number: 2X31132 Calibration frequency: Once per year Date of last Calibration: 19/08/2010 Validity: 18/08/2011
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 $M_{d,out}$ 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:	4.0 % $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
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: ±5% Serial number: 80-091100-1 Calibration frequency: Once per 2 years Date of last Calibration: 24/11/2008 Validity: 23/11/2010
Measuring/ Reading/	Once per year, at least

Recording frequency:	
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:	11.3 % $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
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
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.

Type	Gas Sampling Analyzer
Accuracy class	±5%
Serial number	601023
Calibration frequency	Once per 2 years
Date of last Calibration	17/03/2010
Validity	16/03/2012

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:	835 mmHg This is the average value during the monitoring period. To comply precisely with US EPA Methods required in both AM0078 and registered PDD and also to monitor "continuously", actual monitoring was done every second and monitored values were immediately converted by the algorithm in the program of the monitoring system for real-time determination of $V_{s,in}$, $V_{s,out}$, Q_{in}, Q_{out}, $E_{SF6,in}$ and $E_{SF6,out}$ using each real-time value of $P_{s,in}$, $P_{s,out}$, $T_{s,in}$, $T_{s,out}$, $P_{avg,in}$, $P_{avg,out}$ and SF_6 concentration and fixed values of $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ which were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
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: ±3% Serial number: 69453A Calibration frequency: Once per year Date of last Calibration: 23/06/2010, newly installed Validity: 22/06/2011
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:	759 mmHg This is the average value during the monitoring period. To comply precisely with US EPA Methods required in both AM0078 and registered PDD and also to monitor "continuously", actual monitoring was done every second and monitored values were immediately converted by the algorithm in the program of the monitoring system for real-time determination of $V_{s,in}$, $V_{s,out}$, Q_{in}, Q_{out}, $E_{SF6,in}$ and $E_{SF6,out}$ using each real-time value of $P_{s,in}$, $P_{s,out}$, $T_{s,in}$, $T_{s,out}$, $P_{avg,in}$, $P_{avg,out}$ and SF_6 concentration and fixed values of $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ which were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This data is used for the project emission calculation.
Monitoring equipment (type,	(outlet annubar device)

accuracy class, serial number, calibration frequency, date of last calibration, validity)	Type: Differential Pressure-Pitot tube Accuracy class: ±3% Serial number: 69453B Calibration frequency: Once per year Date of last Calibration: 23/06/2010, newly installed Validity: 22/06/2011
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:	309 K This is the average value during the monitoring period. To comply precisely with US EPA Methods required in both AM0078 and registered PDD and also to monitor "continuously", actual monitoring was done every second and monitored values were immediately converted by the algorithm in the program of the monitoring system for real-time determination of $V_{s,in}$, $V_{s,out}$, Q_{in}, Q_{out}, $E_{SF6,in}$ and $E_{SF6,out}$ using each real-time value of $P_{s,in}$, $P_{s,out}$, $T_{s,in}$, $T_{s,out}$, $P_{avg,in}$, $P_{avg,out}$ and SF_6 concentration and fixed values of $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ which were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
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: Standard Platinum Resistance Thermometer Accuracy class: ±3% Serial number: 69453A Calibration frequency: Once per year Date of last Calibration: 23/06/2010, newly installed Validity: 22/06/2011
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:	317 K This is the average value during the monitoring period. To comply precisely with US EPA Methods required in both AM0078 and registered PDD and also to monitor "continuously", actual monitoring was done every second and monitored values were immediately converted by the algorithm in the program of the monitoring system for real-time determination of $V_{s,in}$, $V_{s,out}$, Q_{in}, Q_{out}, $E_{SF6,in}$ and $E_{SF6,out}$ using each real-time value of $P_{s,in}$, $P_{s,out}$, $T_{s,in}$, $T_{s,out}$, $P_{avg,in}$, $P_{avg,out}$ and SF_6 concentration and fixed values of $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ which were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
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: Standard Platinum Resistance Thermometer Accuracy class: ±3% Serial number: 69453B Calibration frequency: Once per year Date of last Calibration: 23/06/2010, newly installed Validity: 22/06/2011
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:	1.50 mmH_2O This is the average value during the monitoring period. To comply precisely with US EPA Methods required in both AM0078 and registered PDD and also to monitor "continuously", actual monitoring was done every second and monitored values were immediately converted by the algorithm in the program of the monitoring system for real-time determination of $V_{s,in}$, $V_{s,out}$, Q_{in}, Q_{out}, $E_{SF6,in}$ and $E_{SF6,out}$ using each real-time value of $P_{s,in}$, $P_{s,out}$, $T_{s,in}$, $T_{s,out}$, $P_{avg,in}$, $P_{avg,out}$ and SF_6 concentration and fixed values of $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ which were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
Indicate what the data are used for (Baseline/ Project/ Leakage emission	This data is used for the baseline emission calculation.

calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	(inlet annubar device) Type: Differential Pressure-Pitot tube Accuracy class: ±3% Serial number: 69453A Calibration frequency: Once per year Date of last Calibration: 23/06/2010, newly installed Validity: 22/06/2011
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:	0.70 mmH_2O This is the average value during the monitoring period. To comply precisely with US EPA Methods required in both AM0078 and registered PDD and also to monitor "continuously", actual monitoring was done every second and monitored values were immediately converted by the algorithm in the program of the monitoring system for real-time determination of $V_{s,in}$, $V_{s,out}$, Q_{in}, Q_{out}, $E_{SF6,in}$ and $E_{SF6,out}$ using each real-time value of $P_{s,in}$, $P_{s,out}$, $T_{s,in}$, $T_{s,out}$, $P_{avg,in}$, $P_{avg,out}$ and SF_6 concentration and fixed values of $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ which were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
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: ±3% Serial number: 69453B Calibration frequency: Once per year Date of last Calibration: 23/06/2010, newly installed Validity: 22/06/2011
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:	4.88 m/sec This is the average value during the monitoring period. To comply precisely with US EPA Methods required in both AM0078 and registered PDD and also to monitor "continuously", actual monitoring was done every second and monitored values were immediately converted by the algorithm in the program of the monitoring system for real-time determination of $V_{s,in}$, $V_{s,out}$, Q_{in}, Q_{out}, $E_{SF6,in}$ and $E_{SF6,out}$ using each real-time value of $P_{s,in}$, $P_{s,out}$, $T_{s,in}$, $T_{s,out}$, $P_{avg,in}$, $P_{avg,out}$ and SF_6 concentration and fixed values of $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ which were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
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 /Default:	Calculated
Source of data:	Data processing program
Value(s) of monitored parameter:	3.58 m/sec This is the average value during the monitoring period. To comply precisely with US EPA Methods required in both AM0078 and registered PDD and also to monitor "continuously", actual monitoring was done every second and monitored values were immediately converted by the algorithm in the program of the monitoring system for real-time determination of $V_{s,in}$, $V_{s,out}$, Q_{in}, Q_{out}, $E_{SF6,in}$ and $E_{SF6,out}$ using each real-time value of $P_{s,in}$, $P_{s,out}$, $T_{s,in}$, $T_{s,out}$, $P_{avg,in}$, $P_{avg,out}$ and SF_6 concentration and fixed values of $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ which were determined with separated investigation called "experimental setup" in AM0078. Please see more

	details in the spreadsheet.
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/sec
Description:	Inlet volumetric flow rate
Measured /Calculated /Default:	Calculated
Source of data:	Data processing program
Value(s) of monitored parameter:	0.47 m^3/sec This is the average value during the monitoring period. To comply precisely with US EPA Methods required in both AM0078 and registered PDD and also to monitor "continuously", actual monitoring was done every second and monitored values were immediately converted by the algorithm in the program of the monitoring system for real-time determination of $V_{s,in}$, $V_{s,out}$, Q_{in}, Q_{out}, $E_{SF6,in}$ and $E_{SF6,out}$ using each real-time value of $P_{s,in}$, $P_{s,out}$, $T_{s,in}$, $T_{s,out}$, $P_{avg,in}$, $P_{avg,out}$ and SF_6 concentration and fixed values of $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ which were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
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:	0.83 m^3/sec This is the average value during the monitoring period. To comply precisely with US EPA Methods required in both AM0078 and registered PDD and also to monitor "continuously", actual monitoring was done every second and monitored values were immediately converted by the algorithm in the program of the monitoring system for real-time determination of $V_{s,in}$, $V_{s,out}$, Q_{in}, Q_{out}, $E_{SF6,in}$ and $E_{SF6,out}$ using each real-time value of $P_{s,in}$, $P_{s,out}$, $T_{s,in}$, $T_{s,out}$, $P_{avg,in}$, $P_{avg,out}$ and SF_6 concentration and fixed values of $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ which were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
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:	335.9 ppm This is the average value during the monitoring period. To comply precisely with US EPA Methods required in both AM0078 and registered PDD and also to monitor "continuously", actual monitoring was done every second and monitored values were immediately converted by the algorithm in the program of the monitoring system for real-time determination of $V_{s,in}$, $V_{s,out}$, Q_{in}, Q_{out}, $E_{SF6,in}$ and $E_{SF6,out}$ using each real-time value of $P_{s,in}$, $P_{s,out}$, $T_{s,in}$, $T_{s,out}$, $P_{avg,in}$, $P_{avg,out}$ and SF_6 concentration and fixed values of $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ which were determined with separated investigation called "experimental setup" in AM0078. Please see more details in the spreadsheet.
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: ±2% Serial number: 580 Calibration frequency: Once per year Date of last Calibration: 07/12/2010 Validity: 06/12/2011
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:	2.1 ppm This is the average value during the monitoring period. To comply precisely with US EPA Methods required in both AM0078 and registered PDD and also to monitor "continuously", actual monitoring was done every second and monitored values were immediately converted by the algorithm in the program of the monitoring system for real-time determination of $V_{s,in}$, $V_{s,out}$, Q_{in}, Q_{out}, $E_{SF6,in}$ and $E_{SF6,out}$ using each real-time value of $P_{s,in}$, $P_{s,out}$, $T_{s,in}$, $T_{s,out}$, $P_{avg,in}$, $P_{avg,out}$ and SF_6 concentration and fixed values of $M_{d,in}$, $M_{d,out}$, $B_{ws,in}$, $B_{ws,out}$, $M_{s,in}$ and $M_{s,out}$ which were determined with separated

<table>
<tr><td></td><td>investigation called “experimental setup” in AM0078. Please see more details in the spreadsheet.</td></tr>
<tr><td>Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)</td><td>This data is used for the project emission calculation.</td></tr>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)</td><td>outlet FTIR<table><tr><td>Type</td><td>FT-IR spectrometry</td></tr><tr><td>Accuracy class</td><td>±2%</td></tr><tr><td>Serial number</td><td>581</td></tr><tr><td>Calibration frequency</td><td>Once per year</td></tr><tr><td>Date of last Calibration</td><td>08/11/2010</td></tr><tr><td>Validity</td><td>07/11/2011</td></tr></table></td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>Once per 40 seconds</td></tr>
<tr><td>Calculation method (if applicable):</td><td>Not applicable</td></tr>
<tr><td>QA/QC procedures applied:</td><td>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.</td></tr>
</table>

<table>
<tr><td>Data / Parameter:</td><td>FCi,j,y volume unit per year of natural gas consumed by the abatement device.</td></tr>
<tr><td>Data unit:</td><td>Nm^3</td></tr>
<tr><td>Description:</td><td>Quantity of natural gas combusted in the abatement process during the year y
(From January 20, 2011 to April 30, 2011, for this monitoring purpose. The pre-treatment maintenance period, from January 1, 2011 to January 19, 2011 is excluded from the emission reductions calculation for conservativeness.)</td></tr>
<tr><td>Measured /Calculated /Default:</td><td>Measured</td></tr>
<tr><td>Source of data:</td><td>a LNG flow-meter</td></tr>
<tr><td>Value(s) of monitored parameter:</td><td>339,848 Nm^3</td></tr>
<tr><td>Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)</td><td>This data is used for the project emission calculation.</td></tr>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)</td><td>LNG flow meter<table><tr><td>Type</td><td>LNG flow meter</td></tr><tr><td>Accuracy class</td><td>±2%
(Grade 2, certified by Youngnam Energy Service)</td></tr><tr><td>Serial number</td><td>606920</td></tr></table></td></tr>
</table>

	Calibration frequency: Once per 8 years Date of last Calibration: 21/07/2010 Validity: 20/07/2018
Measuring/ Reading/ Recording frequency:	Recording Frequency: Once per second Calculating Frequency: Once per the given monitoring period
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	The flow meter will be maintained by Korea Gas Corporation (a public enterprise). The value recorded in the system is 330,819 Nm^3 and the applied value comes from daily log book manually recorded by operators. The latter data has human errors as checking time of the meter cannot be exactly same for everyday. Nevertheless, the latter value is applied as it is higher than the system value. This is one of conservative approaches made for the emission reductions calculation.

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:	ρi,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/ 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:	$EC_{,y}$
Data unit:	kWh
Description:	Electricity Consumption in year y (From January 20, 2011 to April 30, 2011, for this monitoring purpose. The pre-treatment maintenance period, from January 1, 2011 to January 19, 2011 is excluded from the emission reductions calculation for conservativeness.)
Measured /Calculated /Default:	Measured
Source of data:	Logbooks and 6 electricity meters
Value(s) of monitored parameter:	337,309 kWh
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: ±**2%** (Grade 2, Certified by KEPCO) Serial number: 97001891 Calibration frequency: Once per 8 years Date of last Calibration: 20/12/2009 Validity: 19/12/2017 Meter #2 Type: Electric meter Accuracy class: ±**2%** (Grade 2, Certified by KEPCO) Serial number: 90064842 Calibration frequency: Once per 10 years Date of last Calibration: 10/12/2009 Validity: 09/12/2019 Meter #3 Type: Electric meter Accuracy class: ±**2%** (Grade 2, Certified by KEPCO) Serial number: 98001026 Calibration frequency: Once per 8 years

<table>
<tr><td></td><td>
<table>
<tr><td>Date of last Calibration</td><td>30/09/2009</td></tr>
<tr><td>Validity</td><td>29/09/2017</td></tr>
</table>

Meter #4
<table>
<tr><td>Type</td><td>Electric meter</td></tr>
<tr><td>Accuracy class</td><td>±2%
(Grade 2, Certified by KEPCO)</td></tr>
<tr><td>Serial number</td><td>9084449</td></tr>
<tr><td>Calibration frequency</td><td>Once per 8 years</td></tr>
<tr><td>Date of last Calibration</td><td>13/01/2009</td></tr>
<tr><td>Validity</td><td>12/01/2017</td></tr>
</table>

Meter #5
<table>
<tr><td>Type</td><td>Electric meter</td></tr>
<tr><td>Accuracy class</td><td>±2%
(Grade 2, Certified by KEPCO)</td></tr>
<tr><td>Serial number</td><td>90064836</td></tr>
<tr><td>Calibration frequency</td><td>Once per 10 years</td></tr>
<tr><td>Date of last Calibration</td><td>10/12/2009</td></tr>
<tr><td>Validity</td><td>09/12/2019</td></tr>
</table>

Meter #6
<table>
<tr><td>Type</td><td>Electric meter</td></tr>
<tr><td>Accuracy class</td><td>±2%
(Grade 2, Certified by KEPCO)</td></tr>
<tr><td>Serial number</td><td>90004868</td></tr>
<tr><td>Calibration frequency</td><td>Once per 10 years</td></tr>
<tr><td>Date of last Calibration</td><td>10/10/2009</td></tr>
<tr><td>Validity</td><td>09/10/2019</td></tr>
</table>
</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>Recording Frequency: Once per second
Calculating Frequency: Once per the given monitoring period</td></tr>
<tr><td>Calculation method (if applicable):</td><td>Not applicable</td></tr>
<tr><td>QA/QC procedures applied:</td><td>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.
The value recorded in the system is 337,087 kWh and the applied value comes from daily log book manually recorded by operators. The latter data has human errors as six(6) meters cannot be checked at the same time. Nevertheless, the latter value is applied as it is higher than the system value. This is one of conservative approaches made for the emission reductions calculation.</td></tr>
</table>

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

>>

The Baseline emissions calculation is as follows (The pre-treatment maintenance period, from January 1, 2011 to January 19, 2011 is excluded from the emission reductions calculation for conservativeness.);

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

Facility	$E_{SF6.y}$ (Jan 20, 2011~April 30, 2011)	k	GWP_{SF6}	$BE_{in,y}$ (Jan 20, 2011~April 30, 2011)
P6	8.8087	0.9729	23,900	204,814

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	0.0000134193	23.017	1,668,635	0.9729

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	13.869	18.650	19.161	1,028,081	1,323,881	1,427,845	0.0000134193

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	$E_{SF6,in,y}$ (Jan 20, 2011 ~ April 30, 2011)	0.48 x $C_{SF6,y}$	$C_{SF6,y}$ (Jan 20, 2011 ~ April 30, 2011)	0.48 x $C_{SF6,hist}$	$C_{SF6,hist}$	$E_{SF6,y}$ (Jan 20, 2011 ~ April 30, 2011)
P6	8.8087	11.0480	23.0166	10.0968	21.0350	8.8087

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 electronic 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

>>

The Project emissions calculation is as follows (The pre-treatment maintenance period, from January 1, 2011 to January 19, 2011 is excluded from the emission reductions calculation for conservativeness.);

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

Facility	BE_y (Jan 20, 2011 ~ April 30, 2011)	DRE_y (Jan 20, 2011 ~ April 30, 2011)	$C_{CO2,y}$ (Jan 20, 2011 ~ April 30, 2011)	PE_y (Jan 20, 2011 ~ April 30, 2011)
P6	204,814	0.9890	396	2,650

Where

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

Facility	$E_{SF6,in,y}$ (Jan 20, 2011 ~ April 30, 2011)	$E_{SF6,out,y}$ (Jan 20, 2011 ~ April 30, 2011)	DRE_y (Jan 20, 2011 ~ April 30, 2011)
P6	8.8087	0.0969	0.9890

where

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

As well as $E_{SF6,in}$, $E_{SF6,out}$ 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 electronic 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 Jan 20,2011 and ending at Apr 30,2011) 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	**$tCO2_{electricity,y}$ (Jan 20, 2011 ~ April 30, 2011)**	**$tCO2_{LNG,y}$ (Jan 20, 2011 ~ April 30, 2011)**	**$C_{CO2,y}$ (Jan 20, 2011 ~ April 30, 2011)**
P6	193	204	396

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

Facility	**EC_y (Jan 20, 2011 ~ April 30, 2011)**	**$EF_{grid,CM,y}$**	**$tCO2_{electricity,y}$ (Jan 20, 2011 ~ April 30, 2011)**
P6	337.309	0.5708	193

And where
$$tCO2_{LNG,y} = FC_{i,j,y} \cdot wc_{i,y} \cdot r_{i,y}$$

Facility	**$FC_{i,j,y}$ (Jan 20, 2011 ~ April 30, 2011)**	**$wc_{i,y}$**	**$\rho_{i,y}$**	**$tCO2_{LNG,y}$ (Jan 20, 2011 ~ April 30, 2011)**
P6	339,848	0.752	0.0007976	204

E.3. Leakage calculation

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

E.4. Emission reductions calculation / table

>>
The Emission reductions calculation is as follows (The pre-treatment maintenance period, from January 1, 2011 to January 19, 2011 is excluded from the emission reductions calculation for conservativeness.);

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

Facility	BE_y (Jan 20, 2011 ~ April 30, 2011)	PE_y (Jan 20, 2011 ~ April 30, 2011)	ER_y (Jan 20, 2011 ~ April 30, 2011)
P6	204,814	2,650	202,165

*No leakage occurs from the project activity.

Therefore, the total emission reductions achieved during the monitoring period is 202,165 tCO_2e.

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

>>

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)	**136,720 (equivalent to 101/365 of 494,087 tCO2e which is the reduction estimated for the Year 1.)**	**202,165**

* The pre-treatment maintenance period, from January 1, 2011 to January 19, 2011 is excluded from the emission reductions calculation for conservativeness.

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

>>

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. The following table shows differences between IPCC default values used in the ex-ante emission reductions calculation of the registered PDD and the actual values achieved through project implementation.

Parameters	IPCC default value /Assumed value	Actual Value	Effect on the emission reductions
$C_{SF6,y}$ (P6)	23,884 kg (101/365 of the annual value, 86,313 kg derived from the biz plan)	23,017 kg	The actual value is slightly lower than the business plan set up in 2009. This increase led to small decrease of the baseline emission.
SF6 etch utilization efficiency	70.0%	61.7%	Actual value is lower than IPCC default value. While the methodology used 60% SF6 utilization efficiency and 20% uncertainty (equation 2), the more conservative value of 70% (Tier2.b) was used for the calculation of $E_{SF6,in,y}$ in the PDD to ensure conservativeness on projection. The lower value of utilization

			efficiency led to greater baseline emission as it directly affect to the mass of SF6 entering into the system. While $E_{SF6,in,y}$ is smaller than $0.48*C_{SF6,hist}$ in the PDD, $E_{SF6,in,y}$ is greater than $0.48*C_{SF6,hist}$ due to the decreased SF6 etch utilization efficiency and $0.48*C_{SF6,hist}$ becomes $E_{SF6,in}$ of this monitoring period. This is a major reason of the increase.
heel value	10%	10%	In this monitoring report, 10% heel value is used although the actual heel value recorded (6.0%) is much lower than 10%. It was done for a conservative approach to the emission reductions.
DRE	90.00%	98.90%	90% DRE was used for the ex-ante calculation as it is generally used in performance projection of uninstalled systems. Therefore it is easily expected that the actual performance of installed systems should be different from the projection. The applied system has much higher DRE and it led to the smaller project emission.

*The pre-treatment maintenance period, from January 1, 2011 to January 19, 2011 is excluded from the emission reductions calculation for conservativeness.

In the PDD, The value of $E_{SF6,in,y}$ was calculated by multiplying SF6 etch utilization efficiency of 70% and heel value of 10% to Expected $C_{SF6,y}$ while $E_{SF6,out,y}$ was simply derived by multiplying DRE of 10% to $E_{SF6,in,y}$. This calculation was a kind of reverse operation and used only for the ex-ante calculation purpose.

The following table shows values of $E_{SF6,in,y}$ and $E_{SF6,out,y}$ projected in the PDD and the real achievement. The differences between values are caused by the abovementioned conservative projection.

Parameters	Projected in the PDD	Real achievement
$E_{SF6,in,y}$	6,448.8 kg (101/365 of the estimated value on annual basis, 23,305 kg)	8,808.7 kg
$E_{SF6,out,y}$	644.7 kg (101/365 of the estimated value on annual basis, 2,330 kg)	96.9 kg

* The pre-treatment maintenance period, from January 1, 2011 to January 19, 2011 is excluded from the emission reductions calculation for conservativeness.

In conclusion, the increase of emission reductions achieved during the monitoring period is mainly caused by the conservative SF6 etch utilization efficiency used in the ex-ante calculation of the PDD and higher actual DRE of the applied system.

- - - - -

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		