Monitoring report form

(Version 05.1)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.

MONITORING REPORT		
Title of the project activity	Samsung Electronics SF_6 abatement project	
UNFCCC reference number of the project activity	3333	
Version number of the monitoring report	1.0	
Completion date of the monitoring report	24/04/2017	
Monitoring period number and duration of this monitoring period	3rd monitoring period, The first and last days are included (01/11/2013 ~ 28/02/2015)	
Project participant(s)	Samsung Display Co., Ltd.	
Host Party	Republic of Korea	
Sectoral scope(s)	Scope 11- Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride	
Selected methodology(ies)	AM0078 ver1.1. - Point of Use Abatement Device to Reduce SF_6 emissions in LCD Manufacturing Operations	
Selected standardized baseline(s)	N/A	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	1,020,778 tCO_2e (This monitoring period is 485 days : 1,020,778 tCO_2e / 485 days)	
Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	0	255,725 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>>

Samsung Electronics SF_6 abatement project (the Project or the Project activity) involves the installation of SF_6 abatement devices at Samsung Display LCD production plant. Samsung Display (SDC) Tangjung plant (the plant) has four LCD production lines (7-1 line, 7-2 line, 8-1 line and 8-2 line). The Project activity installs SF_6 abatement devices at 7-2 lines, which has produced the LCD substrates since January 2006. The installed abatement system will reduce the emission of greenhouse gas through thermal treatment of SF_6 gas.

SF_6 gas destructed by the Project activity is from the etching process where the SF_6 gas is used as etching gas. Though a part of SF_6 gas used in the etching process is decomposed during the process, some part gas is not decomposed and vented into the atmosphere. Though SF_6 gas is one of the greenhouse gases, SF_6 gas itself is odourless, non-toxic and non-flammable and there is no law or regulation that mandates the decomposition or destruction of SF_6 gas in Korea. Due to these reasons, the undecomposed SF_6 gas from the LCD etching process is now being emitted into the atmosphere. In the absence of the Project activity, the current practice will continue and as described in Section E.1 below, this current practice is the baseline scenario.

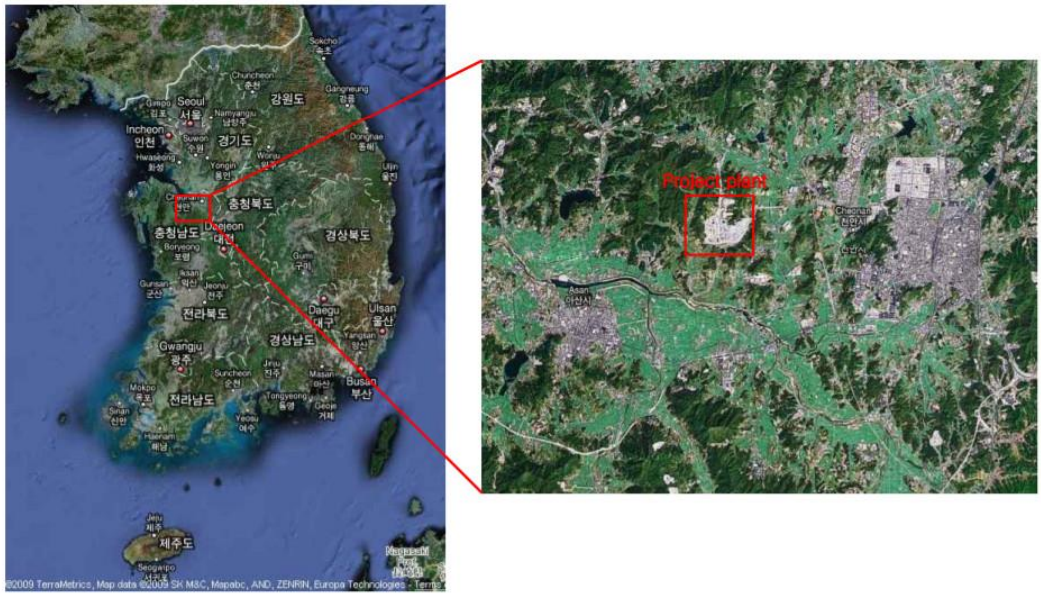
- To reduce greenhouse gas emissions is one of the most important issues for the sustainable development of Korea against the climate change. Therefore, greenhouse gas emission reductions achieved by the project will contribute to the sustainable development of Korea.**Total GHG emission reductions or net GHG removals by sinks achieved in this monitoring period**

This is the 3rd monitoring period covering 485 days (from 01/11/2013 to 28/02/2015) and monitored emission reductions are 255,725 tCO_2e.

A.2. Location of project activity

>>

- Host Party
  Republic of Korea
- Region/state/province
  Chungcheongnam-do
- City/town/community
  200 Tangjung-Myeon, Asan-si
- Physical/geographical location
  Its geographical coordinates are 36°48'53.04"N and 127°03'51.23"E.



A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate whether the Party involved wishes to be considered as project participant (yes/no)
Republic of Korea (Host)	Samsung Display Co., Ltd	No

A.4. Reference of applied methodology and standardized baseline

>>

The applied methodology is AM0078 “Point of Use Abatement Device to Reduce SF_6 emissions in LCD Manufacturing Operations” (version 01.1)
(http://cdm.unfccc.int/methodologies/DB/OBL29PEZ5MIIFE3T6YNRYPRX98RJK3)

The applied Tool is “Combined tool to identify the baseline scenario and demonstrate additionality” (Version 02.2)
(https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v2.2.pdf)

“Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (Version 01)
(http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf)

“Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” (Version 02)
(http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf)

A.5. Crediting period of project activity

>>

- **Type** : Fixed
- **Start date** : 21/10/2010
- **Length of the crediting period** : 21/10/2010 ~ 20/10/2020
- **3rd monitoring period** : 01/11/2013 ~ 28/02/2015

A.6. Contact information of responsible persons/entities

>>
The persons/entities responsible for completing the monitoring report:

Dongsun Yoon / Samsung Display
e-mail: dongsun.yoon@samsung.com, Telephone: +82-41-535-1361

Bo-reum Kueon / RCC Co.,Ltd
e-mail: jesslk@ircc.co.kr, Telephone: +82-54-223-2303

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

>>

- **Information on the implementation status of the project activity**

- Relevant dates of the project activity
The project was registered in 15/07/2010 and installation of equipment was completed on the 14/10/2010. After few weeks of condition setting and final testing, the project finally started in 21/10/2010. 1st Monitoring was conducted from 21/10/2010 to 28/02/2011, 2nd monitoring period was from 01/03/2011 to 31/10/2013 and 3rd monitoring period was from 01/11/2013 to 28/02/2015. During the period, some of the monitoring data was lost and/or in error as shown in table below. The lost data and minus values excluded from the calculation of $E_{SF6,in}$ and $E_{SF6,out}$.

Date	Interrupted time	Events	Comments
04/11/2013	10:33~15:52	Bypass	Annubar data ($T_{s,out}$ and $P_{avg,out}$) was recorded as minus values.
13/11/2013	00:00~12:43 13:31~23:59	FTIR measurement error	FTIR data was not recorded.
28/11/2013	09:44~10:25	Bypass	Some Annubar data was recorded as minus values.
13/12/2013	01:04~12:33	Annubar program error	Annubar data was not recorded.
20/12/2013	03:00~03:42	Shut down because of fail alarm	Annubar data was recorded as minus values.
26/12/2013	10:34~13:27	Annubar equipment error	Some data was recorded as minus values during this period.
27/12/2013	10:17~19:33	Annubar equipment error	Some data was recorded as minus values.
27/01/2014	00:03~15:23	FTIR cell error FTIR parts replacement Bypass	Some FTIR data was not recorded during this period.
01/02/2014~ 03/02/2014	-	FTIR window pollution FTIR parts replacement and inspection	FTIR data was recorded as minus values during this period.
12/02/2014	00:00~23:59	FTIR measurement error	FTIR data was not recorded during this period.
14/02/2014	08:39~19:13	Separation of FTIR monitoring port for CER data calculation	FTIR data was recorded as minus values during this period.
27/02/2014~ 02/03/2014	-	FTIR measurement error	Some FTIR data was recorded as minus values during this period.
10/03/2014	05:11~13:37	Annubar measurement error	Some Annubar data was recorded as minus values during this period.
13/03/2014	08:37~10:04	FTIR measurement error	FTIR data was not recorded.

Date	Interrupted time	Events	Comments
12/05/2014~ 22/05/2014	-	FTIR measurement error (Damage of IN/OUT Laser and IR)	FTIR data was not recorded or recorded as minus values during this period.
21/05/2014~ 22/05/2014	21/05 13:28~ 22/05 07:53	Annubar measurement error	Annubar data was recorded as minus values during this period.
10/06/2014~ 11/06/2014	-	FTIR measurement error Annubar measurement error	Some data was recorded as minus values during this period.
13/06/2014 18/06/2014~ 20/06/2014 24/06/2014	-	FTIR measurement error	Some data was recorded as minus values during this period.
22/06/2014~ 24/06/2014	-	Annubar communication error	Some data was recorded as minus values during this period.
25/06/2014~ 02/07/2014	-	Annubar Masstron error	FTIR data was not recorded during this period.
05/07/2014 10/07/2014 20/07/2014 31/07/2014	-	FTIR measurement error	Some data was recorded as minus values during this period.
02/08/2014 03/08/2014	-	FTIR measurement error	Some data was recorded as minus values during this period.
09/08/2014 15/08/2015	12:55~13:50 13:25~14:56	Annubar inspection Bypass due to Shut down	Some Annubar data was recorded as minus values during this period.
20/08/2014		FTIR calibration	Some FTIR data was not recorded during this period.
02/09/2014	-	Annubar cleaning	Some Annubar data was recorded as minus values during this period.
04/09/2014	-	Installation of security program	FTIR and Annubar Data were not recorded during this period.
05/09/2014 11/09/2014 13/09/2014 25/09/2014 28/09/2014	13:38~15:49 21:56~23:03 10:21~13:19 18:45~19:51 09:37~16:08	FTIR measurement error	Some FTIR data was recorded as minus values during this period.
12/09/2014	03:36~09:10	Annubar measurement error	Annubar data was not recorded during this period.
26/09/2014	09:39~10:56	Bypass	Some Annubar data was recorded as minus values during this period.
02/10/2014	15:30~17:12	Bypass	Annubar data was not recorded during this period.
08/10/2014~ 14/10/2014	-	Annubar computer error/down Bypass for cleaning	Annubar data was not recorded during this period.
15/10/2014	00:48~10:02	FTIR measurement error	Some FTIR data was recorded as minus values.
31/10/2014	00:00~23:59	Annubar measurement error	Annubar data was not recorded during this period.
12/11/2014	15:42~16:30	Bypass	FTIR data was recorded as minus values.
18/11/2014	16:31~17:33	Bypass	Annubar data was recorded as minus values.
21/11/2014	11:59~17:26	Measurement of moisture content	Some FTIR data was recorded as minus values.
25/11/2014	00:00~23:59	FTIR measurement error	FTIR data was not recorded during this period.
26/11/2014	-	Bypass	Some Annubar data was recorded as minus values.
27/11/2014	14:41~15:00	Bypass	Annubar data was not recorded during this period.
01/12/2014~ 03/12/2014	-	FTIR measurement error FTIR calibration	FTIR data was not recorded during this period.

Date	Interrupted time	Events	Comments
15/12/2014	16:10~19:09	Bypass	Some Annubar data was recorded as minus values.
08/01/2015 30/01/2015	15:34~17:48 11:23~15:03	Bypass	FTIR data was recorded as minus values.
08/01/2015 12/01/2015 18/01/2015 29/01/2015 30/01/2015	14:09~17:49 16:03~17:38 07:49~08:46 15:32~17:34 12:32~14:25	Bypass	Some Annubar data was recorded as minus values.
09/02/2015	09:22~14:42	Bypass	Some Annubar data was recorded as minus values during this period.
13/02/2015	10:39~14:55	FTIR In/Out calibration	FTIR data was not recorded during this period.
25/02/2015	15:39~17:22	Annubar measurement error	Some Annubar data was recorded as minus values during this period.
25/02/2015 26/02/2015	16:28~23:59 20:14~22:29	FTIR measurement error	FTIR data was not recorded during this period.

During the 3rd monitoring period, calibrations for FTIR, Annubar and steam flow meter were delayed as below. The monitoring data during the period were deducted or added by applying the allowable error. Refer to the Emission Reduction Sheet for details.

Type of meter	Delayed period	Allowable error
Inlet/Outlet FTIR	01/11/2013~13/11/2013, 12/05/2014, 12/08/2014, 12/11/2014~25/11/2014, 25/02/2015~28/02/2015	±5%
Inlet/Outlet Annubar	01/11/2013 ~ 04/08/2014	±2%
Steam flow meter	#2: 01/11/2013~20/05/2014 #3: 01/11/2013~23/04/2014 #5: 01/11/2013~03/04/2014 #6: 01/11/2013~17/10/2014 #7: 01/11/2013~22/05/2014 #8: 01/11/2013~16/06/2014	±1%

B.2. Post-registration changes

B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

>>
Not applicable

B.2.2. Corrections

>>
Not applicable

B.2.3. Changes to start date of crediting period

>>
Not applicable

B.2.4. Inclusion of a monitoring plan to the registered PDD that was not included at registration

>>
Not applicable

B.2.5. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

>>
Permanent changes for monitoring plan were approved at 2nd monitoring period, 01/03/2011~31/10/2013. There were 2 changes. One is QMS calibration frequency and the other is addition of monitoring equipment. Before changing, calibration frequency of QMS is once a 3month. However, QMS is used only one time (6hours) to measure $M_{d,in}$ and $M_{d,out}$. This is unreasonable so calibration frequency of QMS is changed from once per 3month to once a year. The other one is addition of monitoring equipment. Before changing, only QMS is registered to measure $M_{d,in}$. However, SO_2F_2, which was found in inlet of abatement system, couldn't be measured exactly by QMS. So, FTIR, which is installed to measure the concentration of SF_6, was added to measure the concentration of SO_2F_2. The details are described in PRC document. The approval date is 28/07/2015 and reference number is PRC-3333-001.

B.2.6. Changes to project design of registered project activity

>>
Not applicable

B.2.7. Types of changes specific to afforestation or reforestation project activity

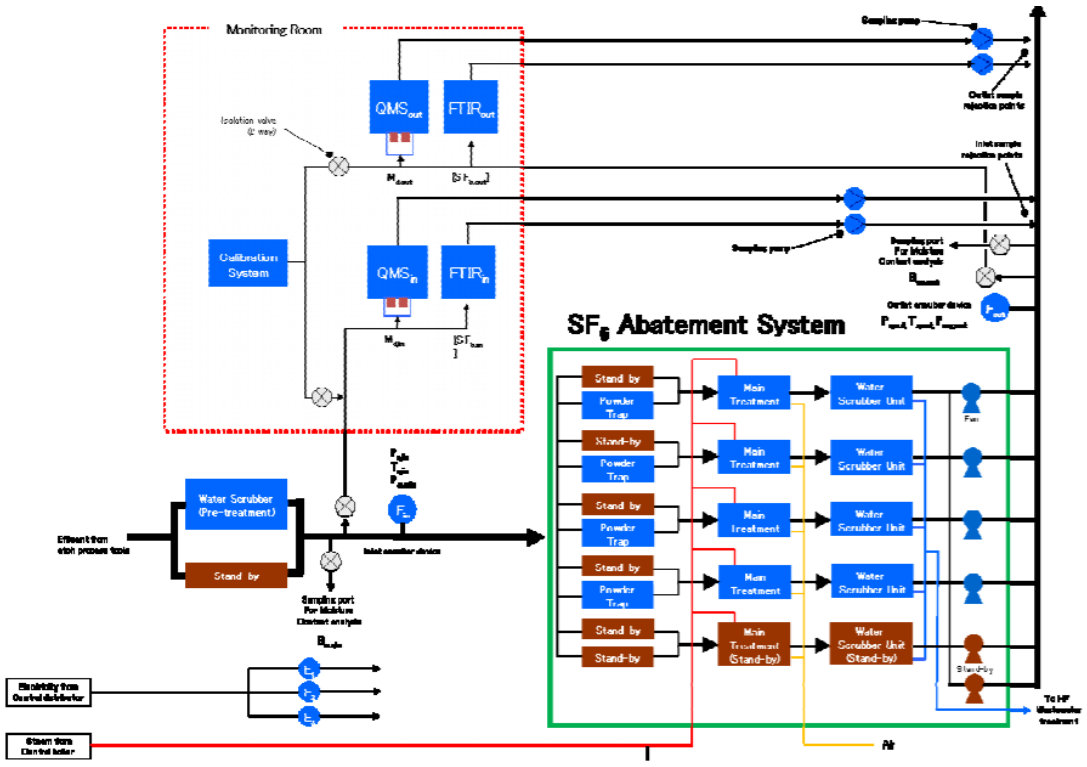
>>
Not applicable

SECTION C. Description of monitoring system

>>

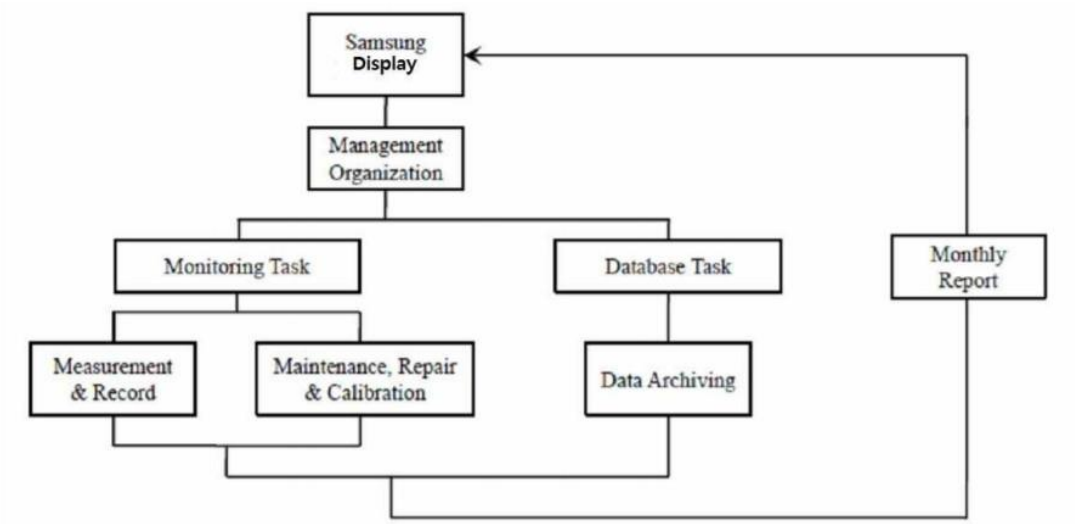
- **Description of the monitoring system**

The following diagram indicates the location of all relevant monitoring points, used for the Project.



- Monitoring structure

SDC has outsourced monitoring tasks to a third party, Clean System Korea Co., Ltd. (CSK). Project Management by SDC oversees the entire monitoring of the project. Accordingly, CSK has organized a monitoring structure, which consists of two qualified management teams which are; Monitoring & Database task team as shown below.



The organization and tasks of this Project will likely be organized as follows:

Management Organization, organized by Clean System Korea – This organization will be responsible for coordinating the overall monitoring plan implementation. They will perform monitoring and database tasks, and will also coordinate all other logistics, including for example:

- Ensuring compliance with CDM methodology,
- Ensuring manpower needs are met,
- Evaluating training needs and carrying out training programs,
- Liaising with SDC to ensure a smooth implementation of the monitoring function.

Monitoring Task – As data collection and monitoring is one of the most critical components of the methodology, it is important to gather the data in the manner detailed in the approved methodology. For the sake of the task, they will ensure the monitoring system is operation properly and the meters are calibrated as per the methodology. They are the focal point for the data gathering. They will use the raw collected to make monthly reports of the results including any irregularities and remedies.

Database Task – This task is to document the data and ensure that it is correctly entered into a database. They will prepare an appropriate database format prior to the start of the project implementation phase. Once the project commences, the required data will be entered on a daily basis.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data/parameter:	$EF_{grid,y}$
Unit	tCO_2/MWh
Description	Emission factor for electricity generation for source j in year y
Source of data	Based on data from Statistics of Electric Power in Korea, emission factor was calculated in accordance with Tool to calculate baseline, project and/or leakage emissions from electricity consumption (ver. 1)
Value(s) applied)	0.5914
Choice of data or measurement methods and procedures	Measurement method is described in PDD
Purpose of data	Calculation of project emissions
Additional comments	NA

Data/parameter:	GWP of SF_6
Unit	$kgCO_2e/Kg\ SF_6$
Description	Global warming potential of SF6
Source of data	IPCC
Value(s) applied)	22,800
Choice of data or measurement methods and procedures	According to Project Standard ver. 9.0 para. 242, GWP of SF_6 was decided of 22,800. This figure will be applied after 01/01/2013.
Purpose of data	Calculation of baseline emissions
Additional comments	NA

Data/parameter:	Historical SF_6 consumption ($C_{SF6,hist}$)
Unit	Tonnes
Description	Historical SF_6 consumption, calculated as the three years maximum consumption prior to the implementation of the project activity before 31/01/2009. 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	Record of purchase and inventory
Value(s) applied)	74.48 ton /year
Choice of data or measurement methods and procedures	Inventory information is used
Purpose of data	Calculation of baseline emissions
Additional comments	Historical three years consumption data is as follows: Year 2006 (01/01/2006 ~ 31/12/2006): 38.00 tonnes Year 2007 (01/01/2007 ~ 31/12/2007): 69.92 tonnes Year 2008 (01/01/2008 ~ 31/12/2008): 74.48 tonnes

Data/parameter:	Historical production of LCD substrate (SP_{-i})
Unit	m^2
Description	Historical production of LCD substrate (m^2) during year i (where i = -1, -2, -3) prior to the implementation of the project activity before January 31, 2009
Source of data	Production records
Value(s) applied)	6,485,252 m^2
Choice of data or measurement methods and procedures	Production records from the project developer are used.
Purpose of data	Calculation of baseline emissions
Additional comments	Historical three years consumption data is as follows: Year 2006 (01/01/2006 ~ 31/12/2006): 2,455,198 m^2 Year 2007 (01/01/2007 ~ 31/12/2007): 5,126,394 m^2 Year 2008 (01/01/2008 ~ 31/12/2008): 6,485,252 m^2

Data/parameter:	$C_{p,in}$
Unit	Coefficient of the inlet Annubar device (dimensionless)
Description	Inlet annubar device coefficients
Source of data	Korea Research Institute of Standards and Science
Value(s) applied)	1.0126
Choice of data or measurement methods and procedures	Test report of KRISS (Korea Research Institute of Standards and Science – nationally recognized standard organization) was used.
Purpose of data	Calculation of project emissions
Additional comments	NA

Data/parameter:	$C_{p,out}$
Unit	Coefficient of the inlet Annubar device (dimensionless)
Description	Outlet annubar device coefficients
Source of data	Korea Research Institute of Standards and Science
Value(s) applied)	1.0126
Choice of data or measurement methods and procedures	Test report of KRISS (Korea Research Institute of Standards and Science – nationally recognized standard organization) was used.
Purpose of data	Calculation of project emissions
Additional comments	NA

Data/parameter:	Cross sectional area of the inlet stack (A_{in})
Unit	m^2
Description	Cross-sectional areas of the inlet stacks
Source of data	Isometric Drawing
Value(s) applied)	0.0755
Choice of data or measurement methods and procedures	Diameter of inlet stack is 310 mm, which equals to be 0.0755 m^2
Purpose of data	Calculation of project emissions
Additional comments	NA

Data/parameter:	Cross sectional area of the outlet stack (A_{out})
Unit	m^2
Description	Cross-sectional areas of the outlet stacks
Source of data	Isometric Drawing
Value(s) applied)	0.0755
Choice of data or measurement methods and procedures	Diameter of inlet stack is 310 mm, which equals to be 0.0755 m^2
Purpose of data	Calculation of project emissions
Additional comments	NA

Data/parameter:	$EF_{CO2,NG,y}$
Unit	tCO_2/TJ
Description	CO_2 emission factor of the natural gas combusted in the Project
Source of data	IPCC
Value(s) applied)	58.3
Choice of data or measurement methods and procedures	Default value from table 1.4 of Chapter 1 of Vol 2 of the 2006 IPCC Guidelines for National GHG Inventories is used. 95% upper confidence interval was applied.
Purpose of data	Calculation of project emissions
Additional comments	This factor is used to calculate $COEF_{NG,y}$

D.2. Data and parameters monitored

<table>
<tr><td>Data/parameter:</td><td>$EC_{PJ,j,y}$</td></tr>
<tr><td>Unit</td><td>MWh/yr</td></tr>
<tr><td>Description</td><td>Quantity of electricity consumed by the project electricity consumption source j in year y (01/11/2013 – 28/02/2015)</td></tr>
<tr><td>Measured/calculated/default</td><td>Measured</td></tr>
<tr><td>Source of data</td><td>Watt-hour Meter</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><td rowspan="2">Date</td><td>$EC_{PJ,j,y}$</td></tr>
<tr><td>MWh</td></tr>
<tr><td>01/11/2013 ~ 31/12/2013</td><td>134</td></tr>
<tr><td>01/01/2014 ~ 31/12/2014</td><td>792</td></tr>
<tr><td>01/01/2015 ~ 28/02/2015</td><td>138</td></tr>
<tr><td>Total</td><td>1,064</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>Meter #1
<table>
<tr><td>Type</td><td>Electric meter</td></tr>
<tr><td>Accuracy Class</td><td>±1.0%</td></tr>
<tr><td>Serial number</td><td>0363955</td></tr>
<tr><td>Calibration frequency</td><td>Once per 7 years</td></tr>
<tr><td>Past calibration date</td><td>01/06/2011</td></tr>
<tr><td>Date of last calibration</td><td>13/03/2014</td></tr>
<tr><td>Validity</td><td>01/06/2011~31/05/2018
13/03/2014~12/03/2021</td></tr>
</table>
Meter #2
<table>
<tr><td>Type</td><td>Electric meter</td></tr>
<tr><td>Accuracy Class</td><td>±1.0%</td></tr>
<tr><td>Serial number</td><td>0410616</td></tr>
<tr><td>Calibration frequency</td><td>Once per 7 years</td></tr>
<tr><td>Past calibration date</td><td>14/09/2011</td></tr>
<tr><td>Date of last calibration</td><td>13/03/2014</td></tr>
<tr><td>Validity</td><td>01/09/2011~31/08/2018
13/03/2014~12/03/2021</td></tr>
</table>
Meter #3
<table>
<tr><td>Type</td><td>Electric meter</td></tr>
<tr><td>Accuracy Class</td><td>±1.0%</td></tr>
<tr><td>Serial number</td><td>0410617</td></tr>
<tr><td>Calibration frequency</td><td>Once per 7 years</td></tr>
<tr><td>Past calibration date</td><td>14/09/2011</td></tr>
<tr><td>Date of last calibration</td><td>13/03/2014</td></tr>
<tr><td>Validity</td><td>01/09/2011~31/08/2018
13/03/2014~12/03/2021</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Daily</td></tr>
<tr><td>Calculation method (if applicable):</td><td>NA</td></tr>
<tr><td>QA/QC procedures:</td><td>The meters will be calibrated once per 7 years meeting the manufacturer’s instruction and/or national standard.</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of Project Emission</td></tr>
<tr><td>Additional comments:</td><td>NA</td></tr>
</table>

Data/parameter:	$TDL_{j,y}$
Unit	%
Description	Average technical transmission and distribution losses for providing electricity to source j in year y
Measured/calculated/default	Measured and calculated by KOREA ELECTRIC POWER CORPORATION
Source of data	STATISTICS OF ELECTRIC POWER IN KOREA 2016 (by KOREA ELECTRIC POWER CORPORATION)
Value(s) of monitored parameter	– 2013: 3.73% – 2014: 3.69% – 2015: 3.60%
Monitoring equipment	NA
Measuring/reading/recording frequency:	The value is published annually
Calculation method (if applicable):	NA
QA/QC procedures:	NA
Purpose of data:	Calculation of Project Emission
Additional comments:	This value is in Statistics of electric power in Korea 2016, page 16. Retrieved from http://home.kepco.co.kr/kepco/KO/ntcob/list.do?boardCd=BRD_000099&menuCd=FN05030103

Data/parameter:	$E_{SF6,in,y}$
Unit	tonnes
Description	Mass of SF_6 gas entering the abatement device in year y
Measured/calculated/default	Calculated
Source of data	Calculation data from inlet FTIR and inlet Annubar device
Value(s) of monitored parameter	
Monitoring equipment	NA
Measuring/reading/recording frequency:	NA
Calculation method (if applicable):	Sum of $E_{SF6,in}$
QA/QC procedures:	All of the manufacturer's maintenance and calibration procedures and timetables have been followed. Data is manually calculated by a data processing program. Refer to the ER spread sheet.
Purpose of data:	Calculation of baseline emissions
Additional comments:	NA

Date	$E_{SF6,in,y}$
	Tonnes
01/11/2013 ~ 31/12/2013	1.626
01/01/2014 ~ 31/12/2014	10.364
01/01/2015 ~ 28/02/2015	1.020
Total	13.010

Data/parameter:	$C_{SF6,y}$
Unit	tonnes
Description	Annual consumption of SF_6 during the year y, defined as the total SF_6 purchase in a specific project year y taking into account the change in inventory in the same year.
Measured/calculated/default	Measured
Source of data	Record of purchase and inventory (These values are from G-ERP, which is electric accounting system.)
Value(s) of monitored parameter	<table><tr><th rowspan="2">Date</th><th>$C_{SF6,y}$</th></tr><tr><th>Tonnes</th></tr><tr><td>01/11/2013 ~ 31/12/2013</td><td>8.170</td></tr><tr><td>01/01/2014 ~ 31/12/2014</td><td>51.439</td></tr><tr><td>01/01/2015 ~ 28/02/2015</td><td>6.169</td></tr><tr><td>Total</td><td>65.778</td></tr></table>
Monitoring equipment	NA
Measuring/reading/recording frequency:	Recording when purchase SF_6 with G-ERP
Calculation method (if applicable):	{(The number of SF_6 bombe) * 450kg} – Remaining of SF_6
QA/QC procedures:	NA
Purpose of data:	Calculation of baseline emissions
Additional comments:	Consumption of SF_6 is deemed as amount of SF_6 purchase taking into account the change in inventory in the same year. Remaining of SF_6 gas in bombe was measured by Load-cell, which is installed in gas-operation room. Total SF_6 gas consumption was calculated considering SF_6 purchase data and remaining of SF_6.

Data/parameter:	$SP_{project,y}$
Unit	m^2
Description	Production of LCD substrate during the project year y
Measured/calculated/default	Measured
Source of data	Manufacturing Workplace system of Samsung Display
Value(s) of monitored parameter	<table><tr><th rowspan="2">Date</th><th>$SP_{project,y}$</th></tr><tr><th>m^2</th></tr><tr><td>01/11/2013 ~ 31/12/2013</td><td>1,156,091</td></tr><tr><td>01/01/2014 ~ 31/12/2014</td><td>7,540,871</td></tr><tr><td>01/01/2015 ~ 28/02/2015</td><td>948,635</td></tr><tr><td>Total</td><td>9,645,597</td></tr></table>
Monitoring equipment	NA
Measuring/reading/recording frequency:	Recording monthly
Calculation method (if applicable):	NA
QA/QC procedures:	NA
Purpose of data:	Calculation of baseline emissions
Additional comments:	This data comes from the Manufacturing Workplace system of Samsung Display, which is a computerized system commonly used in the manufacturing industry.

Data/parameter:	$E_{SF6,in}$
Unit	Gram/second
Description	Amount of SF_6 gas measured at the inlet of the SF_6 abatement system
Measured/calculated/default	Calculated
Source of data	Data calculation from inlet QMS, FTIR and Annubar device
Value(s) of monitored parameter	<table><tr><th rowspan="2">Date</th><th>$E_{SF6,in}$</th></tr><tr><th>Gram/second</th></tr><tr><td>01/11/2013 ~ 31/12/2013</td><td>0.3138</td></tr><tr><td>01/01/2014 ~ 31/12/2014</td><td>0.3286</td></tr><tr><td>01/01/2015 ~ 28/02/2015</td><td>0.2001</td></tr></table> This is average value during this monitoring period. Please see more details in the ER spread sheet.
Monitoring equipment	NA
Measuring/reading/recording frequency:	NA
Calculation method (if applicable):	$E_{SF6,in} = 65.18 * Q_{in}$ [$SF_{6,in}$]
QA/QC procedures:	All of the manufacturer's maintenance and calibration procedures and timetables have been followed. Data is manually calculated by a data processing program. According to the QA/QC procedure and conservativeness for monitoring of the inlet flow as described in PDD, any SF_6 emissions measured are discounted from the crediting period when the value of the gas flow measured at the inlet during the monitoring period decreases by more than 5%, compared to the baseline flow rate (i.e. if $Q_{in,monitoring} < 0.95*Q_{in,baseline}$). Refer to the ER spread sheet.
Purpose of data:	Calculation of baseline emissions
Additional comments:	If the value of $E_{SF6,in}$ is less than the value of $E_{SF6,out}$ both values of $E_{SF6,in}$ and $E_{SF6,out}$ are discounted from the crediting period.

Data/parameter:	$E_{SF6,out}$
Unit	Gram/second
Description	Amount of SF6 gas measured at the outlet of the SF6 abatement system
Measured/calculated/default	Calculated
Source of data	Data calculation from outlet QMS, FTIR and Annubar device
Value(s) of monitored parameter	<table><tr><th rowspan="2">Date</th><th>$E_{SF6,out}$</th></tr><tr><th>Gram/second</th></tr><tr><td>01/11/2013 ~ 31/12/2013</td><td>0.0444</td></tr><tr><td>01/01/2014 ~ 31/12/2014</td><td>0.0456</td></tr><tr><td>01/01/2015 ~ 28/02/2015</td><td>0.0235</td></tr></table> This is average value during this monitoring period. Please see more details in the ER spread sheet.
Monitoring equipment	NA
Measuring/reading/recording frequency:	NA
Calculation method (if applicable):	$E_{SF6,out} = 65.18 * Q_{out}$ [$SF_{6,out}$]

QA/QC procedures:	All of the manufacturer's maintenance and calibration procedures and timetables have been followed. Data is manually calculated by a data processing program. According to the QA/QC procedure and conservativeness for monitoring of the outlet flow as described in PDD, any SF_6 emissions measured are discounted from the crediting period when the value of the gas flow measured at the outlet during the monitoring period increases by more than 5%, compared to the averaged velocity(i.e. if $Q_{out,monitoring} > 1.05*Q_{out,baseline}$). Refer to the ER spread sheet.
Purpose of data:	Calculation of project emissions
Additional comments:	If the value of $E_{SF6,in}$ is less than the value of $E_{SF6,out}$ both values of $E_{SF6,in}$ and $E_{SF6,out}$ are discounted from the crediting period.

<table>
<tr><td>Data/parameter:</td><td>$M_{d,in}$</td></tr>
<tr><td>Unit</td><td>Gram/mole</td></tr>
<tr><td>Description</td><td>Total dry molecular weight of inlet stack gas</td></tr>
<tr><td>Measured/calculated/default</td><td>Measured and calculated</td></tr>
<tr><td>Source of data</td><td>Inlet QMS and FTIR data</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><td rowspan="2">Date</td><td>$M_{d,in}$</td></tr>
<tr><td>Gram/mole</td></tr>
<tr><td>01/11/2013 ~ 31/12/2013</td><td>28.3807</td></tr>
<tr><td>01/01/2014 ~ 31/12/2014</td><td>29.0900</td></tr>
<tr><td>01/01/2015 ~ 28/02/2015</td><td>28.8888</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>
Inlet QMS
<table>
<tr><td>Type</td><td>Quadruple Mass Spectrometry</td></tr>
<tr><td>Accuracy Class</td><td>±2%</td></tr>
<tr><td>Serial number</td><td>44506282</td></tr>
<tr><td>Calibration frequency</td><td>1 year</td></tr>
<tr><td>Past calibration date</td><td>13/10/2013
12/02/2014
12/05/2014
12/08/2014
12/11/2014
13/02/2015</td></tr>
<tr><td>Date of last calibration</td><td>14/11/2015</td></tr>
<tr><td>Validity</td><td>13/10/2013~12/10/2014
12/02/2014~11/02/2015
12/05/2014~11/05/2015
12/08/2014~11/08/2015
12/11/2014~11/11/2015
13/02/2015~12/02/2016
14/11/2015~13/11/2016</td></tr>
</table>
Inlet FTIR
<table>
<tr><td>Type</td><td>Fourier transform infrared spectroscopy</td></tr>
<tr><td>Accuracy Class</td><td>±5%</td></tr>
<tr><td>Serial number</td><td>K2000010</td></tr>
<tr><td>Calibration frequency</td><td>3 months</td></tr>
<tr><td>Past calibration date</td><td>13/11/2013
12/02/2014
12/05/2014
12/08/2014
25/11/2014</td></tr>
<tr><td>Date of last calibration</td><td>10/11/2015</td></tr>
<tr><td>Validity</td><td>13/11/2013~12/02/2014
12/02/2014~11/05/2014
12/05/2014~11/08/2014
12/08/2014~11/11/2014
25/11/2014~24/02/2015
10/11/2015~09/02/2016</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Measuring for 6 hours a year</td></tr>
</table>

Calculation method (if applicable):	$M_{d,in} = 1.460[SF_{6,in}] + 0.440\ [CO_{2,in}] + 0.399\ [Ar_{in}] + 0.320\ [O_{2,in}] + 0.280[N_{2,in}] + 1.021[SO_2F_{2,in}] + 0.040[He_{in}]$
QA/QC procedures:	QMS was calibrated with all components having more than 100 ppmv concentrations in inlet gases, which include SF_6, SO_2F_2, CO_2, Ar, O_2, N_2 and He. And the applied value of $M_{d,in}$ is the highest value of $M_{d,in}$ during the 6 hours measuring period. More detailed information on QA/QC procedure is included in the Data Management Manual which has been provided to DOE for verification purpose. Concentration of SO_2F_2 was measured by Inlet FTIR, so the molecular weight of SO_2F_2 was added by 5% for applying the conservative manner.
Purpose of data:	Calculation of baseline emissions
Additional comments:	$M_{d,in}$ measurement was conducted in 14/11/2013, 13/11/2014 and 14/11/2015, which are within the validity of Inlet QMS.

<table>
<tr><td>Data/parameter:</td><td>$M_{d,out}$</td></tr>
<tr><td>Unit</td><td>Gram/mole</td></tr>
<tr><td>Description</td><td>Total dry molecular weight of outlet stack gas</td></tr>
<tr><td>Measured/calculated/default</td><td>Measured and calculated</td></tr>
<tr><td>Source of data</td><td>Outlet QMS data</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><td rowspan="2">Date</td><td>$M_{d,out}$</td></tr>
<tr><td>Gram/mole</td></tr>
<tr><td>01/11/2013 ~ 31/12/2013</td><td>28.4898</td></tr>
<tr><td>01/01/2014 ~ 31/12/2014</td><td>28.6589</td></tr>
<tr><td>01/01/2015 ~ 28/02/2015</td><td>28.6832</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>Outlet QMS
<table>
<tr><td>Type</td><td>Quadruple Mass Spectrometry</td></tr>
<tr><td>Accuracy Class</td><td>±2%</td></tr>
<tr><td>Serial number</td><td>44506283</td></tr>
<tr><td>Calibration frequency</td><td>1 year</td></tr>
<tr><td>Past calibration date</td><td>13/10/2013
12/08/2014
12/11/2014
13/02/2015</td></tr>
<tr><td>Date of last calibration</td><td>14/11/2015</td></tr>
<tr><td>Validity</td><td>13/10/2013~12/10/2014
12/08/2014~11/08/2015
12/11/2014~11/11/2015
13/02/2015~12/02/2016
14/11/2015~13/11/2016</td></tr>
</table>
Outlet FTIR
<table>
<tr><td>Type</td><td>Fourier transform infrared spectroscopy</td></tr>
<tr><td>Accuracy Class</td><td>±5%</td></tr>
<tr><td>Serial number</td><td>K2000009</td></tr>
<tr><td>Calibration frequency</td><td>3 months</td></tr>
<tr><td>Past calibration date</td><td>13/11/2013
12/02/2014
12/05/2014
12/08/2014
25/11/2014</td></tr>
<tr><td>Date of last calibration</td><td>10/11/2015</td></tr>
<tr><td>Validity</td><td>13/11/2013~12/02/2014
12/02/2014~11/05/2014
12/05/2014~11/08/2014
12/08/2014~11/11/2014
25/11/2014~24/02/2015
10/11/2015~09/02/2016</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Measuring for 6 hours a year</td></tr>
<tr><td>Calculation method (if applicable):</td><td>$M_{d,out} = 1.460[SF_{6,out}] + 0.440\ [CO_{2,out}] + 0.399\ [Ar_{out}] + 0.320\ [O_{2,out}] + 0.280[N_{2,out}] + 1.021[SO_2F_{2,out}] + 0.040[He_{out}]$</td></tr>
</table>

QA/QC procedures:	QMS was calibrated with all components having more than 100 ppmv concentrations in inlet gases, which include SF_6, SO_2F_2, CO_2, Ar, O_2, N_2 and He. And the applied value of $M_{d,out}$ is the lowest value of $M_{d,out}$ during the 6 hours measuring period. More detailed information on QA/QC procedure is included in the Data Management Manual which has been provided to DOE for verification purpose. Concentration of SO_2F_2 was measured by Outlet FTIR, so the molecular weight of SO_2F_2 was deducted by 5% for applying the conservative manner.
Purpose of data:	Calculation of baseline emissions
Additional comments:	$M_{d,out}$ measurement was conducted in 14/11/2013, 13/11/2014 and 14/11/2015, which are within the validity of Outlet QMS.

<table>
<tr><td>Data/parameter:</td><td>$B_{ws,in}$</td></tr>
<tr><td>Unit</td><td>Dimensionless (percentage volume fraction)</td></tr>
<tr><td>Description</td><td>The proportion of water in the inlet gas stream measured using EPA Method 4, and used to calculate the inlet gas molecular weight.</td></tr>
<tr><td>Measured/calculated/default</td><td>Measured</td></tr>
<tr><td>Source of data</td><td>measurement report</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><td rowspan="2">Date</td><td>$B_{ws,in}$</td></tr>
<tr><td>%</td></tr>
<tr><td>01/11/2013 ~ 31/12/2013</td><td>0.995</td></tr>
<tr><td>01/01/2014 ~ 31/12/2014</td><td>1.050</td></tr>
<tr><td>01/01/2015 ~ 28/02/2015</td><td>1.148</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>
- Monitoring equipment for 2013
<table>
<tr><td>Type</td><td>Dust stack sampler</td></tr>
<tr><td>Accuracy Class</td><td>±5% (Gas meter)
±2% (Barometer)
±2% (Thermometer)</td></tr>
<tr><td>Serial number</td><td>1309043</td></tr>
<tr><td>Calibration frequency</td><td>2 years</td></tr>
<tr><td>Past calibration date</td><td>16/09/2013</td></tr>
<tr><td>Date of last calibration</td><td>24/02/2014</td></tr>
<tr><td>Validity</td><td>16/09/2013~15/09/2015
24/02/2014~23/02/2016</td></tr>
</table>
- Monitoring equipment for 2014
<table>
<tr><td>Type</td><td>Dust stack sampler</td></tr>
<tr><td>Accuracy Class</td><td>±5% (Gas meter)
±2% (Barometer)
±2% (Thermometer)</td></tr>
<tr><td>Serial number</td><td>020329K</td></tr>
<tr><td>Calibration frequency</td><td>2 years</td></tr>
<tr><td>Past calibration date</td><td>NA</td></tr>
<tr><td>Date of last calibration</td><td>24/02/2014</td></tr>
<tr><td>Validity</td><td>24/02/2014~23/02/2016</td></tr>
</table>
- Monitoring equipment for 2015
<table>
<tr><td>Type</td><td>Dust stack sampler</td></tr>
<tr><td>Accuracy Class</td><td>±5% (Gas meter)
±2% (Barometer)
±2% (Thermometer)</td></tr>
<tr><td>Serial number</td><td>1303018</td></tr>
<tr><td>Calibration frequency</td><td>2 years</td></tr>
<tr><td>Past calibration date</td><td>NA</td></tr>
<tr><td>Date of last calibration</td><td>03/04/2015</td></tr>
<tr><td>Validity</td><td>03/04/2015~02/04/2017</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Measuring once a year</td></tr>
<tr><td>Calculation method (if applicable):</td><td>NA</td></tr>
<tr><td>QA/QC procedures:</td><td>Dust stack sampler is calibrated once per 2 years according to national standard.</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of baseline emissions</td></tr>
</table>

Additional comments:	This value was measured by an independent company which is specialized in measuring and analysing. The entire measurement process followed EPA method 4. $B_{ws,in}$ measurement was conducted in 21/10/2013, 21/11/2014 and 18/08/2015, which are within the validity of the monitoring equipment.

Data/parameter:	$B_{ws,out}$
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 inlet gas molecular weight.
Measured/calculated/default	Measured
Source of data	measurement report
Value(s) of monitored parameter	

Date	$B_{ws,out}$
	%
01/11/2013 ~ 31/12/2013	4.363
01/01/2014 ~ 31/12/2014	2.000
01/01/2015 ~ 28/.02/2015	1.717

Monitoring equipment

- Monitoring equipment for 2013

Type	Dust stack sampler
Accuracy Class	±5% (Gas meter) ±2% (Barometer) ±2% (Thermometer)
Serial number	1309045
Calibration frequency	2 years
Past calibration date	NA
Date of last calibration	16/09/2013
Validity	16/09/2013~15/09/2015

- Monitoring equipment for 2014

Type	Dust stack sampler
Accuracy Class	±5% (Gas meter) ±2% (Barometer) ±2% (Thermometer)
Serial number	020329K
Calibration frequency	2 years
Past calibration date	NA
Date of last calibration	24/02/2014
Validity	24/02/2014~23/02/2016

- Monitoring equipment for 2015

Type	Dust stack sampler
Accuracy Class	±5% (Gas meter) ±2% (Barometer) ±2% (Thermometer)
Serial number	1303018
Calibration frequency	2 years
Past calibration date	NA
Date of last calibration	03/04/2015
Validity	03/04/2015~02/04/2017

Measuring/reading/recording frequency:	Measuring once a year
Calculation method (if applicable):	NA
QA/QC procedures:	Dust stack sampler is calibrated once per 2 years according to national standard.

Purpose of data:	Calculation of baseline emissions
Additional comments:	This value was measured by an independent company which is specialized in measuring and analysing. The entire measurement process followed EPA method 4. $B_{ws,out}$ measurement was conducted in 21/10/2013, 21/11/2014 and 18/08/2015, which are within the validity of the monitoring equipment.

Data/parameter:	$P_{s,in}$
Unit	mmHg
Description	The inlet stack pressure measured during manufacturing operations
Measured/calculated/default	Measured
Source of data	Pressure gauge
Value(s) of monitored parameter	Date: 01/11/2013 ~ 31/12/2013 — $P_{s,in}$ (mmHg): 719.949 Date: 01/01/2014 ~ 31/12/2014 — $P_{s,in}$ (mmHg): 700.219 Date: 01/01/2015 ~ 28/02/2015 — $P_{s,in}$ (mmHg): 724.181 This is average value during this monitoring period. Please see more details in the ER spread sheet.
Monitoring equipment	Inlet Annubar Type: Different pressure gauge Accuracy Class: ±2% Serial number: 72691A Calibration frequency: Once per year Past calibration date: 04/08/2014 Date of last calibration: 07/01/2016 Validity: 04/08/2014~03/08/2015, 07/01/2016~06/01/2017 Delayed dates: 01/11/2013~04/08/2014
Measuring/reading/recording frequency:	Value is continuously measured and recorded every 1 min.
Calculation method (if applicable):	NA
QA/QC procedures:	This value is measured in accordance with the US EPA guideline.
Purpose of data:	Baseline and project emission
Additional comments:	Since the calibration of Inlet Annubar was delayed from 01/11/2013~04/08/2014, the monitoring data during this period have been deducted by its allowable error, which is -2%.

Data/parameter:	$P_{s,out}$
Unit	mmHg
Description	The outlet stack pressure measured during manufacturing operations
Measured/calculated/default	Measured
Source of data	Pressure gauge

<table>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><td rowspan="2">Date</td><td>$P_{s,out}$</td></tr>
<tr><td>mmHg</td></tr>
<tr><td>01/11/2013 ~ 31/12/2013</td><td>744.762</td></tr>
<tr><td>01/01/2014 ~ 31/12/2014</td><td>725.731</td></tr>
<tr><td>01/01/2015 ~ 28/02/2015</td><td>746.073</td></tr>
</table>
This is average value during this monitoring period. Please see more details in the ER spread sheet.
</td></tr>
<tr><td>Monitoring equipment</td><td>Outlet Annubar
<table>
<tr><td>Type</td><td>Different pressure gauge</td></tr>
<tr><td>Accuracy Class</td><td>±2%</td></tr>
<tr><td>Serial number</td><td>72691B</td></tr>
<tr><td>Calibration frequency</td><td>Once per year</td></tr>
<tr><td>Past calibration date</td><td>04/08/2014</td></tr>
<tr><td>Date of last calibration</td><td>07/01/2016</td></tr>
<tr><td>Validity</td><td>04/08/2014~03/08/2015
07/01/2016~06/01/2017</td></tr>
<tr><td>Delayed dates</td><td>01/11/2013~04/08/2014</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Value is continuously measured and recorded at least every 1 min.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>NA</td></tr>
<tr><td>QA/QC procedures:</td><td>This value is measured in accordance with the US EPA guideline</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of project emissions</td></tr>
<tr><td>Additional comments:</td><td>Since the calibration of Outlet Annubar was delayed from 01/11/2013~04/08/2014, the monitoring data during this period have been added by its allowable error, which is +2%.</td></tr>
</table>

<table>
<tr><td>Data/parameter:</td><td>$T_{s,in}$</td></tr>
<tr><td>Unit</td><td>^{o}K</td></tr>
<tr><td>Description</td><td>The inlet stack temperature measured during manufacturing operations</td></tr>
<tr><td>Measured/calculated/default</td><td>Measured</td></tr>
<tr><td>Source of data</td><td>Thermocouple</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><td rowspan="2">Date</td><td>$T_{s,in}$</td></tr>
<tr><td>^{o}K</td></tr>
<tr><td>01/11/2013 ~ 31/12/2013</td><td>281.553</td></tr>
<tr><td>01/01/2014 ~ 31/12/2014</td><td>284.080</td></tr>
<tr><td>01/01/2015 ~ 28/02/2015</td><td>280.569</td></tr>
</table>
This is average value during this monitoring period. Please see more details in the ER spread sheet.
</td></tr>
</table>

<table>
<tr><td>Monitoring equipment</td><td>Inlet Annubar

<table><tr><td>Type</td><td>Thermometer</td></tr><tr><td>Accuracy Class</td><td>±2%</td></tr><tr><td>Serial number</td><td>72691A</td></tr><tr><td>Calibration frequency</td><td>Once per year</td></tr><tr><td>Past calibration date</td><td>04/08/2014</td></tr><tr><td>Date of last calibration</td><td>07/01/2016</td></tr><tr><td>Validity</td><td>04/08/2014~03/08/2015
07/01/2016~06/01/2017</td></tr><tr><td>Delayed dates</td><td>01/11/2013~04/08/2014</td></tr></table></td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Value is continuously measured and recorded at least every 1 min.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>NA</td></tr>
<tr><td>QA/QC procedures:</td><td>This value is measured in accordance with the US EPA guideline.</td></tr>
<tr><td>Purpose of data:</td><td>Baseline and project emission</td></tr>
<tr><td>Additional comments:</td><td>Since the calibration of Inlet Annubar was delayed from 01/11/2013~04/08//2014, the monitoring data during this period have been deducted by its allowable error, which is -2%.</td></tr>
</table>

<table>
<tr><td>Data/parameter:</td><td>$T_{s,out}$</td></tr>
<tr><td>Unit</td><td>^{o}K</td></tr>
<tr><td>Description</td><td>The outlet stack temperature measured during manufacturing operations</td></tr>
<tr><td>Measured/calculated/default</td><td>Measured</td></tr>
<tr><td>Source of data</td><td>Thermocouple</td></tr>
<tr><td>Value(s) of monitored parameter</td><td><table><tr><td rowspan="2">Date</td><td>$T_{s,out}$</td></tr><tr><td>^{o}K</td></tr><tr><td>01/11/2013 ~ 31/12/2013</td><td>299.064</td></tr><tr><td>01/01/2014 ~ 31/12/2014</td><td>301.052</td></tr><tr><td>01/01/2015 ~ 28/02/2015</td><td>298.586</td></tr></table>
This is average value during this monitoring period. Please see more details in the ER spread sheet.</td></tr>
<tr><td>Monitoring equipment</td><td>Outlet Annubar

<table><tr><td>Type</td><td>Thermometer</td></tr><tr><td>Accuracy Class</td><td>±2%</td></tr><tr><td>Serial number</td><td>72691B</td></tr><tr><td>Calibration frequency</td><td>Once per year</td></tr><tr><td>Past calibration date</td><td>04/08/2014</td></tr><tr><td>Date of last calibration</td><td>07/01/2016</td></tr><tr><td>Validity</td><td>04/08/2014~03/08/2015
07/01/2016~06/01/2017</td></tr><tr><td>Delayed dates</td><td>01/11/2013~04/08/2014</td></tr></table></td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Value is continuously measured and recorded at least every 1 min.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>NA</td></tr>
<tr><td>QA/QC procedures:</td><td>This value is measured in accordance with the US EPA guideline.</td></tr>
<tr><td>Purpose of data:</td><td>Baseline and project emission</td></tr>
</table>

Additional comments:	Since the calibration was delayed from 01/11/2013~04/08/2014, the monitoring data during this period have been added by its allowable error, which is +2%.

Data/parameter:	$P_{avg,in}$
Unit	mmH_2O
Description	The averaged velocity head measurement used to calculate the inlet gas velocity
Measured/calculated/default	Measured
Source of data	Differential pressure gauge
Value(s) of monitored parameter	<table><tr><th rowspan="2">Date</th><th>$P_{avg,in}$</th></tr><tr><th>mmH_2O</th></tr><tr><td>01/11/2013 ~ 31/12/2013</td><td>0.2891</td></tr><tr><td>01/01/2014 ~ 31/12/2014</td><td>0.2755</td></tr><tr><td>01/01/2015 ~ 28/02/2015</td><td>0.2960</td></tr></table> This is average value during this monitoring period. Please see more details in the ER spread sheet.
Monitoring equipment	Inlet Annubar <table><tr><td>Type</td><td>Different pressure gauge</td></tr><tr><td>Accuracy Class</td><td>±2%</td></tr><tr><td>Serial number</td><td>72691A</td></tr><tr><td>Calibration frequency</td><td>Once per year</td></tr><tr><td>Past calibration date</td><td>04/08/2014</td></tr><tr><td>Date of last calibration</td><td>07/01/2016</td></tr><tr><td>Validity</td><td>04/08/2014~03/08/2015 07/01/2016~06/01/2017</td></tr><tr><td>Delayed dates</td><td>01/11/2013~04/08/2014</td></tr></table>
Measuring/reading/recording frequency:	Value is continuously measured and recorded at least every 1 min.
Calculation method (if applicable):	NA
QA/QC procedures:	This value is measured in accordance with the US EPA guideline.
Purpose of data:	Calculation of baseline emissions
Additional comments:	Since the calibration was delayed from 01/11/2013~04/08/2014, the monitoring data during this period have been deducted by its allowable error, which is -2%.

Data/parameter:	$P_{avg,out}$
Unit	mmH_2O
Description	The averaged velocity head measurement used to calculate the outlet gas velocity
Measured/calculated/default	Measured
Source of data	Differential pressure gauge

<table>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><th rowspan="2">Date</th><th>$P_{avg,out}$</th></tr>
<tr><th>mmH_2O</th></tr>
<tr><td>01/11/2013 ~ 31/12/2013</td><td>0.5230</td></tr>
<tr><td>01/01/2014 ~ 31/12/2014</td><td>0.7937</td></tr>
<tr><td>01/01/2015 ~ 28/02/2015</td><td>0.4108</td></tr>
</table>

This is average value during this monitoring period. Please see more details in the ER spread sheet.
</td></tr>
<tr><td>Monitoring equipment</td><td>Outlet Annubar
<table>
<tr><td>Type</td><td>Different pressure gauge</td></tr>
<tr><td>Accuracy Class</td><td>±2%</td></tr>
<tr><td>Serial number</td><td>72691B</td></tr>
<tr><td>Calibration frequency</td><td>Once per year</td></tr>
<tr><td>Past calibration date</td><td>04/08/2014</td></tr>
<tr><td>Date of last calibration</td><td>07/01/2016</td></tr>
<tr><td>Validity</td><td>04/08/2014~03/08/2015
07/01/2016~06/01/2017</td></tr>
<tr><td>Delayed dates</td><td>01/11/2013~04/08/2014</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Value is continuously measured and recorded at least every 1 min.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>NA</td></tr>
<tr><td>QA/QC procedures:</td><td>This value is measured in accordance with the US EPA guideline.</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comments:</td><td>Since the calibration was delayed from 01/11/2013~04/08/2014, the monitoring data during this period have been added by its allowable error, which is +2%.</td></tr>
</table>

<table>
<tr><td>Data/parameter:</td><td>$v_{s,in}$</td></tr>
<tr><td>Unit</td><td>m/sec</td></tr>
<tr><td>Description</td><td>Inlet gas velocity</td></tr>
<tr><td>Measured/calculated/default</td><td>Calculated</td></tr>
<tr><td>Source of data</td><td>Calculation of inlet gas velocity corrected for pressure and temperature variations</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><th rowspan="2">Date</th><th>$v_{s,in}$</th></tr>
<tr><th>m/sec</th></tr>
<tr><td>01/11/2013 ~ 31/12/2013</td><td>2.2391</td></tr>
<tr><td>01/01/2014 ~ 31/12/2014</td><td>2.1991</td></tr>
<tr><td>01/01/2015 ~ 28/02/2015</td><td>2.2226</td></tr>
</table>

This is average value during this monitoring period. Please see more details in the ER spread sheet.
</td></tr>
<tr><td>Monitoring equipment</td><td>NA</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Value is calculated and recorded at least every 1 min</td></tr>
<tr><td>Calculation method (if applicable):</td><td>$$v_{s,in} = K_p \times C_{p,in} \times \sqrt{P_{avg,in}} \times \sqrt{\frac{T_{s,in}}{P_{s,in} \times M_{s,in}}}$$</td></tr>
<tr><td>QA/QC procedures:</td><td>NA</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of baseline emissions</td></tr>
</table>

Additional comments:	NA

Data/parameter:	$v_{s,out}$
Unit	m/sec
Description	Outlet gas velocity
Measured/calculated/default	Calculated
Source of data	Calculation of outlet gas velocity corrected for pressure and temperature variations
Value(s) of monitored parameter	Date: 01/11/2013 ~ 31/12/2013; $v_{s,out}$ (m/sec): 2.9152 Date: 01/01/2014 ~ 31/12/2014; $v_{s,out}$ (m/sec): 2.7451 Date: 01/01/2015 ~ 28/02/2015; $v_{s,out}$ (m/sec): 2.6959 This is average value during this monitoring period. Please see more details in the ER spread sheet.
Monitoring equipment	NA
Measuring/reading/recording frequency:	Value is calculated and recorded at least every 1 min
Calculation method (if applicable):	$v_{s,out} = K_p \times C_{p,out} \times \sqrt{P_{avg,out}} \times \sqrt{\frac{T_{s,out}}{P_{s,out} \times M_{s,out}}}$
QA/QC procedures:	NA
Purpose of data:	Calculation of baseline emissions
Additional comments:	NA

Data/parameter:	Q_{in}
Unit	㎥/s
Description	Dry volumetric flow rate at the inlet
Measured/calculated/default	Calculated
Source of data	Measurement of inlet gas velocity corrected for pressure and temperature variations.
Value(s) of monitored parameter	Date: 01/11/2013 ~ 31/12/2013; Q_{in} (㎥/s): 0.1630 Date: 01/01/2014 ~ 31/12/2014; Q_{in} (㎥/s): 0.1573 Date: 01/01/2015 ~ 28/02/2015; Q_{in} (㎥/s): 0.1649 This is average value during this monitoring period. Please see more details in the ER spread sheet.
Monitoring equipment	NA
Measuring/reading/recording frequency:	NA
Calculation method (if applicable):	$Q_{in} = \{(100 - B_{ws,in}) \div 100\} \times v_{s,in} \times A_{in} \times \left[\frac{T_{std} \times P_{s,in}}{T_{s,in} \times P_{std}}\right]$
QA/QC procedures:	NA
Purpose of data:	Calculation of baseline emissions

Additional comments:	NA

Data/parameter:	Q_{out}
Unit	㎥ /s
Description	Dry volumetric flow rate at the outlet
Measured/calculated/default	Calculated
Source of data	Measurement of outlet gas velocity corrected for pressure and temperature variations
Value(s) of monitored parameter	<table><tr><th rowspan="2">Date</th><th>Q_{out}</th></tr><tr><th>㎥ /s</th></tr><tr><td>01/11/2013 ~ 31/12/2013</td><td>0.2071</td></tr><tr><td>01/01/2014 ~ 31/12/2014</td><td>0.1944</td></tr><tr><td>01/01/2015 ~ 28/02/2015</td><td>0.1925</td></tr></table> This is average value during this monitoring period. Please see more details in the ER spread sheet.
Monitoring equipment	NA
Measuring/reading/recording frequency:	NA
Calculation method (if applicable):	$Q_{out} = \{(100 - B_{ws,out}) \div 100\} \times v_{s,out} \times A_{out} \times \left[\frac{T_{std} \times P_{s,out}}{T_{s,out} \times P_{std}}\right]$
QA/QC procedures:	NA
Purpose of data:	Calculation of baseline emissions
Additional comments:	NA

<table>
<tr><td>Data/parameter:</td><td>Inlet SF_6 concentration</td></tr>
<tr><td>Unit</td><td>ppm</td></tr>
<tr><td>Description</td><td>Inlet SF_6 concentration measured by FTIR</td></tr>
<tr><td>Measured/calculated/default</td><td>Measured</td></tr>
<tr><td>Source of data</td><td>Inlet FTIR</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><th rowspan="2">Date</th><th>Inlet SF_6 concentration</th></tr>
<tr><th>ppm</th></tr>
<tr><td>01/11/2013 ~ 31/12/2013</td><td>472.138</td></tr>
<tr><td>01/01/2014 ~ 31/12/2014</td><td>456.428</td></tr>
<tr><td>01/01/2015 ~ 28/02/2015</td><td>267.914</td></tr>
</table>
This is average value during this monitoring period. Please see more details in the ER spread sheet.
</td></tr>
<tr><td>Monitoring equipment</td><td>Inlet FTIR
<table>
<tr><td>Type</td><td>Fourier transform infrared spectroscopy</td></tr>
<tr><td>Accuracy Class</td><td>±5%</td></tr>
<tr><td>Serial number</td><td>K2000010</td></tr>
<tr><td>Calibration frequency</td><td>3 months</td></tr>
<tr><td>Past calibration date</td><td>13/11/2013
12/02/2014
12/05/2014
12/08/2014
25/11/2014</td></tr>
<tr><td>Date of last calibration</td><td>10/11/2015</td></tr>
<tr><td>Validity</td><td>13/11/2013~12/02/2014
12/02/2014~11/05/2014
12/05/2014~11/08/2014
12/08/2014~11/11/2014
25/11/2014~24/02/2015
10/11/2015~09/02/2016</td></tr>
<tr><td>Delayed dates</td><td>01/11/2013~13/11/2013
12/05/2014, 12/08/2014.
12/11/2014~25/11/2014,
25/02/2015~28/02/2015</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Measured every 1 minute</td></tr>
<tr><td>Calculation method (if applicable):</td><td>NA</td></tr>
<tr><td>QA/QC procedures:</td><td>FTIR was calibrated in accordance with the methodology. 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>
<tr><td>Purpose of data:</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comments:</td><td>Since the calibration of Inlet FTIR was delayed from 01/11/2013~13/11/2013, 12/05/2014, 12/08/2014, 12/11/2014~25/11/2014, and 25/02/2015~28/02/2015, the monitoring data during this period have been deducted by its allowable error, which is -5%.</td></tr>
</table>

<table>
<tr><td>Data/parameter:</td><td>Outlet SF_6 concentration</td></tr>
<tr><td>Unit</td><td>ppm</td></tr>
<tr><td>Description</td><td>Outlet SF_6 concentration measured by FTIR</td></tr>
<tr><td>Measured/calculated/default</td><td>Measured</td></tr>
<tr><td>Source of data</td><td>Outlet FTIR</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><th rowspan="2">Date</th><th>Outlet SF_6 concentration</th></tr>
<tr><th>ppm</th></tr>
<tr><td>01/11/2013 ~ 31/12/2013</td><td>57.390</td></tr>
<tr><td>01/01/2014 ~ 31/12/2014</td><td>54.243</td></tr>
<tr><td>01/01/2015 ~ 28/02/2015</td><td>27.414</td></tr>
</table>
This is average value during this monitoring period. Please see more details in the ER spread sheet.
</td></tr>
<tr><td>Monitoring equipment</td><td>Outlet FTIR
<table>
<tr><td>Type</td><td>Fourier transform infrared spectroscopy</td></tr>
<tr><td>Accuracy Class</td><td>±5%</td></tr>
<tr><td>Serial number</td><td>K2000009</td></tr>
<tr><td>Calibration frequency</td><td>3 months</td></tr>
<tr><td>Past calibration date</td><td>13/11/2013
12/02/2014
12/05/2014
12/08/2014
25/11/2014</td></tr>
<tr><td>Date of last calibration</td><td>10/11/2015</td></tr>
<tr><td>Validity</td><td>13/11/2013~12/02/2014
12/02/2014~11/05/2014
12/05/2014~11/08/2014
12/08/2014~11/11/2014
25/11/2014~24/02/2015
10/11/2015~09/02/2016</td></tr>
<tr><td>Delayed dates</td><td>01/11/2013~13/11/2013
12/05/2014, 12/08/2014.
12/11/2014~25/11/2014,
25/02/2015~28/02/2015</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Measured every 1 minute</td></tr>
<tr><td>Calculation method (if applicable):</td><td>NA</td></tr>
<tr><td>QA/QC procedures:</td><td>FTIR was calibrated in accordance with the methodology. 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>
<tr><td>Purpose of data:</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comments:</td><td>Since the calibration of outlet FTIR was delayed from 01/11/2013~13/11/2013, 12/05/2014, 12/08/2014, 12/11/2014~25/11/2014, and 25/02/2015~28/02/2015, the monitoring data during this period have been added by its allowable error, which is +5%.</td></tr>
</table>

<table>
<tr><td>Data/parameter:</td><td>$C_{Steam,y}$</td></tr>
<tr><td>Unit</td><td>ton</td></tr>
<tr><td>Description</td><td>Quantity of steam consumed by the Project year y</td></tr>
<tr><td>Measured/calculated/default</td><td>Measured</td></tr>
<tr><td>Source of data</td><td>Mass flow meter</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><td rowspan="2">Date</td><td>$C_{Steam,y}$</td></tr>
<tr><td>ton</td></tr>
<tr><td>01/11/2013 ~ 31/12/2013</td><td>6.873</td></tr>
<tr><td>01/01/2014 ~ 31/12/2014</td><td>38.222</td></tr>
<tr><td>01/01/2015 ~ 28/02/2015</td><td>5.648</td></tr>
<tr><td>Total</td><td>50.743</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>Steam flow meter for abatement system
<table>
<tr><td>Type</td><td>Vortex</td></tr>
<tr><td>Accuracy Class</td><td>±1.5%</td></tr>
<tr><td>Serial number</td><td>2244980</td></tr>
<tr><td>Calibration frequency</td><td>Once per 3 years</td></tr>
<tr><td>Past calibration date</td><td>28/03/2011</td></tr>
<tr><td>Date of last calibration</td><td>17/07/2014</td></tr>
<tr><td>Validity</td><td>28/03/2011~27/03/2014
17/07/2014~16/07/2017</td></tr>
<tr><td>Delayed dates</td><td>28/03/2014~17/07/2014</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Recorded daily</td></tr>
<tr><td>Calculation method (if applicable):</td><td>NA</td></tr>
<tr><td>QA/QC procedures:</td><td>The meters have been periodically calibrated meeting the manufacturer’s instruction and/or national standard.</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of project emissions</td></tr>
<tr><td>Additional comments:</td><td>Since the calibration of was delayed from 28/03/2014~17/07/2014 and, the monitored data during this period have been added by its allowable error, which is +1.5%.</td></tr>
</table>

<table>
<tr><td>Data/parameter:</td><td>$C_{Steam,plant,y}$</td></tr>
<tr><td>Unit</td><td>ton</td></tr>
<tr><td>Description</td><td>Quantity of steam generated by the central boiler in year y</td></tr>
<tr><td>Measured/calculated/default</td><td>Measured</td></tr>
<tr><td>Source of data</td><td>Mass flow meter</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><td rowspan="2">Date</td><td>$C_{Steam,plant,y}$</td></tr>
<tr><td>ton</td></tr>
<tr><td>01/11/2013 ~ 31/12/2013</td><td>93,633</td></tr>
<tr><td>01/01/2014 ~ 31/12/2014</td><td>368,652</td></tr>
<tr><td>01/01/2015 ~ 28/02/2015</td><td>137,931</td></tr>
<tr><td>Total</td><td>600,216</td></tr>
</table>
</td></tr>
</table>

Monitoring equipment

Steam flow meters for central boiler

Steam Meter #1

Type	Vortex
Accuracy Class	±1%
Serial number	C15-S0990HN
Calibration frequency	Once per 3 years
Past calibration date	08/06/2011
Date of last calibration	20/05/2014
Validity	08/06/2011~07/06/2014 20/05/2014~19/05/2017

Steam Meter #2

Type	Vortex
Accuracy Class	±1%
Serial number	DE24053G
Calibration frequency	Once per 3 years
Past calibration date	27/05/2010
Date of last calibration	20/05/2014
Validity	27/05/2010~26/05/2013 20/05/2014~19/05/2017
Delayed dates	01/11/2013~20/05/2014

Steam Meter #3

Type	Vortex
Accuracy Class	±1%
Serial number	DE24056G
Calibration frequency	Once per 3 years
Past calibration date	28/05/2010
Date of last calibration	23/04/2014
Validity	28/05/2010~27/05/2013 23/04/2014~22/04/2017
Delayed dates	01/11/2013~23/04/2014

Steam Meter #4

Type	Vortex
Accuracy Class	±1%
Serial number	DE24054G
Calibration frequency	Once per 3 years
Past calibration date	09/06/2011
Date of last calibration	23/04/2014
Validity	09/06/2011~08/06/2014 23/04/2014~22/04/2017

Steam Meter #5

Type	Vortex
Accuracy Class	±1%
Serial number	DE24055G
Calibration frequency	Once per 3 years
Past calibration date	28/05/2010
Date of last calibration	03/04/2014
Validity	28/05/2010~27/05/2013 03/04/2014~02/04/2017
Delayed dates	01/11/2013~03/04/2014

Steam Meter #6

Type	Vortex
Accuracy Class	±1%
Serial number	DE25016G
Calibration frequency	Once per 3 years
Past calibration date	28/05/2010
Date of last calibration	17/10/2014
Validity	28/05/2010~27/05/2013 17/10/2014~16/10/2017
Delayed dates	01/11/2013~17/10/2014

Steam Meter #7

Type	Vortex
Accuracy Class	±1%
Serial number	C20-1766SN
Calibration frequency	Once per 3 years
Past calibration date	27/05/2010
Date of last calibration	22/05/2014
Validity	27/05/2010~26/05/2013 22/05/2014~21/05/2017
Delayed dates	01/11/2013~22/05/2014

Steam Meter #8

Type	Vortex
Accuracy Class	±1%
Serial number	C30-0423TN
Calibration frequency	Once per 3 years
Past calibration date	19/07/2010
Date of last calibration	16/06/2014
Validity	19/07/2010~18/07/2013 16/06/2014~15/06/2017
Delayed dates	01/11/2013~16/06/2014

Measuring/reading/recording frequency:	Recorded daily
Calculation method (if applicable):	NA
QA/QC procedures:	The meters have been calibrated every 3 year meeting national standard.
Purpose of data:	Calculation of project emissions
Additional comments:	Because of delay of calibration for steam flow meters, monitored data from these meters were deducted by its allowable error.

Data/parameter:	$C_{NG,plant}$
Unit	Nm^3
Description	Quantity of natural gas consumed by the central boiler in year y
Measured/calculated/default	Measured
Source of data	Gas Meter
Value(s) of monitored parameter	

Date	$C_{NG,plant}$
	Nm^3
01/11/2013 ~ 31/12/2013	6,361,169
01/01/2014 ~ 31/12/2014	24,971,760
01/01/2015 ~ 28/02/2015	9,219,782
Total	40,552,711

Monitoring equipment

LNG Flow Meter

LNG Meter #1

- Until 20/08/2014

Type	Turbine gas meter
Accuracy Class	±1%
Serial number	71379
Calibration frequency	Once per 8 years
Date of last calibration	06/05/2009
Validity	06/05/2009~05/05/2017

- From 21/08/2014 (Replacement date: 21/08/2014)

Type	Turbine gas meter
Accuracy Class	±0.5%
Serial number	624960
Calibration frequency	Once per 8 years
Date of last calibration	09/05/2013
Validity	09/05/2013~08/05/2021

LNG Meter #2

- Until 22/09/2014

Type	Turbine gas meter
Accuracy Class	±1%
Serial number	10400413
Calibration frequency	Once per 8 years
Date of last calibration	12/06/2009
Validity	12/06/2009~11/06/2017

- From 23/09/2014 (Replacement date: 23/09/2014)

Type	Turbine gas meter
Accuracy Class	±0.5%
Serial number	710938
Calibration frequency	Once per 8 years
Date of last calibration	25/04/2014
Validity	25/04/2014~24/04/2022

LNG Meter #3

- Until 22/09/2014

Type	Turbine gas meter
Accuracy Class	±1%
Serial number	10400414
Calibration frequency	Once per 8 years
Date of last calibration	12/06/2009
Validity	12/06/2009~11/06/2017

- From 23/09/2014 (Replacement date: 23/09/2014)

Type	Turbine gas meter
Accuracy Class	±0.5%
Serial number	710937
Calibration frequency	Once per 8 years
Date of last calibration	25/04/2014
Validity	25/04/2014~24/04/2022

LNG Meter #4

- Until 22/09/2014

Type	Turbine gas meter
Accuracy Class	±1%
Serial number	10400416
Calibration frequency	Once per 8 years
Date of last calibration	06/05/2009
Validity	06/05/2009~05/05/2017

- From 23/09/2014 (Replacement date: 23/09/2014)

Type	Turbine gas meter
Accuracy Class	±0.5%
Serial number	710939
Calibration frequency	Once per 8 years
Date of last calibration	25/04/2014
Validity	25/04/2014~24/04/2022

LNG Meter #5

- Until 22/09/2014

Type	Turbine gas meter
Accuracy Class	±1%
Serial number	10400415
Calibration frequency	Once per 8 years
Date of last calibration	06/05/2009
Validity	06/05/2009~05/05/2017

- From 23/09/2014 (Replacement date: 23/09/2014)

Type	Turbine gas meter
Accuracy Class	±0.5%
Serial number	710940
Calibration frequency	Once per 8 years
Date of last calibration	25/04/2014
Validity	25/04/2014~24/04/2022

LNG Meter #6

Type	Turbine gas meter
Accuracy Class	±1%
Serial number	520065
Calibration frequency	Once per 8 years
Past calibration date	04/03/2010
Validity	04/03/2010~03/03/2018

LNG Meter #7

Type	Turbine gas meter
Accuracy Class	±1%
Serial number	410163
Calibration frequency	Once per 8 years
Date of last calibration	12/09/2007
Validity	12/09/2007~11/09/2015

LNG Meter #8

Type	Turbine gas meter
Accuracy Class	±1%
Serial number	520162
Calibration frequency	Once per 8 years
Date of last calibration	11/04/2012
Validity	11/04/2012~10/04/2020

Measuring/reading/recording frequency:	Recorded daily
Calculation method (if applicable):	NA
QA/QC procedures:	The meters have been periodically calibrated meeting the manufacturer's instruction and/or national standard.
Purpose of data:	Calculation of project emissions
Additional comments:	NA

Data/parameter:	$NCV_{NG,y}$
Unit	TJ/Nm^3
Description	Net calorific value of natural gas
Measured/calculated/default	NA
Source of data	Korea Gas Cooperation data
Value(s) of monitored parameter	
Monitoring equipment	NA
Measuring/reading/recording frequency:	The Calorific value is published monthly.
Calculation method (if applicable):	NCV = (GCV) x (1-10%)
QA/QC procedures:	Since the natural gas supplier, Korea Gas Cooperation (KOGAS), only releases Gross Calorific Value (GCV), it is converted to NCV by discounting 10%, which is in line with the IPCC Guideline for National Greenhouse Gas Inventories. The GCV was published on monthly bases, from which weighted average annual value was calculated.
Purpose of data:	Calculation of project emissions
Additional comments:	The Regional supplier of natural gas in Asan-si is JUNGBU CITY GAS Co., Ltd.

Date	Average $NCV_{NG,y}$ TJ/Nm^3
01/11/2013 ~ 31/12/2013	38.884×10^{-6}
01/01/2014 ~ 31/12/2014	38.821×10^{-6}
01/01/215 ~ 28/02/2015	38.784×10^{-6}

D.3. Implementation of sampling plan

>>
Not applicable.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

>>

<Year 2013>

- **Mass of SF_6 gas entering the abatement system**

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

Whereas, value for each parameters are,

$E_{SF6,in,2013}$ = 1.654 ton
$C_{SF6,2013}$ = 8.170 ton
$C_{SF6,hist}$ = 12.447 ton (74.480 ton/year was converted for 61 days.)

$E_{SF6,2013} = \min \{ E_{SF6,in,2013} ; 0.48 * C_{SF6,2013} ; 0.48 * C_{SF6,hist}\}$
$= \min \{1.654 ; 0.48 * 8.170 ; 0.48 * 12.447\}$
$= 1.654$

- **SF_6 consumption ratio**

$SF_{6,ratio} = \min(C_{sF6,-1}/SP_{-1} ; C_{SF6,-2}/SP_{-2} ; C_{SF6-3.}/SP_{-3})$

Whereas, value for each parameters are,

Year	$C_{SF6,-i}$	SP_{-i}	$SF_{6,ratio}$
2006	38.000	2,455,198	0.0000155
2007	69.920	5,126,394	0.0000136
2008	74.480	6,485,252	0.0000115

$SF_{6,ratio}$ = 0.0000115

- **SF_6 consumption factor**

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

Whereas, value for each parameters are,

$C_{SF6,2013}$ = 8.170 ton
$SP_{project,2013}$ = 1,156,091 ㎡
$(C_{SF6,2013} / SP_{project,2013})$ = 0.0000071
$SF_{6,ratio} \geq (C_{SF6,2013} / SP_{project,2013})$

Therefore, k = 1

- **Baseline emissions**

$BE_{in,y} = k \times E_{SF6,y} \times GWP_{SF6}$

Whereas, value for each parameters are,

$k = 1$
$E_{SF6,2013} = 1.654$
$GWP_{SF6} = 22{,}800\ kgCO_2e/kg\ SF_6$

$BE_{in\ 2013} = 37{,}702\ tCO_2e$

<Year 2014>

- **Mass of SF_6 gas entering the abatement system**

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

Whereas, value for each parameters are,

$E_{SF6,in,2014} = 10.364$ ton
$C_{SF6,2014} = 51.439$ ton
$C_{SF6,hist} = 74.480$ ton
$E_{SF6,2014} = \min \{ E_{SF6,in,2014} ; 0.48 * C_{SF6,2014} ; 0.48 * C_{SF6,hist} \}$
$= \min \{ 10.364 ; 0.48 * 51.43 ; 0.48 \times 74.480 \}$
$= 10.364$

- **SF_6 consumption ratio**

$SF_{6,ratio} = \min (C_{sF6,-1}/SP_{-1} ; C_{SF6,-2}/SP_{-2} ; C_{SF6-3.}/SP_{-3})$

Whereas, value for each parameters are,

Year	$C_{SF6,-i}$	SP_{-i}	$SF_{6,ratio}$
2006	38	2,455,198	0.0000155
2007	69.92	5,126,394	0.0000136
2008	74.48	6,485,252	0.0000115

$SF_{6,ratio} = 0.0000115$

- **SF_6 consumption factor**

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

Whereas, value for each parameters are,

$C_{SF6,2014} = 51.439$ ton
$SP_{project,2014} = 7{,}540{,}871\ m^2$
$(C_{SF6,2014} / SP_{project,2014}) = 0.0000068$
$SF_{6,ratio} \geq (C_{SF6,2014} / SP_{project,2014})$

Therefore, k = 1

- **Baseline emissions**

$BE_{in,y} = k \times E_{SF6,y} \times GWP_{SF6}$

Whereas, value for each parameters are,

k = 1
$E_{SF6,2014}$ = 10.364
GWP_{SF6} = 22,800 $kgCO_2e/kg\ SF_6$

$BE_{in\ 2014}$ = 236,295 tCO_2e

<Year 2015>

- **Mass of SF_6 gas entering the abatement system**

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

Whereas, value for each parameters are,

$E_{SF6,in,2015}$ = 1.020 ton
$C_{SF6,2015}$ = 6.169 ton
$C_{SF6,hist}$ = 12.039 ton (74.480 ton/year was converted for 59 days.)
$E_{SF6,2015}$ = min { $E_{SF6,in,2015}$; 0.48 X $C_{SF6,2015}$; 0.48 X $C_{SF6,hist}$}
= min { 1.020 ; 0.48 X 6.169; 0.48 X 12.039; }
= 1.020

- **SF_6 consumption ratio**

$SF_{6,ratio} = \min(C_{sf6,-1}/SP_{-1} ; C_{SF6,-2}/SP_{-2} ; C_{SF6-3.}/SP_{-3})$

Whereas, value for each parameters are,

Year	$C_{SF6,-it}$	SP_{-i}	$SF_{6,ratio}$
2006	38	2,455,198	0.0000155
2007	69.92	5,126,394	0.0000136
2008	74.48	6,485,252	0.0000115

$SF_{6,ratio}$ = 0.0000115

- **SF_6 consumption factor**

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

Whereas, value for each parameters are,

$C_{SF6,2015}$ = 6.169 ton
$SP_{project,2015}$ = 948,635 ㎡
($C_{SF6,2015}$ / $SP_{project,2015}$) = 0.0000065
$SF_{6,ratio} \geq (C_{SF6,2015} / SP_{project,2015})$

Therefore, k = 1

- **Baseline emissions**

$BE_{in,y}$= k X $E_{SF6,y}$ X GWP_{SF6}

Whereas, value for each parameters are,

k = **1**
$E_{SF6,2015}$ = 1.020
GWP_{SF6} = 22,800 $kgCO_2e/kg\ SF_6$

$BE_{in\ 2015}$ = 23,251 tCO_2e

<Baseline Emissions in this monitoring period>

$BE_{in,2013}$ + $BE_{in,2014}$ + $BE_{in,2015}$ = 37,702 + 236,295 + 23,251

= 297,248 tCO_2e

E.2. Calculation of project emissions or actual net GHG removals by sinks

>>

<Year 2013>

- **CO_2 emissions from electricity consumption**

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{grid,y} \times \left(1 + TDL_{j,y}\right)$$

Whereas, values for each parameters are,

$EC_{PJ,j,2013}$ = 134 MWh
$EF_{grid,2013}$ = 0.5914 tCO_2/MWh
$TDL_{j,2013}$ = 0.0373

$PE_{EC,2013}$ = 82 tCO_2

- **CO_2 emissions from steam consumption**

Fuel Consumption

$$FC_{NG,y} = C_{NG,plant,y} \times W_{steam}$$

$$W_{steam} = C_{steam,y} \div C_{steam,plant,y}$$

Whereas, values for each parameters are,

$C_{NG,plant,2013}$ = 6,361,169 Nm^3
$C_{steam,plant,2013}$ = 93,633 ton
$C_{steam,2013}$ = 7 ton
W_{steam} = 0.0000734
$FC_{NG,2013}$ = 467 Nm^3

Emission from steam

$$COEF_{NG,y} = NCV_{NG,y} \times EF_{CO2,NG,y}$$
$$PE_{NG,y} = FC_{NG,y} \times COEF_{NG,y}$$

Values for each parameter are,

$NCV_{NG,2013}$ = 0.000038884 TJ/Nm^3
$EF_{CO2,NG,2013}$ = 58.3 tCO_2/TJ
$COEF_{NG,2013}$ = 0.002267 tCO_2/Nm^3
$FC_{NG,2013}$ = 467 Nm^3
$PE_{NG,2013}$ = 1 tCO_2

- **Determination of the SF_6 destruction removal efficiency(DRE) of the abatement device**

$$DRE_y = 1 - \frac{E_{SF6,out,y}}{E_{SF6,in,y}}$$

Values for each parameter are,

$E_{SF6,out,2013}$ = 0.234 ton
$E_{SF6,in,2013}$ = 1.654 ton
DRE_{2013} = 0.86

- **Project emissions**

$$PE_y = BE_y \cdot (1 - DRE_y) + PE_{EC,y} + PE_{NG,y}$$

Values for each parameter are,

BE_{2013} = 37,702 tCO_2e
DRE_{2013} = 0.86
$PE_{EC,2013}$ = 82 tCO_2
$PE_{NG,2013}$ = 1 tCO_2
PE_{2013} = 5,423 tCO_2e

<Year 2014>

- **CO_2 emissions from electricity consumption**

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{grid,y} \times (1 + TDL_{j,y})$$

Whereas, values for each parameters are,

$EC_{PJ,j,2014}$ = 792 MWh
$EF_{grid,2014}$ = 0.5914 tCO_2/MWh
$TDL_{j,2014}$ = 0.0369

$PE_{EC,2014}$ = 486 tCO_2

- **CO_2 emissions from steam consumption**

Fuel Consumption

$$FC_{NG,y} = C_{NG,plant,y} \times W_{steam}$$

$$W_{steam} = C_{steam,y} \div C_{steam,plant,y}$$

Whereas, values for each parameters are,

$C_{NG,plant,2014}$ = 24,971,760 Nm^3
$C_{steam,plant,2014}$ = 368,652 ton
$C_{steam,2014}$ = 38 ton
W_{steam} = 0.0001037
$FC_{NG,2014}$ = 2,589 Nm^3

Emission from steam

$$COEF_{NG,y} = NCV_{NG,y} \times EF_{CO2,NG,y}$$

$$PE_{NG,y} = FC_{NG,y} \times COEF_{NG,y}$$

Values for each parameter are,

$NCV_{NG,2014}$ = 0.000038821 TJ/Nm^3
$EF_{CO2,NG,2014}$ = 58.3 tCO_2/TJ
$COEF_{NG,2014}$ = 0.002263 tCO_2/Nm^3
$FC_{NG,2014}$ = 2,589 Nm^3
$PE_{NG,2014}$ = 6 tCO_2

- **Determination of the SF_6 destruction removal efficiency(DRE) of the abatement device**

$$DRE_y = 1 - \frac{E_{SF6,out,y}}{E_{SF6,in,y}}$$

Values for each parameter are,

$E_{SF6,out,2014}$ = 1.438 ton
$E_{SF6,in,2014}$ = 10.364 ton
DRE_{2014} = 0.86

- **Project emissions**

$$PE_y = BE_y \cdot (1 - DRE_y) + PE_{EC,y} + PE_{NG,y}$$

Values for each parameter are,

BE_{2014} = 236,295 tCO_2e
DRE_{2014} = 0.86
$PE_{EC,2014}$ = 486 tCO_2
$PE_{NG,2014}$ = 6 tCO_2
PE_{2014} = 33,286 tCO_2e

<Year 2015>

- **CO_2 emissions from electricity consumption**

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{grid,y} \times (1 + TDL_{j,y})$$

Whereas, values for each parameters are,

$EC_{PJ,j,2015}$ = 138 MWh
$EF_{grid,2015}$ = 0.5914 tCO_2/MWh
$TDL_{j,2015}$ = 0.0360

$PE_{EC,2015}$ = 85 tCO_2

- **CO_2 emissions from steam consumption**

Fuel Consumption

$$FC_{NG,y} = C_{NG,plant,y} \times W_{steam}$$

$$W_{steam} = C_{steam,y} \div C_{steam,plant,y}$$

Whereas, values for each parameters are,

$C_{NG,plant,2015}$ = 9,219,782 Nm^3
$C_{steam,plant,2015}$ = 137,931 ton
$C_{steam,2015}$ = 6 ton
W_{steam} = 0.00004095
$FC_{NG,2015}$ = 378 Nm^3

Emission from steam

$$COEF_{NG,y} = NCV_{NG,y} \times EF_{CO2,NG,y}$$

$$PE_{NG,y} = FC_{NG,y} \times COEF_{NG,y}$$

Values for each parameter are,

$NCV_{NG,2015}$ = 0.000038784 TJ/Nm^3
$EF_{CO2,NG,2015}$ = 58.3 tCO_2/TJ
$COEF_{NG,2015}$ = 0.002261 tCO_2/Nm^3
$FC_{NG,2015}$ = 378 Nm^3
$PE_{NG,2015}$ = 1 tCO_2

- **Determination of the SF_6 destruction removal efficiency(DRE) of the abatement device**

$$DRE_y = 1 - \frac{E_{SF6,out,y}}{E_{SF6,in,y}}$$

Values for each parameter are,

$E_{SF6,out,2015}$ = 0.120 ton
$E_{SF6,in,2015}$ = 1.020 ton
DRE_{2015} = 0.88

- **Project emissions**

$$PE_y = BE_y \cdot (1 - DRE_y) + PE_{EC,y} + PE_{NG,y}$$

Values for each parameter are,

BE_{2015} = 23,251 tCO_2e
DRE_{2015} = 0.88
$PE_{EC,2015}$ = 85 tCO_2
$PE_{NG,2015}$ = 1 tCO_2
PE_{2015} = 2,814 tCO_2e

<Project Emissions in this monitoring period>

$PE_{in,2013} + PE_{in,2014} + PE_{in,2015}$ = 5,423 + 33,286 + 2,814

= 41,523 tCO_2e

E.3. Calculation of leakage

>> There is no leakage associated with the project activity and therefore, leakage is zero.

E.4. Summary of calculation of emission reductions or net GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	GHG emission reductions or net GHG removals by sinks (t CO_2e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
Total	297,248	41,523	0	0	255,725	255,725

E.5. Comparison of actual emission reductions or net GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	1,020,778 tCO_2e (This monitoring period is 485 days: 768,215tCO_2e/365days * 485days)	255,725

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

>>

The actual emission reduction resulting from the 3rd monitoring period was lower than the estimation in the PDD. The estimation of emission reduction during the monitoring period is 1,020,778 tCO_2e, but the actual amount is 255,725 tCO_2e which is about 25% of the estimated emission reduction.

External situation could easily result in deviation between the actual and the estimated emission reduction. First, the calibration of monitoring equipment was delayed several times during the 3rd monitoring period. The calibration of Inlet/Outlet Annubar was delayed for 277days among the total monitoring period of 485 days, so the monitoring data during the period were deducted (inlet) or

added (outlet) by allowable error of 2%. In addition, the calibration of Inlet/Outlet FTIR was delayed for 33days, therefore the monitoring data during the period were deducted (inlet) or added (outlet) by allowable error of 5%. The addition and deduction by allowable errors resulted in decreasing the value of $E_{SF6,in,y}$ and increasing the value of $E_{SF6,out,y}$.

Second, the QA/QC procedure and conservativeness for monitoring is also another reason to the shrunken emission reduction. During this monitoring period, a lot of SF_6 emissions measured were discounted from the crediting period because the value of the gas flow measured at the inlet decreased by more than 5%, compared to the baseline flow rate (i.e. $Q_{in,monitoring} < 0.95*Q_{in,baseline}$), and because the value of the gas flow measured at the outlet increased by more than 5%, compared to the averaged velocity(i.e. $Q_{out,monitoring} > 1.05*Q_{out,baseline}$).

Finally, some of the monitoring data was lost or in error (Refer to Section B.1, Information on the implementation status of the project activity). In case the error data are included in the calculation of $E_{SF6,in}$ or $E_{SF6,out}$, the values result in zero. These lost or error data contributed more or less to the decreased emission reduction.

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

Project participant and/or responsible person/ entity	☒ Project participant ☐ Person/entity responsible for completing the CDM-MR-FORM
Organization name	Samsung Display
Street/P.O. Box	#200, Myeongam-ri, Tangjeong-myeon
Building	
City	Asan
State/region	Chungcheongnam-Do
Postcode	31454
Country	Republic of Korea
Telephone	+82-41-535-1361
Fax	+82-41-535-1111
E-mail	dongsun.yoon@samsung.com
Website	www.samsungdisplay.co.kr
Contact person	Dongsun Yoon
Title	Principal Professional
Salutation	
Last name	Yoon
Middle name	
First name	Dongsun
Department	Environment Safety Center
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Project participant and/or responsible person/ entity	☐ Project participant ☒ Person/entity responsible for completing the CDM-MR-FORM
Organization name	RCC Co., Ltd.
Street/P.O. Box	205 Venture bldg., Pohang Technopark, 394, Jigok-ro, Namgu
Building	
City	Pohang-si
State/region	Gyeonsangbuk-do, Korea
Postcode	37666
Country	Korea
Telephone	+82-54-223-2303
Fax	+82-54-223-2310
E-mail	jesslk@ircc.co.kr
Website	www.ircc.co.kr
Contact person	Boreum Kueon
Title	Research Assistant
Salutation	Ms
Last name	Kueon
Middle name	
First name	Boreum
Department	
Mobile	
Direct fax	
Direct tel.	+82-54-223-2303
Personal e-mail	jesslk@ircc.co.kr

- - - - -

Document information

Version	*Date*	*Description*
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Issuance
Keywords: monitoring report