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 SF6 abatement project	
UNFCCC reference number of the project activity	3333	
Version number of the monitoring report	1.0	
Completion date of the monitoring report	03/08/2015	
Monitoring period number and duration of this monitoring period	2nd monitoring period, The first and last days are included (01/03/2011 ~ 31/10/2013)	
Project participant(s)	Samsung Display Co., Ltd.	
Host Party	Republic of Korea	
Sectoral scope(s)	Scope 4 - Manufacturing industries 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 SF6 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	2,054,185 tCO_2e (This monitoring period is 976days : 768,215tCO_2e / 365 * 976days)	
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
	654,231 tCO_2e	119,724 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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Samsung Electronics SF6 abatement project (the Project or the Project activity) involves the installation of SF6 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 SF6 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 SF6 gas.

SF6 gas destructed by the Project activity is from the etching process where the SF6 gas is used as etching gas. Though a part of SF6 gas used in the etching process is decomposed during the process, some part of SF6 gas is not decomposed and vented into the atmosphere.

Though SF6 gas is one of the greenhouse gases, SF6 gas itself is odourless, non-toxic and non-flammable and there is no law or regulation that mandates the decomposition or destruction of SF6 gas in Korea. Due to these reasons, the undecomposed SF6 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 activity will contribute to the sustainable development of Korea.

- **Relevant dates for the project activity**

Item	Completion of Construction	Electricity equipment test period	Starting Date of Operation
Date	11/2009	First period : 10/11/2009 ~23/11/2009 Second period : 10/05/2010 ~ 19/05/2010	15/10/2010

- **Total GHG emission reductions or net GHG removals by sinks achieved in this monitoring period**

This is the 2nd monitoring period covering 3 year (from 01/03/2011 to 31/10/2013) and monitored emission reductions is 773,955 tCO_2e.

A.2. Location of project activity

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- **Host Party**

Republic of Korea

- **Region/state/province**

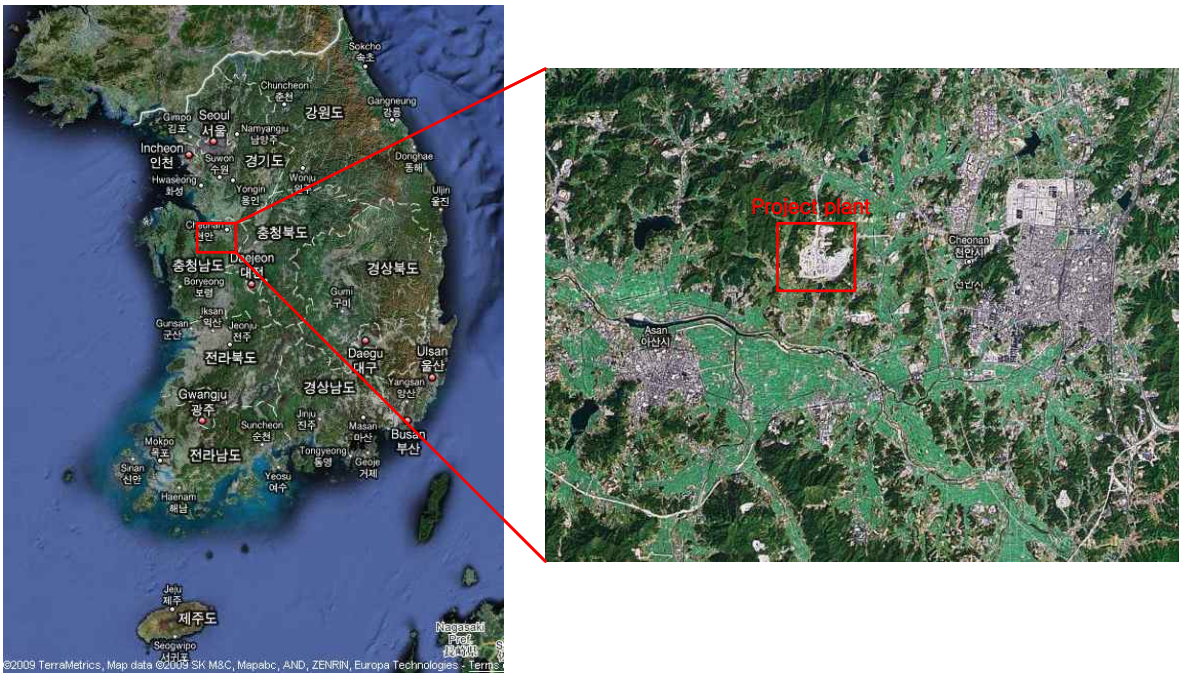
Chungcheongnam-do

- **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

>>

- **Indicate the exact reference (number, title, version) and refer to the UNFCCC CDM website**

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) (http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v5.0.0.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 CO2 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

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- **Type :** Fixed
- **Start date :** 21/10/2010
- **Length of the crediting period :** 21/10/2010 ~ 20/10/2020
- **2th monitoring period :** 01/03/2011 ~ 31/10/2013

A.6. Contact information of responsible persons/entities

>>

Name	Position	Is the person a PP in Appendix 1?	PP which is involved in	E-mail
Da-jung Jung	Consultant	No	ECOEYE Co., Ltd	Jdj0301@ecoeye.com
Myung-min Kim	Consultant	No	ECOEYE Co., Ltd	Ky08715@ecoeye.com

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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

- Relevant dates of the project activity

1st Monitoring was conducted from 21/10/2010 to 28/02/2011 and 2nd monitoring period was from 01/03/2011 to 31/10/2013. During this period, monitoring data was lost and/or in error because of calibration, shutdown and some minor events, as shown below.

Events	Date
1. Calibration	- 2011 : 12/04, 13/04, 14/05, 14/08, 14/11 - 2012 : 14/02. 14/05, 14/08
2. Shut Down	- 2011 : 12/08 ~ 19/09 - 2012 : 07/11 ~ 22/11
3. Bypass	- 2011 : 14/03, 15/03, 19/04, 20/04, 30/04, 01/05, 30/05, 22/06, 17/10, 08/11, 15/11, 16/11, 01/12 - 2012 : 04/01, 27/01, 23/02, 12/03, 13/03, 16/03, 18/04, 19/04, 28/06, 30/06, 06/07, 09/07, 20/07, 24/07, 26/07, 09/08, 10/08, 20/08, 23/08, 25/08, 26/08, 07/09, 10/09, 13/09, 18/09, 24/09, 26/09, 09/10, 10/10, 11/10, 12/10, 18/10, 27/10, 28/10, 29/10, 30/10, 31/10, 01/11 ~ 23/11, 06/12, 07/12, 09/12, 10/12, 12/12, 26/12, 27/12 - 2013 : 01/01 ~ 08, 07/02, 08/03, 09/03, 11/03, 12/03, 13/03, 14/03, 18/03, 19/03, 24/03, 25/03, 04/04, 05/04, 08/04, 09/04, 15/04, 24/04, 30/04, 01/05, 07/05, 08/05, 09/05, 10/05, 13/05, 14/05, 15/05, 16/05, 19/05, 20/05, 21/05, 27/05, 30/05, 03/06, 04/06, 05/06, 06/06, 10/06, 11/06, 12/06, 13/06, 20/06, 22/06, 22/07, 20/08, 22/08, 23/08, 28/08, 04/10, 14/10, 21/10
4. Replacement of parts	- 2011 : 09/03, 21/03, 22/04, 30/04, 02/05, 18/05, 27/05, 28/05, 24/06, 05/07, 06/07, 22/07, 23/07, 06/08, 07/08, 09/08, 18/09, 25/09, 30/09, 12/10, 18/10, 06/12, 12/12 - 2012 : 09/02, 19/02, 26/03, 10/04, 20/04, 05/05, 18/06, 21/05, 06/07, 30/08, 28/09 - 2013 : 15/03, 11/04, 19/04, 31/05, 30/08, 08/10
5. Cell Cleaning	- 2011 : 03/03, 17/03, 01/04, 15/04, 29/04, 04/05, 14/06, 26/06, 29/06, 30/06, 04/07, 06/07, 11/07, 14/07, 19/07, 29/07, 01/08, 04/08, 18/09, 08/10, 01/12 - 2012 : 10/05, 11/05
6. Program check and device error	- 2011 : 08/03, 23/04, 29/04, 05/05, 11/05, 13/05, 16/05, 19/05, 23/05, 27~28/05, 30/05, 31/05, 04/06, 06/06, 08/06, 14/06, 15/06, 24/06, 25/06, 28/06, 30/06, 01/07, 03/07, 04/07, 07/07, 11/07, 12/07, 13/07, 19/07, 22/07, 23/07, 30/07, 31/07, 03/08, 05/08, 20/09, 22/09, 30/09, 09/10, 11/10, 13/10, 18/10, 17/11, 21/10, 24/11, 30/11 - 2012 : 18/02, 14/03, 15/03, 23/03, 26/03, 11/05, 15/08, 05/09, 04/10, 09/12, 14/12 - 2013 : 19/02, 20~22/04, 23/06, 27/06, 01/07, 21/08, 31/10
7. Inflow of water	- 2011 : 20/04, 25~27/06, 29~30/06, 03/07, 11/07, 14/07. 19/07, 23/07, 29/07, 04/08 - 2012 : 23/03, 08/10
8. Pressure down	- 2011 : 18/04, 29/06, 29/07, 01/08, 02/08, 04/08
9. Flow instability	- 2011 : 12/11, 20/11

	- 2012 : 19/05, 20/05, 02/09, 27/09, 29/09, 01/10, 02/10, 04/10, 05/1009/12, 06/10, 07/10, 08/10, 11/12 - 2013 : 13/04

Because of the above events, monitoring data was lost and/or in error on those days.

- Delay of the equipment calibration

For some period within the second monitoring, FTIR, QMS, Annubar and steam flow meters wasn't calibrated as below. Because of calibration delay, the monitoring data was deducted by applying the allowable error. It was reflected in the emission reduction sheet. According to allowable error, inlet data and outlet data was added/deducted as a conservative manner.

Type of meter	Delay period	Allowable error	Latest Calibration date
Inlet, Outlet FTIR	14/11/2012 ~ 31/10/2013	±5%	12/05/2014
Inlet, Outlet Annubar	01/03/2011 ~ 31/10/2013	±5%	04/08/2014
Inlet, Oulet QMS	01/03/2011 ~ 13/05/2011 14/11/2012 ~ 12/10/2013	±2%	13/10/2013
Boiler #1 steam flow meter	01/03/2011 ~ 07/06/2011	±1%	20/05/2014
Boiler #2 steam flow meter	27/05/2013 ~ 31/10/2013	±1%	20/05/2014
Boiler #3 steam flow meter	28/05/2013 ~ 31/10/2013	±1%	23/04/2014
Boiler #4 steam flow meter	01/03/2011 ~ 08/06/2011	±1%	24/04/2014
Boiler #5 steam flow meter	28/05/2013 ~ 31/10/2013	±1%	03/04/2014
Boiler #6 steam flow meter	28/05/2013 ~ 31/10/2013	±1%	17/10/2014
Boiler #7 steam flow meter	27/05/2013 ~ 31/10/2013	±1%	22/05/2014
Boiler #8 steam flow meter	27/05/2013 ~ 31/10/2013	±1%	16/06/2014

B.2. Post-registration changes

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

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B.2.2. Corrections

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B.2.3 Changes to start date of crediting period

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

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

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Permanent changes for monitoring plan was 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 $Md_{,in}$ and $Md_{,out}$. 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 $Md_{,in}$. However, SO2F2, which was found in inlet of abatement system, couldn't be measured exactly by QMS. So, FTIR, which is installed to measure SF6, was added to measure SO2F2. 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

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

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SECTION C. Description of monitoring system

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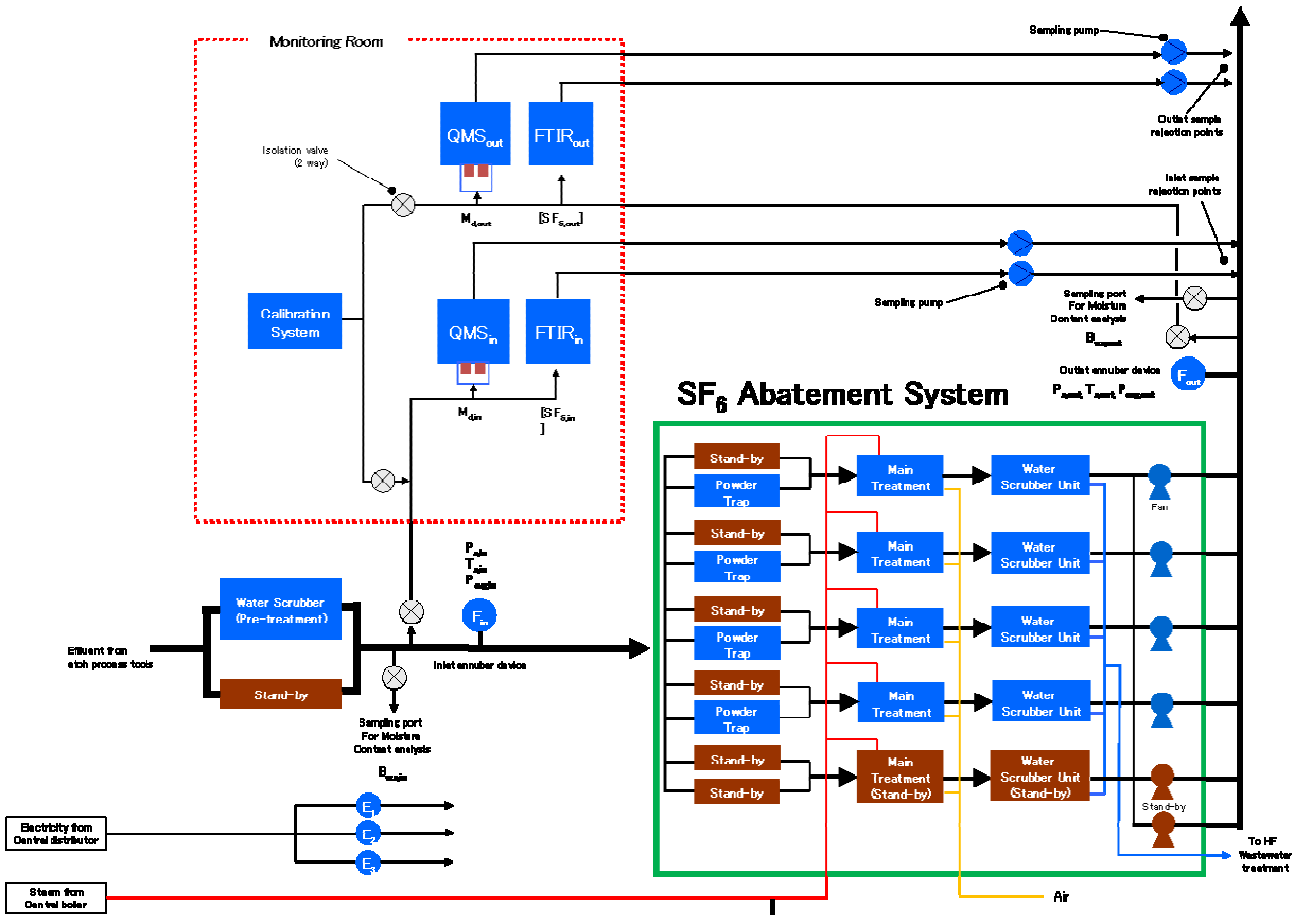
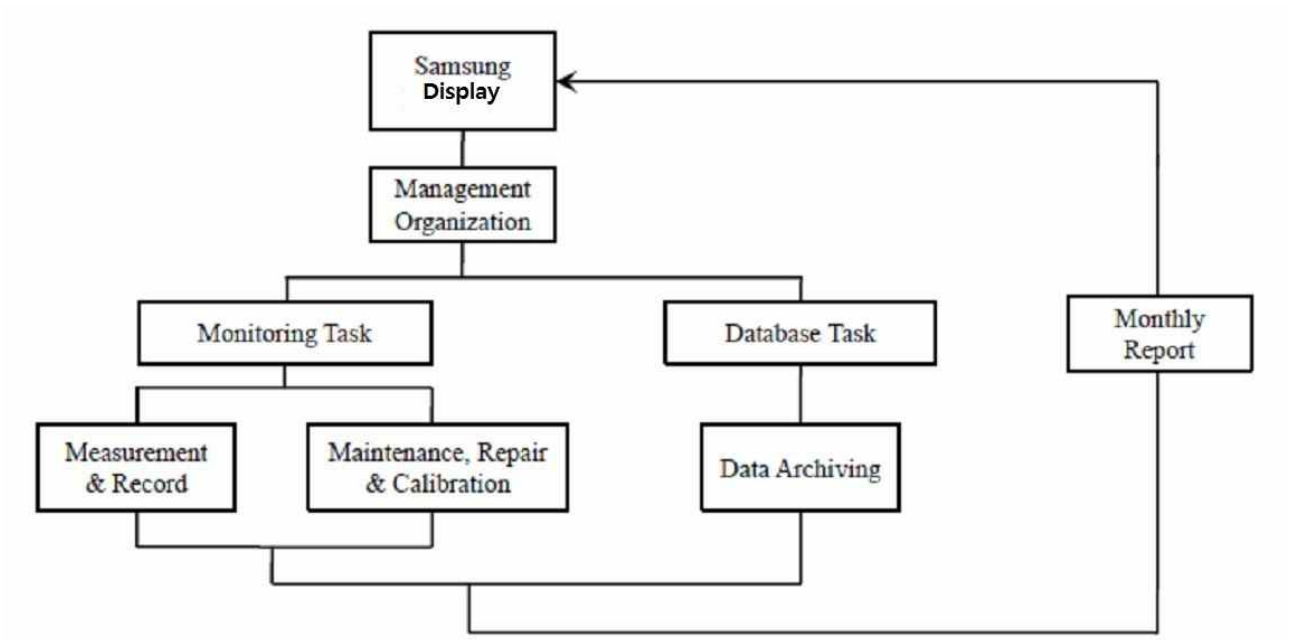
- **Description of the monitoring system**

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	N/A

Data/parameter:	GWP of SF6
Unit	kgCO2eq/Kg SF6
Description	Global warming potential of SF6
Source of data	IPCC
Value(s) applied)	23,900
Choice of data or measurement methods and procedures	This value is from IPCC 4^{th} report
Purpose of data	Calculation of baseline emissions
Additional comments	N/A

Data/parameter:	GWP of SF6
Unit	kgCO2eq/Kg SF6
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 ver9.0 para 242, GWP of SF6 was decided of 22,800. This figure will be applied After 01/01/2013
Purpose of data	Calculation of baseline emissions
Additional comments	N/A

Data/parameter:	Historical SF6 consumption ($C_{SF6, hist}$)
Unit	Tonnes
Description	Historical SF6 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 SF6 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	This data is from Samsung ERP system
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 m2 Year 2007 (01/01/2007 ~ 31/12/2007): 5,126,394 m2 Year 2008 (01/01/2008 ~ 31/12/2008): 6,485,252 m2

Data/parameter:	Maintenance schedule for abatement device
Unit	Maintenance requirements by the manufacturer
Description	Maintenance schedule for each item required by the manufacturer's instruction
Source of data	Manufacturers specification
Value(s) applied)	N/A
Choice of data or measurement methods and procedures	N/A
Purpose of data	N/A
Additional comments	N/A

Data/parameter:	Maintenance schedule for FTIR measurement devices
Unit	Maintenance requirements by the manufacturer
Description	Maintenance schedule for each item required by the manufacturer's instruction
Source of data	Manufacturers specification
Value(s) applied)	N/A
Choice of data or measurement methods and procedures	N/A
Purpose of data	N/A
Additional comments	N/A

Data/parameter:	Maintenance schedule for Annubar device
Unit	Maintenance requirements by the manufacturer
Description	Maintenance schedule for each item required by the manufacturer's instruction
Source of data	Manufacturers specification
Value(s) applied)	N/A
Choice of data or measurement methods and procedures	N/A
Purpose of data	N/A
Additional comments	N/A

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	N/A
Purpose of data	Calculation of project emissions
Additional comments	N/A

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	N/A
Purpose of data	Calculation of project emissions
Additional comments	N/A

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	N/A
Purpose of data	Calculation of project emissions
Additional comments	N/A

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	N/A
Purpose of data	Calculation of project emissions
Additional comments	N/A

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	N/A
Purpose of data	Calculation of project emissions
Additional comments	This factor is used to calculate $COEF_{NG,y}$

D.2. Data and parameters monitored

Data/parameter:	$EC_{PJ,j,y}$
Unit	MWh/yr
Description	Quantity of electricity consumed by the project electricity consumption source j in year y (01/03/2011 – 31/10/2013)
Measured/calculated/default	Measured
Source of data	Meter
Value(s) of monitored parameter	

Date	$EC_{PJ,j,y}$
	MWh
01/03/2011 – 31/12/2011	655.491
01/01/2012 – 31/12/2012	823.118
01/01/2013 – 31/10/2013	641.278
Total	2,119.887

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(Previous)
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<tr><td>Calibration frequency</td><td>Once per 7 years</td></tr>
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(New)
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<tr><td>Date of last calibration</td><td>13/03/2014</td></tr>
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13/03/2014~12/03/2021</td></tr>
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<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>
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<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>Recording daily</td></tr>
<tr><td>Calculation method (if applicable):</td><td>N/A</td></tr>
</table>

QA/QC procedures:	The meters will be calibrated once per 7 years meeting the manufacturer's instruction and/or national standard.
Purpose of data:	Calculation of Project Emission
Additional comments:	There was monitoring interruption during shutdown of monitoring devices. - Shutdown Period 2011 : 12/08 ~ 19/09 2012 : 07/11 ~ 22/11

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 2014 (by KOREA ELECTRIC POWER CORPORATION)
Value(s) of monitored parameter	- 2011 : 3.69% - 2012 : 3.57% - 2013 : 3.73%
Monitoring equipment	N/A
Measuring/reading/recording frequency:	The value is published annually
Calculation method (if applicable):	N/A
QA/QC procedures:	N/A
Purpose of data:	Calculation of Project Emission
Additional comments:	This value is in Statistics of electric power in Korea 2014, page 117

Data/parameter:	$E_{SF6,in,y}$
Unit	tonnes
Description	Mass of SF6 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	

Date	$E_{SF6,in,y}$
	Tonnes
01/03/2011 – 31/12/2011	20.904
01/01/2012 – 31/12/2012	12.570
01/01/2013 – 31/10/2013	7.691
Total	41.165

Monitoring equipment	N/A
Measuring/reading/recording frequency:	N/A
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 spread sheet.
Purpose of data:	Calculation of baseline emissions
Additional comments:	N/A

Data/parameter:	$C_{SF6,y}$
Unit	tonnes
Description	Annual consumption of SF6 during the year y, defined as the total SF6 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 (This values are from G-ERP, which is electric accounting system.)
Value(s) of monitored parameter	

Date	$C_{SF6,y}$
	tonnes
01/03/2011 – 31/12/2011	55.853
01/01/2012 – 31/12/2012	58.288
01/01/2013 – 31/10/2013	38.727
Total	152.868

Monitoring equipment	N/A
Measuring/reading/recording frequency:	Recording when purchase SF6 with G-ERP
Calculation method (if applicable):	{(The number of SF6 bombe)*450kg} – Remaining of SF6
QA/QC procedures:	N/A
Purpose of data:	Calculation of baseline emissions
Additional comments:	Consumption of SF6 is deeded as amount of SF6 purchase taking into account the change in inventory in the same year. Remaining of SF6 gas in bombe was measured by Load-cell, which is installed in gas-operation room. Total SF6 gas consumption was calculated considering SF6 purchase data and remaining of SF6.

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	

Date	$SP_{project,y}$
	m^2
01/03/2011 – 31/12/2011	6,265,067
01/01/2012 – 31/12/2012	7,454,700
01/01/2013 – 31/10/2013	5,287,012
Total	19,006,779

Monitoring equipment	N/A
Measuring/reading/recording frequency:	Recording monthly
Calculation method (if applicable):	N/A
QA/QC procedures:	N/A
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 SF6 gas measured at the inlet of the SF6 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><td rowspan="2">Date</td><td>$E_{SF6,in}$</td></tr><tr><td>Gram/sec</td></tr><tr><td>01/03/2011 – 31/12/2011</td><td>1.166</td></tr><tr><td>01/01/2012 – 31/12/2012</td><td>0.889</td></tr><tr><td>01/01/2013 – 31/10/2013</td><td>0.670</td></tr></table> This is average value during this monitoring period. Please see more details in the spread sheet.
Monitoring equipment	N/A
Measuring/reading/recording frequency:	N/A
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. Refer to the spread sheet.
Purpose of data:	Calculation of baseline emissions
Additional comments:	N/A

Data/parameter:	$E_{SF6,out}$
Unit	Gram/second
Description	Amount of SF6 gas measured at the inlet 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><td rowspan="2">Date</td><td>$E_{SF6,in}$</td></tr><tr><td>Gram/sec</td></tr><tr><td>01/03/2011 – 31/12/2011</td><td>0.115</td></tr><tr><td>01/01/2012 – 31/12/2012</td><td>0.100</td></tr><tr><td>01/01/2013 – 31/10/2013</td><td>0.095</td></tr></table> This is average value during this monitoring period. Please see more details in the spread sheet.
Monitoring equipment	N/A
Measuring/reading/recording frequency:	N/A
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. Refer to the spread sheet.
Purpose of data:	Calculation of project emissions
Additional comments:	N/A

Data/parameter:	$M_{d,in}$
Unit	Gram/mole
Description	Total dry molecular weight of inlet stack gas

<table>
<tr><td>Measured/calculated/default</td><td>Measured and calculated</td></tr>
<tr><td>Source of data</td><td>Inlet QMS 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>01/03/2011 – 31/12/2011</td><td>28.5691</td></tr>
<tr><td>01/01/2012 – 31/12/2012</td><td>28.3571</td></tr>
<tr><td>01/01/2013 – 31/10/2013</td><td>28.3793</td></tr>
</table>
Please see more details in the spreadsheet.
</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>14/05/2011, 14/08/2011, 14/11/2011,
14/02/2012, 14/05/2012, 14/08/2012</td></tr>
<tr><td>Date of last calibration</td><td>13/10/2013</td></tr>
<tr><td>Validity</td><td>14/05/2011~13/05/2012
14/08/2011~13/08/2012
14/11/2011~13/11/2012
14/02/2012~13/02/2013
14/05/2012~13/05/2013
14/08/2012~13/08/2013
13/10/2013~12/10/2014</td></tr>
<tr><td>Delayed Date</td><td>01/03/2011~13/05/2011
14/08/2013~12/10/2013</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>14/02/2011, 14/05/2011, 14/08/2011,
14/11/2011, 14/02/2012, 14/05/2012,
14/08/2012</td></tr>
<tr><td>Date of last calibration</td><td>12/05/2014</td></tr>
<tr><td>Validity</td><td>14/05/2011~13/08/2011
14/08/2011~13/11/2011
14/11/2011~13/02/2012
14/02/2012~13/05/2012
14/05/2012~13/08/2012
14/08/2012~13/11/2012
12/05/2014~11/08/2014</td></tr>
<tr><td>Delayed Date</td><td>14/11/2012~31/10/2013</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>$M_{d,\,in} = 1.460[SF_{6in}] + 0.440[CO_{2in}] + 0.399[Ar_{in}] + 0.320[O_{2in}] + 0.280[N_{2in}] + 1.021[SO_2F_{2in}] + 0.040[He_{in}]$</td></tr>
<tr><td>QA/QC procedures:</td><td>QMS was calibrated with all components having more than 100 ppmv concentrations in inlet gases, which include SF_6, 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.</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Additional comments:</td><td>Concentration of SO_2F_2 was measured by FTIR
Md,in data is measured on 02/12/2011, 12/08/2012 and 14/11/2013.
This measured date is within validity of QMS and FTIR.</td></tr>
</table>

<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>01/03/2011 – 31/12/2011</td><td>28.5684</td></tr>
<tr><td>01/01/2012 – 31/12/2012</td><td>28.4426</td></tr>
<tr><td>01/01/2013 – 31/10/2013</td><td>28.4898</td></tr>
</table>
Please see more details in the spread sheet.
</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>3 month</td></tr>
<tr><td>Past Calibration date</td><td>14/05/2011, 14/08/2011, 14/11/2011,
14/02/2012, 14/05/2012, 14/08/2012</td></tr>
<tr><td>Date of last calibration</td><td>13/10/2013</td></tr>
<tr><td>Validity</td><td>14/02/2011~13/05/2011
14/05/2011~13/05/2012
14/08/2011~13/08/2012
14/11/2011~13/11/2012
14/02/2012~13/02/2013
14/05/2012~13/05/2013
14/08/2012~13/08/2013
13/10/2013~12/10/2014</td></tr>
<tr><td>Delayed Date</td><td>01/03/2011~13/05/2011
14/08/2013~12/10/2013</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Measuring 6 hours a year</td></tr>
<tr><td>Calculation method (if applicable):</td><td>$M_{d,\,out} = 1.460[SF_{6out}] + 0.399[Ar_{out}] + 0.320[O_{2out}] + 0.280[N_{2out}] + 0.44[CO_{2out}] + 0.040[He_{out}]$</td></tr>
<tr><td>QA/QC procedures:</td><td>QMS and was calibrated with all components having more than 100 ppmv concentrations in outlet gas, which include SF6, Ar, O2, N2, CO2 and He. And the applied value of Md,out is the lowest value of Md, 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.</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of project emissions</td></tr>
<tr><td>Additional comments:</td><td>Md,in data is measured on 02/12/2011, 12/08/2012 and 14/11/2013.
This measured date is within validity of QMS and FTIR.</td></tr>
</table>

Data/parameter:	$B_{ws,in}$
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	

Date	$B_{ws,in}$
	%
01/12/2011	1.772
26/11/2012	9.253
21/10/2013	10.098

Monitoring equipment

Monitoring equipment for 2011

Type	Dust stack sampler
Accuracy class	±5% (Gas meter) ±2% (Barometer) ±2% (Thermometer)
Serial number	03U5129-63M
Calibration frequency	2 years
Date of last calibration	08/03/2010
Validity	08/03/2010~07/03/2012

Monitoring equipment for 2012

Type	Dust stack sampler
Accuracy class	±5% (Gas meter) ±2% (Barometer) ±2% (Thermometer)
Serial number	020329K
Calibration frequency	2 years
Date of last calibration	02/01/2012
Validity	02/01/2012~01/01/2014

Monitoring equipment for 2013

Type	Dust stack sampler
Accuracy class	±5% (Gas meter) ±2% (Barometer) ±2% (Thermometer)
Serial number	1309043
Calibration frequency	2 years
Date of last calibration	16/09/2013
Validity	16/09/2013~15/09/2015

Measuring/reading/recording frequency:	Measuring once a year
Calculation method (if applicable):	N/A
QA/QC procedures:	Dust stack sampler is calibrated once per 2years 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 analyzing. The entire measurement process followed EPA method 4.

Data/parameter:	$B_{ws,out}$
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

<table>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><td rowspan="2">Date</td><td>$B_{ws,out}$</td></tr>
<tr><td>%</td></tr>
<tr><td>01/12/2011</td><td>3.337</td></tr>
<tr><td>26/11/2012</td><td>2.143</td></tr>
<tr><td>21/10/2013</td><td>2.638</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>
Monitoring equipment for 2011
<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>SDS-CO216</td></tr>
<tr><td>Calibration frequency</td><td>2 years</td></tr>
<tr><td>Date of last calibration</td><td>29/03/2010</td></tr>
<tr><td>Validity</td><td>29/03/2010~28/03/2012</td></tr>
</table>
Monitoring equipment for 2012
<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>1005034</td></tr>
<tr><td>Calibration frequency</td><td>2 years</td></tr>
<tr><td>Date of last calibration</td><td>30/04/2011</td></tr>
<tr><td>Validity</td><td>30/04/2011~29/04/2013</td></tr>
</table>
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>1309045</td></tr>
<tr><td>Calibration frequency</td><td>2 years</td></tr>
<tr><td>Date of last calibration</td><td>16/09/2013</td></tr>
<tr><td>Validity</td><td>16/09/2013~15/09/2015</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>N/A</td></tr>
<tr><td>QA/QC procedures:</td><td>Dust stack sampler is calibrated once per 2years according to national standard.</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of project emissions</td></tr>
<tr><td>Additional comments:</td><td>This value was measured by an independent company which is specialized in measuring and analyzing. The entire measurement process followed EPA method 4.</td></tr>
</table>

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	<table><tr><td rowspan="2">Date</td><td colspan="3">$P_{s,in}$</td></tr><tr><td>Before Deduction</td><td>After Deduction (2%)</td><td>Deviation</td></tr><tr><td>01/03/2011 – 31/12/2011</td><td>745.897</td><td>708.602</td><td>37.295</td></tr><tr><td>01/01/2012 – 31/12/2012</td><td>736.759</td><td>699.921</td><td>36.838</td></tr><tr><td>01/01/2013 – 31/10/2013</td><td>724.227</td><td>688.016</td><td>36.211</td></tr></table> This is average value during this monitoring period. Please see more details in the spread sheet
Monitoring equipment	Inlet Annubar <table><tr><td>Type</td><td>Barometer</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>Date of last test</td><td>04/08/2014</td></tr><tr><td>Validity</td><td>04/08/2014~03/08/2015</td></tr><tr><td>Delayed Date</td><td>01/03/2011~13/10/2013</td></tr></table>
Measuring/reading/recording frequency:	Value is continuously measured and recorded every 1 min.
Calculation method (if applicable):	N/A
QA/QC procedures:	This value is measured in accordance with the US EPA guideline.
Purpose of data:	Baseline and project emission
Additional comments:	Because of delay of calibration, all the monitoring data was deducted by its allowable error.

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
Value(s) of monitored parameter	<table><tr><td rowspan="2">Date</td><td colspan="3">$P_{s,out}$</td></tr><tr><td>Before Addition</td><td>After Addition (2%)</td><td>Deviation</td></tr><tr><td>01/03/2011 – 31/12/2011</td><td>733.455</td><td>770.127</td><td>36.672</td></tr><tr><td>01/01/2012 – 31/12/2012</td><td>734.507</td><td>771.232</td><td>36.725</td></tr><tr><td>01/01/2013 – 31/10/2013</td><td>744.984</td><td>782.147</td><td>37.163</td></tr></table> This is average value during this monitoring period. Please see more details in the spread sheet
Monitoring equipment	Inlet annubar <table><tr><td>Type</td><td>Barometer</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>Date of last calibration</td><td>04/08/2014</td></tr><tr><td>Validity</td><td>04/08/2014~03/08/2015</td></tr><tr><td>Delayed Date</td><td>01/03/2011~13/10/2013</td></tr></table>
Measuring/reading/recording frequency:	Value is continuously measured and recorded at least every 1 min.
Calculation method (if applicable):	N/A

QA/QC procedures:	This value is measured in accordance with the US EPA guideline.
Purpose of data:	Calculation of project emissions
Additional comments:	Because of delay of calibration, all the monitoring data was added by its allowable error.

Data/parameter:	$T_{s,in}$
Unit	K
Description	The inlet stack temperature measured during manufacturing operations
Measured/calculated/default	Measured
Source of data	Thermocouple
Value(s) of monitored parameter	See table below
Monitoring equipment	See table below
Measuring/reading/recording frequency:	Value is continuously measured and recorded at least every 1 min.
Calculation method (if applicable):	N/A
QA/QC procedures:	This value is measured in accordance with the US EPA guideline.
Purpose of data:	Baseline and project emission
Additional comments:	Because of delay of calibration, all the monitoring data was deducted by its allowable error.

Date	$T_{s,in}$		
	Before Deduction	After Deduction (2%)	Deviation
01/03/2011 – 31/12/2011	295.009	280.258	14.751
01/01/2012 – 31/12/2012	292.099	277.494	14.605
01/01/2013 – 31/10/2013	286.133	271.827	14.306

This is average value during this monitoring period.
Please see more details in the spread sheet

Inlet annubar

Type	Thermometer
Accuracy class	±2%
Serial number	72691A
Calibration frequency	Once per year
Date of last calibration	04/08/2014
Validity	04/08/2014~03/08/2015
Delayed Date	01/03/2011~13/10/2013

Data/parameter:	$T_{s,out}$
Unit	K
Description	The outlet stack temperature measured during manufacturing operations
Measured/calculated/default	Measured
Source of data	Thermocouple
Value(s) of monitored parameter	See table below

Date	$T_{s,out}$		
	Before Addition	After Addition (2%)	Deviation
01/03/2011 – 31/12/2011	297.392	312.261	14.869
01/01/2012 – 31/12/2012	295.590	310.370	14.78
01/01/2013 – 31/10/2013	303.588	318.732	15.144

This is average value during this monitoring period.
Please see more details in the spread sheet

Monitoring equipment	outlet annubar Type: Thermometer Accuracy class: ±2% Serial number: 72691B Calibration frequency: Once per year Date of last calibration: 04/08/2014 Validity: 04/08/2014~03/08/2015 Delayed Date: 01/03/2011~13/10/2013
Measuring/reading/recording frequency:	Value is continuously measured and recorded at least every 1 min.
Calculation method (if applicable):	N/A
QA/QC procedures:	This value is measured in accordance with the US EPA guideline.
Purpose of data:	Calculation of project emissions
Additional comments:	Because of delay of calibration, all the monitoring data was added by its allowable error.

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	This is average value during this monitoring period. Please see more details in the spread sheet
Monitoring equipment	Inlet annubar Type: Different pressure gauge Accuracy class: ±2% Serial number: 72691A Calibration frequency: Once per year Date of last calibration: 04/08/2014 Validity: 04/08/2014~03/08/2015 Delayed Date: 01/03/2011~13/10/2013
Measuring/reading/recording frequency:	Value is continuously measured and recorded at least every 1 min.
Calculation method (if applicable):	N/A
QA/QC procedures:	This value is measured in accordance with the US EPA guideline.
Purpose of data:	Calculation of baseline emissions
Additional comments:	Because of delay of calibration, all the monitoring data was deducted by its allowable error.

Date	$P_{avg,in}$		
	Before Deduction	After Deduction (2%)	Deviation
01/03/2011 – 31/12/2011	0.518	0.492	0.026
01/01/2012 – 31/12/2012	0.451	0.429	0.022
01/01/2013 – 31/10/2013	0.505	0.480	0.025

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
Value(s) of monitored parameter	<table><tr><td rowspan="2">Date</td><td colspan="3">$P_{avg,out}$</td></tr><tr><td>Before Addition</td><td>After Addition (2%)</td><td>Deviation</td></tr><tr><td>01/03/2011 – 31/12/2011</td><td>0.631</td><td>0.663</td><td>0.032</td></tr><tr><td>01/01/2012 – 31/12/2012</td><td>0.627</td><td>0.658</td><td>0.031</td></tr><tr><td>01/01/2013 – 31/10/2013</td><td>0.743</td><td>0.780</td><td>0.037</td></tr></table> This is average value during this monitoring period. Please see more details in the spread sheet
Monitoring equipment	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>Date of last calibration</td><td>04/08/2014</td></tr><tr><td>Validity</td><td>04/08/2014~03/08/2015</td></tr><tr><td>Delayed Date</td><td>01/03/2011~13/10/2013</td></tr></table>
Measuring/reading/recording frequency:	Value is continuously measured and recorded at least every 1 min.
Calculation method (if applicable):	N/A
QA/QC procedures:	This value is measured in accordance with the US EPA guideline.
Purpose of data:	Calculation of project emissions
Additional comments:	Because of delay of calibration, all the monitoring data was added by its allowable error.

Data/parameter:	$v_{s,in}$
Unit	m/sec
Description	Inlet gas velocity
Measured/calculated/default	Calculated
Source of data	Calculation of inlet gas velocity corrected for pressure and temperature variations
Value(s) of monitored parameter	<table><tr><td rowspan="2">Date</td><td>$v_{s,in}$</td></tr><tr><td>m/sec</td></tr><tr><td>01/03/2011 – 31/12/2011</td><td>2.896</td></tr><tr><td>01/01/2012 – 31/12/2012</td><td>2.702</td></tr><tr><td>01/01/2013 – 31/10/2013</td><td>2.893</td></tr></table> This is average value during this monitoring period. Please see more details in the spread sheet
Monitoring equipment	N/A
Measuring/reading/recording frequency:	Value is calculated and recorded at least every 1 min.
Calculation method (if applicable):	$v_{s,in} = K_P \times C_{p,in} \sqrt{p_{avg,in}} \sqrt{\frac{T_{s,in}}{P_{s,in} \times M_{s,in}}}$
QA/QC procedures:	N/A
Purpose of data:	Calculation of baseline emissions
Additional comments:	N/A

Data/parameter:	$v_{s,out}$
Unit	m/sec
Description	Outlet gas velocity
Measured/calculated/default	Calculated
Source of data	Calculation of inlet gas velocity corrected for pressure and temperature variations
Value(s) of monitored parameter	<table><tr><td rowspan="2">Date</td><td>$v_{s,out}$</td></tr><tr><td>m/sec</td></tr><tr><td>01/03/2011 – 31/12/2011</td><td>3.438</td></tr><tr><td>01/01/2012 – 31/12/2012</td><td>3.376</td></tr><tr><td>01/01/2013 – 31/10/2013</td><td>3.683</td></tr></table> This is average value during this monitoring period. Please see more details in the spread sheet
Monitoring equipment	N/A
Measuring/reading/recording frequency:	N/A
Calculation method (if applicable):	$v_{s,out} = K_P \times C_{p,out} \sqrt{p_{avg,out}} \sqrt{\frac{T_{s,out}}{P_{s,out} \times M_{s,out}}}$
QA/QC procedures:	N/A
Purpose of data:	Calculation of baseline emissions
Additional comments:	N/A

Data/parameter:	Q_{in}
Unit	m^3/s
Description	Inlet volumetric flow rate
Measured/calculated/default	Calculated
Source of data	Data calculation from inlet Annubar and inlet water proportion measurement report
Value(s) of monitored parameter	<table><tr><td rowspan="2">Date</td><td>Q_{in}</td></tr><tr><td>m^3/s</td></tr><tr><td>01/03/2011 – 31/12/2011</td><td>0.209</td></tr><tr><td>01/01/2012 – 31/12/2012</td><td>0.180</td></tr><tr><td>01/01/2013 – 31/10/2013</td><td>0.191</td></tr></table> This is average value during this monitoring period. Please see more details in the spread sheet
Monitoring equipment	N/A
Measuring/reading/recording frequency:	N/A
Calculation method (if applicable):	$Q_{in} = \left\{\left(100 - B_{ws,in}\right) \div 100\right\} v_{s,in} A_{in} \left[\frac{T_{std} P_{s,in}}{T_{s,in} P_{std}}\right]$
QA/QC procedures:	N/A
Purpose of data:	Calculation of baseline emissions
Additional comments:	N/A

Data/parameter:	Q_{out}
Unit	m^3/s
Description	Outlet volumetric flow rate

Measured/calculated/default	Calculated
Source of data	Data calculation from outlet Annubar and outlet water proportion measurement report
Value(s) of monitored parameter	<table><tr><td rowspan="2">Date</td><td>Q_{out}</td></tr><tr><td>m^3/s</td></tr><tr><td>01/03/2011 – 31/12/2011</td><td>0.239</td></tr><tr><td>01/01/2012 – 31/12/2012</td><td>0.237</td></tr><tr><td>01/01/2013 – 31/10/2013</td><td>0.256</td></tr></table> This is average value during this monitoring period. Please see more details in the spread sheet
Monitoring equipment	N/A
Measuring/reading/recording frequency:	N/A
Calculation method (if applicable):	$Q_{out} = \{(100 - B_{ws,out}) \div 100\} v_{s,out} A_{out} \left[\frac{T_{std} P_{s,out}}{T_{s,out} P_{std}} \right]$
QA/QC procedures:	N/A
Purpose of data:	Calculation of project emissions
Additional comments:	N/A

Data/parameter:	Inlet SF_6 concentration
Unit	ppm
Description	Inlet SF_6 concentration measured by FTIR
Measured/calculated/default	Measured
Source of data	Inlet FTIR
Value(s) of monitored parameter	<table><tr><td rowspan="2">Date</td><td colspan="3">Inlet SF6 concentration(ppm)</td></tr><tr><td>Before Deduction</td><td>After Deduction (5%)</td><td>Deviation</td></tr><tr><td>01/03/2011 – 31/12/2011</td><td>831.502</td><td>831.502</td><td>0</td></tr><tr><td>01/01/2012 – 31/12/2012</td><td>654.787</td><td>651.145</td><td>3.642</td></tr><tr><td>01/01/2013 – 31/10/2013</td><td>528.798</td><td>502.358</td><td>26.44</td></tr></table> This is average value during this monitoring period. Please see more details in the spread sheet

<table>
<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>14/02/2011, 14/05/2011, 14/08/2011, 14/11/2011, 14/02/2012, 14/05/2012, 14/08/2012</td></tr>
<tr><td>Date of last calibration</td><td>12/05/2014</td></tr>
<tr><td>Validity</td><td>14/02/2011~13/05/2011
14/05/2011~13/08/2011
14/08/2011~13/11/2011
14/11/2011~13/02/2012
14/02/2012~13/05/2012
14/05/2012~13/08/2012
14/08/2012~13/11/2012
12/05/2014~11/08/2014</td></tr>
<tr><td>Delayed Date</td><td>14/11/2012~31/10/2013</td></tr>
</table></td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Measuring every 1min</td></tr>
<tr><td>Calculation method (if applicable):</td><td>N/A</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>Because of delay of calibration, monitoring data from 14/11/2012 to 31/10/2013 was deducted by its allowable error.</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><td rowspan="2">Date</td><td colspan="3">Outlet SF6 concentration(ppm)</td></tr>
<tr><td>Before Addition</td><td>After Addition (5%)</td><td>Deviation</td></tr>
<tr><td>01/03/2011 – 31/12/2011</td><td>75.440</td><td>75.440</td><td>0</td></tr>
<tr><td>01/01/2012 – 31/12/2012</td><td>71.732</td><td>72.333</td><td>1.01</td></tr>
<tr><td>01/01/2013 – 31/10/2013</td><td>53.260</td><td>55.913</td><td>2.653</td></tr>
</table>
This is average value during this monitoring period.
Please see more details in the spread sheet</td></tr>
</table>

<table>
<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>14/02/2011, 14/05/2011,
14/08/2011, 14/11/2011,
14/02/2012, 14/05/2012,
14/08/2012</td></tr>
<tr><td>Date of last calibration</td><td>12/05/2014</td></tr>
<tr><td>Validity</td><td>14/02/2011~13/05/2011
14/05/2011~13/08/2011
14/08/2011~13/11/2011
14/11/2011~13/02/2012
14/02/2012~13/05/2012
14/05/2012~13/08/2012
14/08/2012~13/11/2012
12/05/2014~11/08/2014</td></tr>
<tr><td>Delayed Date</td><td>14/11/2012~31/10/2013</td></tr>
</table></td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Measuring every 1min</td></tr>
<tr><td>Calculation method (if applicable):</td><td>N/A</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 project emissions</td></tr>
<tr><td>Additional comments:</td><td>Because of delay of calibration, monitoring data from 14/11/2012 to 31/10/2013 was added by its allowable error.</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>01/03/2011 – 31/12/2011</td><td>22</td></tr>
<tr><td>01/01/2012 – 31/12/2012</td><td>52</td></tr>
<tr><td>01/01/2013 – 31/10/2013</td><td>40</td></tr>
<tr><td>Total</td><td>114</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>Date of last calibration</td><td>28/03/2011</td></tr>
<tr><td>Validity</td><td>28/03/2011~27/03/2014</td></tr>
<tr><td>Delayed date</td><td>01/03/2011~27/03/2011</td></tr>
</table></td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Recorded daily</td></tr>
</table>

Calculation method (if applicable):	N/A
QA/QC procedures:	The meters has been periodically calibrated meeting the manufacturer's instruction and/or national standard.
Purpose of data:	Calculation of project emissions
Additional comments:	Because of delayed calibration, data was added by its allowance error.

Data/parameter:	$C_{Steam,plant,y}$
Unit	ton
Description	Quantity of steam generated by the central boiler in year y
Measured/calculated/default	Measured
Source of data	Meter
Value(s) of monitored parameter	

Date	$C_{steam,plant,y}$		
	Before Addition	After Addition (1%)	Deviation
01/03/2011 – 31/12/2011	340,732	341,108	376
01/01/2012 – 31/12/2012	485,303	485,303	0
01/01/2013 – 31/10/2013	440,379	441,064	685

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
Delayed date	01/03/2011~07/06/2011

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 date	27-05-2013~31-10-2013

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 date	28/05/2013~31/10/2013

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
Delayed date	01/03/2011~08/06/2011

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 date	28/05/2013~31/10/2013

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 date: 28/05/2013~31/10/2013 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 date: 27/05/2013~31/10/2013 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 date: 19/07/2013~31/10/2013
Measuring/reading/recording frequency:	Recorded daily
Calculation method (if applicable):	N/A
QA/QC procedures:	The meters have been calibrated every 3year meeting national standard.
Purpose of data:	Calculation of project emissions
Additional comments:	Because of delay of calibration for steam flowmeter #1, 2, 3, 4, 5, 6, 7, 8 monitoring data from was 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	Meter
Value(s) of monitored parameter	

Date	$C_{NG,plant}$
	Nm3
01/03/2011 – 31/12/2011	22,258,726
01/01/2012 – 31/12/2012	34,393,116
01/01/2013 – 31/10/2013	29,864,472
Total	86,516,314

Monitoring equipment

LNG flow meter

LNG meter #1

Type	Turbine gas meter
Accuracy class	±0.5%
Serial number	71379
Calibration frequency	Once per 5 years
Date of last calibration	06/05/2009
Validity	06/05/2009~05/05/2014

LNG meter #2

Type	Turbine gas meter
Accuracy class	±0.5%
Serial number	10400413
Calibration frequency	Once per 5 years
Date of last calibration	12/06/2009
Validity	12/06/2009~11/06/2014

LNG meter #3

Type	Turbine gas meter
Accuracy class	±0.5%
Serial number	10400414
Calibration frequency	Once per 5 years
Date of last calibration	12/06/2009
Validity	12/06/2009~11/06/2014

LNG meter #4

Type	Turbine gas meter
Accuracy class	±0.5%
Serial number	10400416
Calibration frequency	Once per 5 years
Date of last calibration	06/05/2009
Validity	06/05/2009~05/05/2014

LNG meter #5

Type	Turbine gas meter
Accuracy class	±1%
Serial number	10400415
Calibration frequency	Once per 5 years
Date of last calibration	06/05/2009
Validity	06/05/2009~05/05/2014

LNG meter #6

Type	Turbine gas meter
Accuracy class	±1%
Serial number	520065
Calibration frequency	Once per 5 years
Date of last calibration	04/03/2010
Validity	04/03/2010~03/03/2015

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):	N/A
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:	N/A

Data/parameter:	$NCV_{NG,y}$		
Unit	TJ/Nm^3		
Description	Net calorific value of natural gas		
Measured/calculated/default	N/A		
Source of data	Korea Gas Cooperation data		
Value(s) of monitored parameter	Year	Average GCV TJ/Nm^3	Average $NCV_{NG,y}$ TJ/Nm^3
	2011	43.54 x 10-6	39.19 x 10-6
	2012	43.42 x 10-6	39.08 x 10-6
	2013	43.05 x 10-6	38.74 x 10-6
Monitoring equipment	N/A		
Measuring/reading/recording frequency:	Value is published monthly		
Calculation method (if applicable):	NCV = (GCV) x (1-10%)		
QA/QC procedures:	Since the fuel 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 recorded on monthly bases, from which weighted average annual value was calculated.		
Purpose of data:	Calculation of project emissions		
Additional comments:	N/A		

D.3. Implementation of sampling plan

>>

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

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

>>

Mass of SF_6 gas entering the abatement system in 2011

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

Whereas, value (including expected) for each parameters are,

$E_{SF6,,in,2011}$ = 20.904 ton
$C_{SF6,2011}$ = 55.853 ton

$C_{SF6,hist}$ = 62.44 ton (74.48t/year was converted for 306 days in 2011)

$E_{SF6,2011}$ = min {$E_{SF6,in,2011}$; 0.48* $C_{SF6,2011}$; 0.48* $C_{SF6,hist}$ }
= min {20.904 ; 0.48*55.853 ; 0.48*62.44}
= 20.904

SF_6 consumption ratio in 2011

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

Whereas, value for each parameters are,

Table 8. Historical data for SF6 consumption

	$C_{SF6,hist}$	SP_{-i}	$SF_{6,ratio}$
2006 (-3)	38	2,455,198	0.0000155
2007 (-2)	69.92	5,126,394	0.0000136
2008 (-1)	74.48	6,485,252	0.0000115

$SF_{6,ratio} = 0.0000115$

SF_6 consumption factor in 2011

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

Whereas, value for each parameters are,

$C_{SF6,2011}$ = 55.853 ton
$SP_{project,2011}$ = 6,265,067 m2

$C_{SF6,2011} / SP_{project,2011} = 0.0000089$

$SF_{6,ratio} \geq C_{SF6,2011} / SP_{project,2011}$

Therefore, k = 1

Baseline emissions in 2011

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

Whereas, value for each parameters are,

k = 1
$E_{SF6,in,2011}$ = 20.904 ton
GWP_{SF6} = 23,900 tCO_2/ton SF_6

$BE_{in,2011}$ = 499,598 tCO_2e

Mass of SF_6 gas entering the abatement system in 2012

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

Whereas, value (including expected) for each parameters are,

$E_{SF6,,in,2012}$ = 12.570 ton
$C_{SF6,2012}$ = 58.288 ton
$C_{SF6,hist}$ = 74.48 ton

$E_{SF6,2012}$ = min {$E_{SF6,in,2011}$; 0.48* $C_{SF6,2011}$; 0.48* $C_{SF6,hist}$ }
= min {12.570 ; 0.48*58.288 ; 0.48*74.48}
= 12.570

SF_6 consumption ratio in 2012

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

Whereas, value for each parameters are,

Table 8. Historical data for SF6 consumption

	$C_{SF6,hist}$	SP_{-i}	$SF_{6,ratio}$
2006 (-3)	38	2,455,198	0.0000155
2007 (-2)	69.92	5,126,394	0.0000136
2008 (-1)	74.48	6,485,252	0.0000115

$SF_{6,ratio}$ = 0.0000115

SF_6 consumption factor in 2012

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

Whereas, value for each parameters are,

$C_{SF6,2012}$ = 58.288 ton
$SP_{project,2012}$ = 7,454,700 m^2

$C_{SF6,2012} / SP_{project,2012}$ = 0.0000078

$SF_{6,ratio} \geq C_{SF6,2012} / SP_{project,2012}$

Therefore, k = 1

Baseline emissions in 2012

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

Whereas, value for each parameters are,

k = 1
$E_{SF6,in,2011}$ = 12.570 ton
GWP_{SF6} = 23,900 tCO_2/ton SF_6

$BE_{in,2012}$ = 300,413 tCO_2e

Mass of SF6 gas entering the abatement system in 2013

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

Whereas, value (including expected) for each parameters are,

$E_{SF6,in,2013}$ = 7.691 ton
$C_{SF6,2013}$ = 38.727 ton
$C_{SF6,hist}$ = 62.03 ton (74.48t/year was converted for 304 days in 2013)

$E_{SF6,2013} = \min \{E_{SF6,in,2013} ; 0.48* C_{SF6,2013} ; 0.48* C_{SF6,hist}\}$
$=\min \{7.691 ; 0.48*38.727 ; 0.48*62.03\}$
$= 7.691$

SF6 consumption ratio in 2013

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

Whereas, value for each parameters are,

Table 8. Historical data for SF6 consumption

	C SF6,hist	SP–i	SF6 ratio
2006 (-3)	38	2,455,198	0.0000155
2007 (-2)	69.92	5,126,394	0.0000136
2008 (-1)	74.48	6,485,252	0.0000115

$SF_{6,ratio} = 0.0000115$

SF6 consumption factor in 2013

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

Whereas, value for each parameters are,

$C_{SF6,2013}$ = 38.727 ton
$SP_{project,2013}$ = 5,287,012 m2

$C_{SF6,2013} / SP_{project,2013} = 0.0000073$

$SF_{6,ratio} \geq C_{SF6,2012} / SP_{project,2012}$

Therefore, k = 1

Baseline emissions in 2013

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

Whereas, value for each parameters are,

K = 1
$E_{SF6,in,2013}$ = 7.691 ton
GWP_{SF6} = 22,800 tCO2/ton SF6

$BE_{in,2013}$ = 175,363 tCO2e

Baseline emissions in this monitoring period

$BE_{in,2011} + BE_{in,2012} + BE_{in,2013}$ = 499,598 tCO2e + 300,413 tCO2e + 175,363 tCO2e
= 975,374 tCO2e

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

>>

CO2 emissions from electricity consumption in 2011

$$C_{CO2,y} = \sum_{j} EC_{PJ,j,y} \times EF_{grid,y} \times (1 + TDL_{j,y})$$

Whereas, value for each parameters are,

$EC_{PJ,j,2011}$ = 655.491 MWh
$EF_{grid,2011}$ = 0.5914 tCO_2/MWh
$TDL_{j,2011}$ = 0.0369

$C_{EC,2011}$ = 401.96 tCO2e

CO2 emissions from steam consumption in 2011

Fuel Consumption

$$FC_{NG,y} = C_{NG,plant,y} \times w_{Steeam}$$

$$w_{Steam} = C_{Steam,y} / C_{Steam,plant,y}$$

Whereas, value for each parameters are,

$C_{NG,plant,2011}$ = 22,258,726 Nm3
$C_{Steam,plant,2011}$ = 341,108 ton
$C_{Steam,2011}$ = 22 ton
$FC_{NG,2011}$ = 1,428 Nm3

Emission from steam

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

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

Whereas, value for each parameters are,

$NCV_{NG,2011}$ = 39.19 x 10-6 TJ/Nm3
$EF_{CO2,NG,2011}$ = 58.3 tCO2/TJ
$FC_{NG,2011}$ = 1,428 Nm3
$PE_{NG,2011}$ = 3.284 tCO2e

Determination of the SF6 destruction removal efficiency (DRE) of the abatement device in 2011

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

Whereas, value for each parameters are,

$E_{SF6,out,2011}$ = 2.65 ton
$E_{SF6,in,2011}$ = 20.904 ton
DRE_{2011} = 0.873

Project emissions in 2011

$$PE_y = BE_y (1 - DRE_y) + C_{CO2,y} + PE_{NG,y}$$

Whereas, value for each parameters are,

BE_{2011}	=	499,598 ton
DRE_{2011}	=	0.873
$C_{EC,2011}$	=	401.96 tCO2
$PE_{NG,2011}$	=	3.284 tCO2
PE_{2011}	=	63,855 tCO2e

CO2 emissions from electricity consumption in 2012

$$C_{CO2,y} = \sum_j EC_{PJ,j,y} \times EF_{grid,y} \times (1 + TDL_{j,y})$$

Whereas, value for each parameters are,

$EC_{PJ,j,2012}$	=	823.118 MWh
$EF_{grid,2012}$	=	0.5914 tCO_2/MWh
$TDL_{j,2012}$	=	0.0357

$C_{EC,2012}$ = 504.17 tCO2e

CO2 emissions from steam consumption in 2012

Fuel Consumption

$$FC_{NG,y} = C_{NG,plant,y} \times w_{Steeam}$$

$$w_{Steam} = C_{Steam,y} / C_{Steam,plant,y}$$

Whereas, value for each parameters are,

$C_{NG,plant,2012}$	=	34,393,116 Nm3
$C_{Steam,plant,2012}$	=	507,950 ton
$C_{Steam,2012}$	=	52 ton
$FC_{NG,2012}$	=	3,513 Nm3

Emission from steam

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

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

Whereas, value for each parameters are,

$NCV_{NG,2012}$	=	39.19 x 10-6 TJ/Nm3
$EF_{CO2,NG,2012}$	=	58.3 tCO2/TJ
$FC_{NG,2012}$	=	3,513 Nm3
$PE_{NG,2012}$	=	8.080 tCO2e

Determination of the SF6 destruction removal efficiency (DRE) of the abatement device in 2012

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

Whereas, value for each parameters are,

$E_{SF6,out,2012}$	=	3.41 ton
$E_{SF6,in,2012}$	=	12.570 ton

DRE_{2012} = 0.729

Project emissions in 2012

$$PE_y = BE_y (1 - DRE_y) + C_{CO2,y} + PE_{NG,y}$$

Whereas, value for each parameters are,

BE_{2012} = 300,413 ton
DRE_{2012} = 0.729
$C_{EC,2012}$ = 504.17 tCO2
$PE_{NG,2012}$ = 8.080 tCO2

PE_{2012} = 81,925 tCO2e

CO2 emissions from electricity consumption in 2013

$$C_{CO2,y} = \sum_j EC_{PJ,j,y} \times EF_{grid,y} \times (1 + TDL_{j,y})$$

Whereas, value for each parameters are,
$EC_{PJ,j,2013}$ = 641.278 MWh
$EF_{grid,2013}$ = 0.5914 tCO_2/MWh
$TDL_{j,2013}$ = 0.0373

$C_{EC,2013}$ = 393.40 tCO2e

CO2 emissions from steam consumption in 2013

Fuel Consumption

$$FC_{NG,y} = C_{NG,plant,y} \times w_{Steeam}$$
$$w_{Steam} = C_{Steam,y} / C_{Steam,plant,y}$$

Whereas, value for each parameters are,
$C_{NG,plant,2013}$ = 29,864,472 Nm3
$C_{Steam,plant,2013}$ = 441,064 ton
$C_{Steam,2013}$ = 40 ton
$FC_{NG,2013}$ = 2,714 Nm3

Emission from steam

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

Whereas, value for each parameters are,
$NCV_{NG,2013}$ = 38.7 x 10-6 TJ/Nm3
$EF_{CO2,NG,2013}$ = 58.3 tCO2/TJ
$FC_{NG,2013}$ = 3,119 Nm3
$PE_{NG,2013}$ = 6.242 tCO2e

Determination of the SF6 destruction removal efficiency (DRE) of the abatement device in 2013

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

Whereas, value for each parameters are,

$E_{SF6,out,2013}$ = 2.42 ton

$E_{SF6,in,2013}$ = 7.691 ton
DRE_{2013} = 0.685

Project emissions in 2013

$$PE_y = BE_y (1 - DRE_y) + C_{CO2,y} + PE_{NG,y}$$

Whereas, value for each parameters are,

BE_{2013} = 175,363 ton
DRE_{2013} = 0.685
$C_{EC,2013}$ = 393.40 tCO2
$PE_{NG,2013}$ = 6.240 tCO2

PE_{2013} = 55,639 tCO2e

Project emissions in this monitoring period

$PE_{,2011} + PE_{,2012} + PE_{,2013}$ = 63,855 tCO2e + 81,925tCO2e + 55,639 tCO2e
= 201,419 tCO2e

E.3. Calculation of leakage

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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	975,374 tCO2e	201,419 tCO2e	0 tCO_2e	654,231 tCO_2e	119,724 tCO_2e	773,955 tCO_2e

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)	2,054,185 tCO_2e (This monitoring period is 976days : 768,215tCO_2e / 365 * 976days)	773,955 tCO_2e

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

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The actual emission reduction resulting from the Project during 2nd monitoring period(773,955 tCO2e) was lower than the estimation in the PDD (2,054,185 tCO2e). During 2nd monitoring period, specially in 2013, DRE value was lower compared to 2011 and 2012. DRE value determinate project emissions. As you can check above report, project emission of 2011 and 2013 is quite same value. Another reason is Emission Deducting. As in PDD, PP will completely discount from the baseline any SF6 emitted during periods of times where the gas velocity measured at the inlet decreases by more than 5% compared to the averaged

velocity and where the gas velocity measured at the outlet increases by more than 5% compared to the averaged velocity.

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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
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Salutation	
Last name	Park
Middle name	
First name	Ji-Ho
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Mobile	+82-10-3076-6012
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Direct tel.	
Personal e-mail	