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

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SECTION A. General description of project activity

A.1 Title of the project activity:

“SF_6 recovery and reclamation project, South Korea”
PDD Version Number 8
26/02/2013

A.2. Description of the project activity:

The **“SF_6 recovery and reclamation project, South Korea”** (hereafter, the “Project”) developed by Solvay Fluor Korea Co. Ltd (SFK) and the Korea Electrotechnology Research Institute (KERI) (hereafter referred to as the “Project Developers”) is a sulphur hexafluoride (SF_6) recovery and reclamation project in South Korea, hereafter referred to as the “Host Country”.

The purpose of this project activity will be to reduce emissions of SF_6 from the KERI testing facility of electrotechnical equipment in South Korea SF_6 that would have been vented in a business-as-usual scenario. SF_6 that has been used in the testing of gas insulated electrical equipment (GIEE), especially gas circuit breakers (GCB) and gas insulated switchgears (GIS) will be recovered and then reclaimed[1] at Solvay’s SF_6 manufacturing facility located in Ulsan, South Korea.

Solvay Fluor Korea Co. Ltd (SFK) is the entity that is involved in the development and investment in the project activity. SFK investment includes equipment at Korea Electrotechnology Research Institute (KERI) site. The ownership of the recovered SF6 gas from KERI is assigned to SFK. SFK is consequently responsible for transportation, gas analysis, reclamation, and any further costs associated with handling or processing the used SF6[2].

About SF_6

SF_6 is a colourless, odourless, chemically neutral, and inert gas. This inflammable gas is produced from sulphur and fluorine, it is 5 times heavier than air, non–toxic and not ozone depleting. It is produced in two grades: standard grade (purity of more than 99.9%) and electronic grade (purity of more than 99.995%). SF_6 is used mostly as an insulating gas in high voltage switch gear and circuit breakers, but also in the casting process for the magnesium production, in the electronic industry, for the adiabatic properties usage and for other uses, including accelerators, optical fibre production and glazing. The High Voltage (HV) electrical industry uses SF_6 gas for its excellent insulating properties which allow electric arcs occurring in electrical equipment to be quenched (i.e. extinguished) extremely rapidly. Currently,

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[1] For the purpose of this project and in accordance with AM0079, reclamation is defined following the Regulation in reference 1-1 in LIST OF , Annex 6

[2] This is appropriately reflected in the investment analysis in Section B.5. of the PDD.

there are no substitute products for SF_6 and is estimated that 80% of SF_6 is used in electrical industry. SF_6 is physiologically harmless for humans and animals. Legislation for chemicals does not categorise SF_6 as a hazardous material. However, SF_6 is the most potent greenhouse gas covered under the Kyoto Protocol with a Global Warming Potential of 23,900 tCO_2e.

Project Description[3]

The proposed project is focusing on the application of the SF_6 in the testing of GIEE. This kind of equipment has to be tested to ensure it meets quality standards by specialized testing laboratories like the Korea Electrotechnology Research Institute (KERI). KERI is a government sponsored research institute established in 1976 that offers third-party testing and certification services to the electrical industry. KERI is accredited by the Worldwide System for Conformity Testing and Certification of Electrotechnical Equipment and Components (IECEE) as a Certification Body Test Laboratory. KERI is equipped with modern high voltage and high power testing facilities capable of performing short-circuit and breaking test up to 1100kV/63kA. Electrical apparatus that can be tested include switchgears, circuit-breakers, transformers and fuses. KERI undertakes tests for two purposes: certification tests and design tests. Manufacturers of GIEE order these tests in order to certify their equipment or to check equipment during apparatus development.

SF_6 gas is disposed of at KERI for several reasons. All high power tests always result in electric arcing in GIS and GCB equipment insulated using SF_6 gas, except for the short time current test. Therefore, after all other high power testing of gas-insulated electrical equipment, used SF_6 in the equipment likely contains decomposition products and other impurities due to electrical current interruption. Therefore, SF_6 is removed from equipment and disposed of when the equipment is dismantled and removed from the testing area by its manufacturer because of the following reasons: (a) a certification test or design test of equipment is finished, (b) there was an equipment assembly error or maintenance is needed and/or (c) the testing item was invalid. Used gas cannot be used in a new test because any SF_6 used in a test may be contaminated to an unknown degree, and manufacturers demand that certification and design tests are undertaken with new SF_6 gas according to standard IEC[4] 60376. As a result of these circumstances, the non-toxic and relatively cheap used SF_6 is routinely vented in the atmosphere at KERI. Besides, used SF_6 has little or no commercial value. This comprises the scenario existing prior to the start of the implementation of the project activity. It is also identified as the baseline scenario, described as follows: Continuation of current practice where used SF_6 gases are vented to the atmosphere at the testing facility after high power tests are performed to GIEEs.

Under the project scenario, used SF_6 will be recovered using a compressor and piping system and stored in pressurised dedicated recovery cylinders. These cylinders will then be transported to an SF_6

[3] For all documents related to project description, See references 4-1 to 4-8 in LIST OF , Annex 6

[4] International Electrotechnical Commission; www.iec.ch

manufacturing facility, Solvay Fluor Korea (SFK). SFK is a chemical plant which produces new SF_6 (tech and e-grade) and other chemicals. SFK was legally established in July 2005 and the plant became operational in May 2007. At the SFK plant, chemical analysis will be used to evaluate the moisture, gaseous and solid decomposition products of the recovered gas. After checking that used SF_6 gas fulfils specifications for reclamation, the used SF_6 gas will be fed into the new SF_6 production stream through a system of injection piping at a rate of 3 to 10 kg gas/hour. Depending on the impurities of the gas, used SF_6 will be injected to the appropriate stage of production that will remove impurities and reclaim the gas to the same purity as new SF_6 in order to be sold in the market.

The reclaimed SF_6 will follow the same quality standards as new SF_6 (IEC 60376[5]). The proposed project activity provides a closed cycle SF_6 management system through recovery, packaging, transport, analytical services and reclamation of used SF_6. By capturing the SF_6 instead of venting, KERI will improve the health and safety conditions of the testing facility and the environmental footprint of its operations.

The Project activity will result in GHG emission reduction by avoiding venting of used SF_6, which is the current practice of a high power high voltage testing facility in the Host Country. The Project is the first of its kind in the Host Country and would not be implemented without CDM support due to its lack of financial attractiveness in the absence of CER revenues.

<u>Contribution to sustainable development</u>
The Project will have positive contribution to the Sustainable Development of the Host Country:

1. Environment and Natural Resources

- The project will significantly reduce the emissions of SF_6, the most potent greenhouse gas covered under the Kyoto Protocol;
- By reclaiming SF_6 there is
  - Reduction of raw material input (AHF, molten sulphur) for the manufacture of new SF_6. This will result in a reduction of associated emissions upstream (from transportation and energy used in chemical reactions);
  - Reduction in the consumption of electricity because of reduced need for electrolysis of AHF.

2. Social

- Improvement in the health and safety conditions at the testing site.

3. Technology

[5] See reference 1-2 in LIST OF , Annex 6

- The project will result in technology transfer in the integration of SF_6 recovery, handling and reclamation that has not been used previously in the Host Country.

4. Economic

- The project will directly create new employment in logistical support, gas sampling and analysis and overall process monitoring. The construction phase of the project will create employment for local contractors. Overall the proposed project will improve human capacity and diversity of employment opportunity, by training project managers, lab technicians and operators.

A.3. Project participants:

Name of party involved (*) ((host) indicates a host party)	Private and/or public entity(ies) Project participants (*) (as applicable)	Kindly indicate if the party involved wishes to be considered as project participant (Yes/No)
Republic of Korea (host)	Solvay Fluor Korea Co. Ltd	No
United Kingdom of Great Britain and Northern Ireland	EcoSecurities International Limited	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time requesting registration, the approval by the Party(ies) involved is required.		

EcoSecurities International Limited is the CDM consultant and buyer of Certified Emission Reductions generated by the project activity.
At the time requesting registration of the CDM-PDD, Korea Electrotechnology Research Institute (KERI) does not wish to be considered a project participant as defined in the CDM modalities and procedures.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Republic of Korea

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

Solvay Fluor Korea Co. Ltd: Ulsan.

Korea Electrotechnology Research Institute (KERI): Chang Won.

A.4.1.3. City/Town/Community etc:

Solvay Fluor Korea Co. Ltd: Onsan-Eup.

Korea Electrotechnology Research Institute (KERI): Chang Won.

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

Solvay Fluor Korea Co. Ltd: 383, Daejung-Ri, Onsan-Eup, Ulju-kun, Ulsan
Coordinates: Latitude 35.426374 Longitude 129.340193

Korea Electrotechnology Research Institure (KERI): 28-1 Seongju-dong, Changwon-si, Gyeongsangnam-do
Coordinates: Latitude 35.189363 Longitude 128.718224

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

According to Annex A of the Kyoto Protocol, this project fits in Sectoral Scope 11: Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride.

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

The technology to be employed in the proposed project is a recovery and reclamation system that reduces SF_6 emissions through capturing used SF_6 in a user site and reclaiming of SF_6 into an SF_6 production facility, instead of venting it into the atmosphere.

The project will consist of the following steps:

A. **Recovery:** The SF6 recovery equipment is connected to the GIS/GCB equipment tested in order to recover the used SF6 and avoid venting to the atmosphere.
B. **Storage:** After recovery, the gas is stored in special used-gas cylinders.

C. **Dispatching:** Before being dispatched, used-gas cylinders will be weighed and labelled.
D. **Transport:** Transporting the used gas to the SF_6 reclamation site
E. **Reception & Analysis:** Determination of the state of the gas, concentration of SF6 in the cylinder and selection of method of reclaiming
F. **Reclamation:** Injection of used gas to the SF_6 production plant in order to produce new quality SF_6.

Each step is described below:

A. Recovery

This will introduce a 'non-venting' concept to the operations at the user site. SF6 will be recovered from GIEE after testing, before being filled again with new SF_6 for other tests or being disassembled for shipping back to the manufacturer. A new internal regulation regarding management of SF_6 will be introduced to cover the use of SF6 onsite. Records of venting and any other recovery operation will be kept. A mass flow meter will be used to measure the amount of used gas recovered. Modifications made to the existing installation are installation of appropriate piping, the recovery equipment and measuring equipment described in the monitoring plan. Equipment that will be used includes a gas compressor, appropriate piping and filters and special gas cylinders. Such equipment is characterized by (1) resistance of the material to the potentially corrosive effects of SF_6 decomposition products (2) gas tightness (3) absolutely oil free design (4) transportable and easy to handle. This project will use advanced equipment that is designed specifically for SF_6 reclamation and can pump almost all of SF_6 from the breaker. The compressor is expected to consume around 16.9 kW of electricity and to operate for around 100 hours per year, although this may vary during project operation.

B. Storage

The described recovery equipment will be used to pump the used SF_6 out of the tested equipment and stored in a designated gas cylinder. Special compressed gas cylinders for transporting used SF_6 will be used. These compressed gas containers are generally different from the containers for new SF_6 in compliance with IEC 60376 due to their thicker walls (taking into account the larger concentrations of corrosive products). The valves of these used SF_6 compressed gas containers are also different than for new manufactured SF_6. The cylinders are acid resistant.

C. Dispatching

High Capacity Cylinders will be used for the storage and transportation of the used SF_6. Cylinders will typically have a filling pressure of 21-70 bar and 600 litre capacity and estimated weight of 640kg when full, although this may vary during project operation. The cylinders will be labelled and weighed at KERI prior to transport to SFK.

D. Transport

The properly labelled cylinders will be transported by truck in a secure manner to the SF_6 reclamation facility. Upon arrival to the SF_6 reclamation facility, each gas cylinder will be weighed to determine the mass of gas in the cylinder.

E. Reception & Analysis

When the cylinders containing the used SF_6 arrive at the SF_6 reclamation site, the SF_6 gas has to be analysed to determine the concentration of contaminants. An analysis will be conducted by the laboratory of the SF_6 manufacturing facility. Two of the parameters that laboratory will be analysing are:

- SO_2 concentration
- Overall level of SF_6 gas purity

Tests are performed to determine whether the normal current interruptions in switchgear might lead to the formation of decomposition products of SF_6. Such decomposition products are numerous and various:

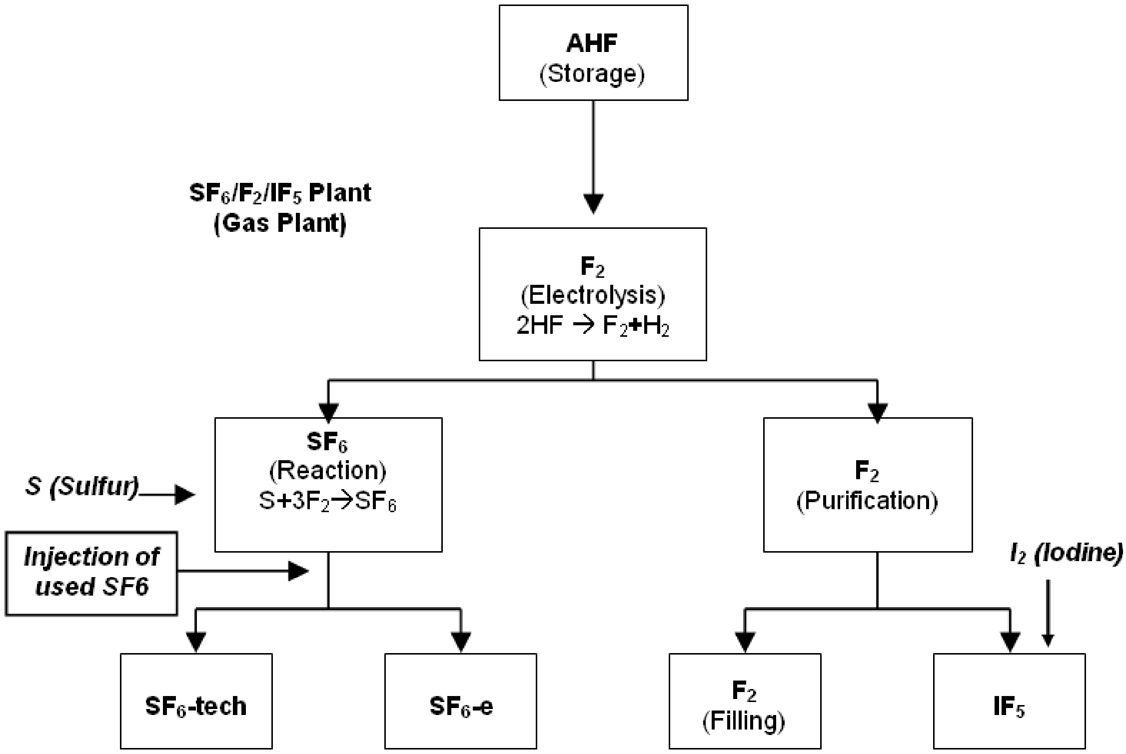
- Gaseous: N_2, O_2, CF_4, moisture, SO_2, SO_2Fs, HF, SiF_4, SOF_4, SF_4, S_2F_{10}, CO_2, SOF2, SO_2F_2, H_2O
- Solid (Dust): CuF_2, WO_3, WO_2F_2, WOF_4AIF_3, carbon, metal dust, particles
- Liquid: Oil

Depending on the results, the method of reclamation will be determined. Because used SF_6 gas collected at the SF_6 user sites is ultimately fed back into the new SF_6 production stream, it must meet certain specifications. Annex 6 gives SFK's guidelines as to the maximum concentration of certain contaminants that is acceptable for the gas to be recycled. If the used SF_6 does not correspond to these specifications, SFK can determine to what extent reclaiming is still possible and what other disposal alternatives are available.

F. Reclamation

The used SF_6 at the reclamation facility will be fed back into the new SF_6 production stream through a system of injection piping. Depending on the impurities of the gas, the used SF6 goes through an appropriate gas purifying system to remove the impurities and the gas is transformed to new SF_6. The recycled SF_6 will follow the same quality standards as new SF_6 (IEC 60376). A basic diagram of the SF6 production process is provided in a Figure below but the techniques and processes for purification/distillation of new SF_6 are proprietary and can therefore not be detailed in the PDD. It is expected that the average amount of SF6 reclaimed will be around 9.7 tonnes of used SF_6 per year, based on the latest information, although this may vary during project operation.

Figure A.4.3.1. Basic diagram of SF_6 production process and SF_6 injection.



G. Certification of reusability of reclaimed SF_6 gas

The reclaimed SF_6 will have the same quality as the new SF_6 as they will come out of the same production line. Laboratory analysis will verify the compliance of the SF6 with quality standards, as per SFK's usual quality control procedures.

In the unlikely case of extreme contamination of recovered SF6, the solution of incineration could be one of the disposal options for SFK, or venting, as in the baseline scenario. Incineration is one of the most popular approaches with advanced technology to recycle the Industrial and Institutional waste in Europe. This service could be provided by a local hazardous waste incinerator in a facility nearby.[6] However, it is expected that incineration will be an extremely rare SF_6 management option and for this reason, it is not part of the project boundary. Any recovered SF_6 that will be incinerated will be recorded and not included in the emission reduction calculations.

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[6] If used gas were to be incinerated, the used SF6 gas would be transported using the same cylinders. Dedicated piping would be installed at the incineration site to inject the non-reclaimable SF_6. The incineration facility would operate at high temperature (>1000°C) and have appropriate environmental licenses. Any solid wastes resulting from incineration of SF_6 would be disposed in a managed landfill. However, the possibility of incinerating used SF_6 gas is very low due to the limited occasion in getting used gas with high enough impurities to prevent reclamation. The results of an experimental test of gas used at KERI show impurities of around 4%.

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

Table A.4.4.1. Estimated emissions reductions from the project

Years	**Annual estimation of emission reductions over the chosen crediting period**
2011	165,092
2012	165,092
2013	165,092
2014	165,092
2015	165,092
2016	165,092
2017	165,092
2018	165,092
2019	165,092
2020	165,092
Total estimated reductions (tonnes of CO_2)	1,650,920
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2)	165,092

A.4.5. Public funding of the project activity:

The project will not receive any public funding from Parties included in Annex I of the UNFCCC.

SECTION B. Application of a baseline and monitoring methodology

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

The baseline methodology AM0079 version 2, "Recovery of SF_6 from Gas insulated electrical equipment in testing facilities" is applied.
The following tools, referred to in the methodology, are also applied:

- "Combined tool to identify the baseline scenario and demonstrate additionality", version 02.2, EB28.
- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion", version 02, EB 41
- "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", version 01, EB 39.

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

This methodology applies

- to projects where SF6 emissions are reduced by implementing recovery of used SF6 gas that would be vented after the testing of gas insulated electrical equipment (GIEE) at a testing facility, called the SF6 recovery site
    - OK, SF6 recovery site is at KERI site
- When the recovered gas is then reclaimed at an SF6 production facility, called the SF6 reclamation site
    - OK, SF6 is reclaimed at SFK SF6 production facility

Furthermore, all applicability conditions are met:

Applicability criteria	Project compliance
The SF_6 recovery site uses SF_6 in the testing of gas insulated electrical equipment (GIEE) (e.g. circuit breaker, switchgear). Such tests are performed as part of a certification or rating process, or during production or development of new electrical equipment.	- The Korea Electrotechnology Research Institute (KERI) is an accredited High Power and High Voltage Testing Facility providing testing and certification services for GIEE - SF_6 is used in the testing of GIEE
The testing considered for the project is Electrical Tests of medium and high voltage rated equipment (>1kV)	- Tests to be considered at the KERI site for this project include equipment from >1kV and suitable records are available

Before the project, SF_6 gas used in the equipment for tests is vented following testing	- Before the project, KERI has been routinely venting the used SF_6 from equipment after the completion of the various electrical tests and replaced with new SF_6 for the execution of new tests. See section A.2 for details
There is no option to reuse the vented SF_6 in the SF_6 recovery site	- Vented SF_6 is used SF_6 from the test equipment. Such contaminated SF_6 can not be used for further tests because it is no longer in accordance with IEC 60376, which is the required SF_6 gas standard for the GIEE tests - Manufacturers who order for the GIEE tests require to test their equipment under ideal circumstances, thus with SF_6 complying with standard IEC 60376 - Used SF_6 according to IEC 60480 is only suitable for re-use when equipment is maintained, repaired or reaching the end of its service life, thus it is not explicitly suitable for use in equipment for type tests, performance tests or tests during equipment development
The recovered gas is reclaimed by using it as a feedstock in the production of new SF_6 on the premises of an existing SF_6 production facility	- The recovered gas is reclaimed by using it as a feedstock in the production of new SF_6 on the premises of the existing SF_6 production facility at Solvay Fluor Korea Co. Ltd (SFK) site in South Korea which started operation in May 2007
Recovered gas injected for reclamation process is directly merged with the flow of gas in the production line of SF_6 newly produced and the two becomes indistinguishable. Furthermore, there are no possible cause of leakage (e.g. purge outlets) between the point of injection and the point of merging;	- For reclamation, the recovered gas in the cylinder flows via injection piping to the production line of SF6 newly produced. - Since the SF_6 molecules are identical they become indistinguishable at the point of merging. - There are no purge outlets between the points of injection and merging.
Reclaimed SF_6 is a minor component of the total SF_6 production of the SF_6 reclamation site (less than 5% of total production)	- The total capacity of SF_6 production at the SFK facility is around 1,500 tonnes per year (design production capacity) - It is expected that the average amount of SF_6, reclaimed will be 9.7 tonnes of used SF_6 per year and the target reclamation rate is 5 kg/hr[7] - Hence, the reclaimed SF_6 would represent less than 1% of total SF_6 production
Issuance requests shall be formulated for periods of at least one year as the procedures to remove the possibility of gaming are designed on a yearly basis	- The issuance request will be formulated for periods of at least one year in order to remove the possibility of gaming

[7] This is based on the Standard Operating Procedure (SOP) for reclamation of Used SF6.

The testing is performed at the request of a client according to a national or international standard, and the facility operator has no discretion in the type or frequency of tests	- The testing facility operator, KERI, does not decide the test type nor the frequency of tests - KERI follows testing protocols required by its clients. These protocols comply with detailed international testing standards for defined testing requirements.
Application of the procedure to identify the baseline scenario must result in a baseline involving the venting of SF_6 as the most plausible scenario of the SF_6 recovery site	- Baseline involving the venting of SF_6 is the most plausible scenario of the SF_6 recovery site, as discussed in section B.4

Applicability conditions of the three tools references are met also

"Tool to calculate project or leakage CO2 emissions from fossil fuel combustion"	- If/when the Project burns fossil fuel the CO2 emissions from the fossil fuel combustion will be based on the quantity of the fuel combusted and its properties - The combustion process may for instance be the transportation of used SF6 from the recovery site to the reclamation site
"Combined tool to identify the baseline scenario and demonstrate additionality"	- All potential alternative scenarios in methodology AM0079 proposed to the project activity are available to proejct participants. - - The modifications to the existing installation operated by project participants applied would be the reduction of SF6 emissions
"Tool to calculate baseline, project and/or leakage emissions from electricity consumption"	- The source of electricity consumed for the project activity is provided from the grid only

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

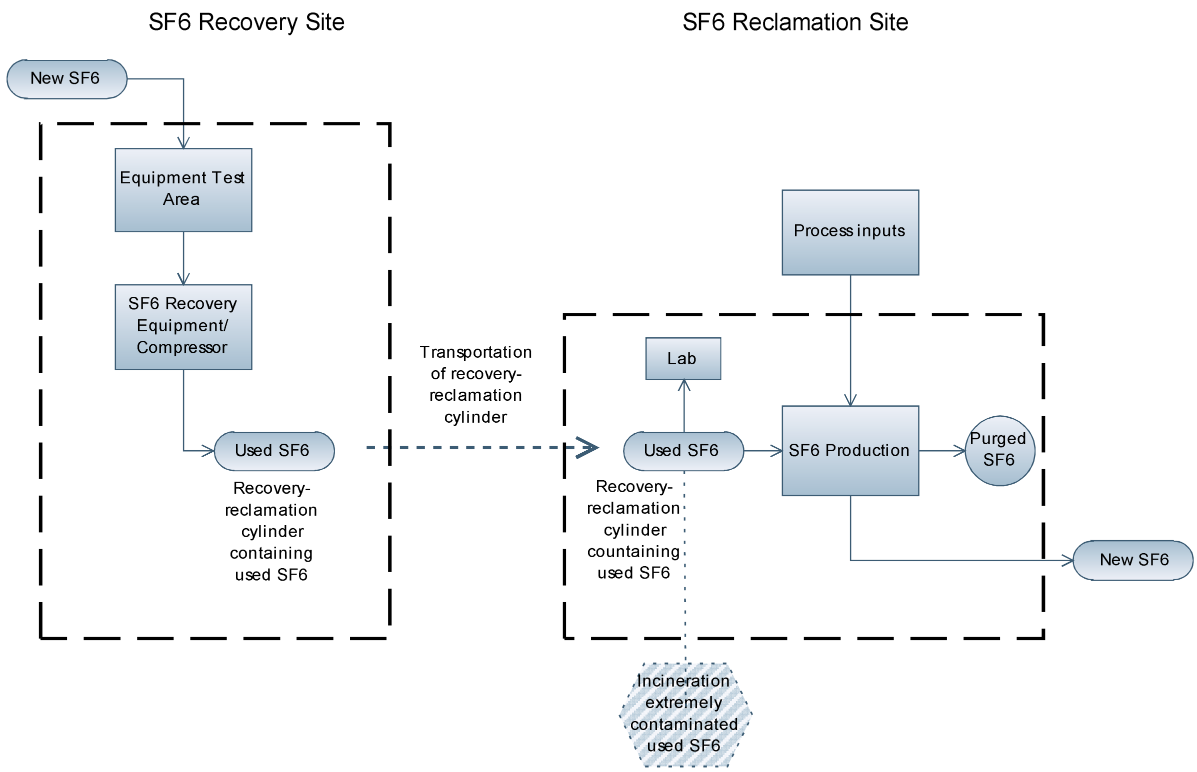
The project boundary encompasses:

1. The site of SF_6 Use and Recovery ("SF6 recovery site"), which is located at the testing facility site (KERI) and is where the SF6 gas is recovered in the project scenario instead of being vented
    a. The locations where test equipment is filled with SF_6, where this equipment is tested, and where the gas is vented (in the baseline scenario) and recovered (in the project scenario)
    b. All equipment for recovery of used SF_6
    c. The dedicated recovery cylinders in which used SF_6 is stored

2. The site of SF_6 reclamation ("SF6 reclamation site"), which is located at the SF6 production facility site (SFK) and is where the used SF_6 gas is reclaimed by injecting it into the normal production line of new SF6
    a. The dedicated recovery cylinders in which used SF_6 is stored
    b. The laboratory where recovered gas is tested for SF_6 content
    c. Connectors, pipework and other equipment used to transfer and measure the used SF_6 from the recovery cylinders to the SF_6 production line

In Figure B.3.1, the Project boundary covers everything inside the dashed lines:

Figure B.3.1. Flow chart of project boundaries (dashed line indicates boundaries).



The following emission sources are considered within the project boundaries:

Table B.3.2. Emissions sources included in or excluded from the project boundary.

Source		Gas	Included?	Justification / Explanation
Baseline	venting of used gas	CO_2	No	Not relevant
		CH_4	No	Not relevant
		SF_6	Yes	Only source of emissions
Project activity	SF_6 emitted during reclamation	CO_2	No	Not relevant
		CH_4	No	Not relevant
		SF_6	Yes	Only source of emissions
	Exceptional SF_6 emissions	CO_2	No	Not relevant
		CH_4	No	Not relevant
		SF_6	Yes	Only source of emissions
	Electricity use of recovery equipment	CO_2	No	Main source of emissions
		CH_4	No	Negligible
		N_2O	No	Negligible
	Energy used at reclamation site prior to reclamation	CO_2	No	Main source of emissions
		CH_4	No	Negligible
		N_2O	No	Negligible

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

In accordance with AM0079, the “Combined tool to identify the baseline scenario and demonstrate additionality” is used. Steps 1 will be described here in section B.4, while steps 2, 3 and 4 will be described in section B.5.

STEP 1. Identification of alternative scenarios

Sub-step 1a. Define alternative scenarios to the proposed CDM project activity

Four alternatives are considered for managing used SF6 gas at the SF6 recovery site (i.e. KERI testing facility):

Alternative 1: Continuation of current practice where used SF_6 gases are vented to the atmosphere at the testing facility after high power tests are performed to GIEEs.

Continuation of the current situation would require no investment on the part of the SF_6 user site, and would not face any technological or other barriers. SF_6 gases would continue to be vented in the atmosphere at the SF_6 user site. Current practice is described in detail in section A.2. There is no

legislation to require alternative management of the SF_6 gases at the SF_6 user site[8]. This alternative is the most plausible and is kept for further analysis.

Alternative 2: Capture and incineration of used SF6

This alternative would face economic barriers as incineration does not offer any revenue and has high economic costs due to the high temperatures (and so energy requirements) necessary to break down SF_6 which is demonstrated in the table below. Furthermore, incineration has been demonstrated to be unnecessary because tests done by SFK demonstrate that gas used at KERI shows low impurities (98-99%) and will always be suitable for reclamation under foreseeable circumstances. In addition, the incineration of SF_6 produces NaF and Na_2SO_4, solid wastes that have to be disposed in a landfill, increasing the cost of this treatment option. Incineration of SF_6 offers no compensation and there is no legal requirement to incinerate SF_6. This alternative is not plausible and therefore excluded from further analysis.

Table B.4.1.Summary of investment analysis for the capture and incineration of SF_6[9]

Financial Parameter	Value
Investment costs (USD)	116,137
Income	0
IRR	n/a
NPV (USD)	(523,890)

Alternative 3: Capture and reclamation of used SF6 at the chosen SF6 reclamation site (the project activity without CDM).

This alternative would face economic barriers as recovery and reclamation of used SF_6 without CDM does not offer sufficient revenue to compensate for the high economic costs due to the piping and equipments that have to be installed. Same with Alternative 2, there is no legal requirement to recover and reclaim SF_6, however, this alternative does generate some (limited) revenues from savings on raw material for SF6 production and hence it is kept for further analysis in section B.5 below to demonstrate that proceeding with this Alternative is not financially viable without CDM.

Alternative 4: Capture and transport of used SF6 to other facilities for reclamation.

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[8] See reference 1-3 in LIST OF , Annex 6

[9] See reference "SFK_FinancialAnalysis"

This alternative would require alternative facilities outside SFK to reclaim the recovered SF_6. However, no other SF_6 reclamation (production) facilities exist in the Host Country. Therefore this alternative is not considered viable. This alternative is not plausible and therefore excluded from further analysis.

Sub-step 1b. Consistency with mandatory applicable laws and regulations:

All the above Alternatives are consistent with existing laws and regulations regarding SF_6 handling in the Host Country. There is no regulation in the Host Country to require any specific treatment of the SF_6. SFK has Permission to Manufacture High Pressure Gases and complies with the SF_6 manufacturing Law of the Host Country where venting is not prohibited by legislation and neither reclamation nor incineration is required.

In conclusion of step 1, the following two alternatives are plausible and in compliance with mandatory laws and regulations:

- *Alternative 1: Continuation of current practice where used SF_6 gases are vented to the atmosphere at the testing facility after high power tests are performed to GIEEs.*
- *Alternative 3: Capture and reclamation of used SF6 at the chosen SF6 reclamation site (the project activity without CDM).*

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

CDM Consideration

The CDM start date of the project activity is earlier than the date of publication of the PDD for global stakeholder consultation. Therefore, in accordance with the "Guidance on the demonstration and assessment of prior consideration of the CDM", it is explained below a) how the benefits of the CDM were seriously considered prior to that date and b) what steps were taken by the project developer after that date to secure CDM status.

Prior to development of the project activity, the project developer has considered CDM as part of its revenue. This can be proven with the signing of a Letter of Commitment (LOC) with carbon finance company EcoSecurities dated 12th of October 2007.Project implementation started with the Purchase Orderfor the purchase of key equipment on November 2007. The proposed project required a new CDM methodology and the approval process started with the submission of NM0251 on the 19th of November. The detailed activities to prove early CDM consideration are presented in Table B.5.1.

Table B.5.1. Schedule of the Proposed CDM Project

Activities	Date
Discussion between SFK and consultancy 'N.Serve' about CDM opportunities for SF6 recycling	7th October 2004
Presentation by consultancy 'RCC'	30th May 2006
Meeting KERI – SFK	25th September 2006
Quotation issued for SF_6 Compressor	18th January 2007
Email from SFK to Solvay HQ with summary CDM proposal	20th April 2007
Letter of Commitment between EcoSecurities and SFK[10] (***CDM Consideration***)	12th October 2007
Submission of New Methodology (NM0251)[11]	19th November 2007
Quotation for the Project Equipment (Compressor)[12]	19th November 2007
Signed Purchase Order (PO) for the Project Equipment (Compressor)[13] (***Starting Date of the CDM Project Activity***)	23rd November 2007
CDM Budget Approval for 2008	7th January 2008
Preliminary Recommendation from the Methodology Panel[14]	8th February 2008
ERPA Signed between EcoSecurities and SFK[15]	19th March 2008
Start of SF_6 Recovery at KERI site[16]	2nd June 2008
Methodology Approval (AM0079)[17]	25th March 2009

STEP 2. Barrier Analysis

The main barrier faced by alternative 1 is the lack of financial attractiveness, hence an investment analysis is used rather than a barrier analysis.

STEP 3. Investment Analysis

In accordance with the "Combined tool to identify the baseline scenario and demonstrate additionality", an investment comparison analysis is used to compare the two alternatives remaining after STEP 2. Since

[10] See reference 1-4 in LIST OF , Annex 6
[11] https://cdm.unfccc.int/methodologies/PAmethodologies/publicview.html?meth_ref=NM0251
[12] See reference 1-5 Purchase Order (PO) made by Solvay Fluor Korea Co., LTD to DILO Armaturen und Antagen GmbH dated 19th November 2007 but signed 23rd November 2007
[13] See reference 1-5 Purchase Order (PO) made by Solvay Fluor Korea Co., LTD to DILO Armaturen und Antagen GmbH dated 19th November 2007 but signed 23rd November 2007
[14] https://cdm.unfccc.int/methodologies/PAmethodologies/publicview.html?meth_ref=NM0251
[15] See reference 1-6 in LIST OF , Annex 6
[16] See reference 6-1 in LIST OF , Annex 6
[17] https://cdm.unfccc.int/EB/046/eb46rep.pdf

Alternative 3 does not have any revenues, the financial indicator used for each alternative is the Net Present Value (NPV) of the project cash flows.

Calculation and comparison of financial indicators

Table B.5.2 summarises the main parameters used in the investment analysis with the conservative assumption that the equipments/piping will be retained for the whole project lifetime (20 years).

Table B.5.2. Main parameters used in the investment analysis.

Parameter	Value	Units	Source
Amount of used SF_6 reclaimed	9,713	Kg	Project Supplier
Assumed percentage of SF_6 in contaminated gas (by mass)	99.77%	%	Project Developer
Depreciation	20%	% p.a.	National Standard[18]
Exchange Rate	923	KRW to USD	Project Developer[19]
Income tax	25%	%	National Standard[20]
Investment Cost SFK Site: Piping Filter KERI Site: DILO Compressor Piping Price of 10 Cylinders	 52,828 10,834 53,629 21,253 38,140	USD	 Technology Suppliers[21]
Operating Cost: Labour (SFK) Labour (KERI) Laboratory Transport Chemicals for SF_6 Purification Additional Operational Costs for Reprocessing Used SF_6	 23,969 5,992 1,941 8,667 2,165	USD	SFK[22]
Savings on SF_6 raw materials at reclamation site[23]	25,788	USD	SFK[24]

[18] See reference 7-19 in LIST OF , Annex 6
[19] See reference 7-24 in LIST OF , Annex 6
[20] See reference 7-20 in LIST OF , Annex 6
[21] See references 7-8, 7-9, 7-10, 7-11, and 7-12 in LIST OF , Annex 6
[22] See references 7-1, 7-2, 7-3, 7-4, in LIST OF , Annex 6

[23] The savings are related to the amount of Energy (Such as steam and Electricity) consumed in the electrolysis and reaction phases (see figure A.4.3.1 for more details of the process) and raw materials (such as Sulphur, AHF, the source or Fluor) for all the amount of SF6 reclaimed (taking into consideration the purified SF6).

Discount rate	9.26%	%	After-tax Weighed Average Cost of Capital (WACC) for Solvay SA at time of decision-making[25].

Table B.5.3 presents the results of the financial analysis for the both alternatives. Detailed calculations are given in Reference "SFK_FinancialAnalysis". Alternative 1 (continued venting) has a null NPV because it doesn't incur any additional cost or revenues. Alternative 3 (project activity) has a negative NPV ((without CDM), showing that it is not financially viable).

Table B.5.3. Summary of project investment analysis without and with CDM financing[26].

Alternative	Alternative 1 (continued venting)	Alternative 3 (project activity)	
		With CDM	Without CDM
NPV (USD)	0	7,476,622	(320,803)
Discount rate used	9.26%		

Sensitivity analysis

The objective of the sensitivity analysis is to assess whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. Key financial parameters have been changed to see their impact on the NPV of the project, i.e. alternative 3 (the NPV of alternative 1 remains at zero whatever the assumptions). The table below shows the percentage by which each of these variables would have to increase or decrease for the NPV to become positive (i.e. above that of alternative 1). It is explained below why these variations are not realistic for the input parameters of the financial analysis.

Table B.5.4 Results of the sensitivity analysis[27].

Scenario	% Change	NPV of alternative 3 (project activity) (USD)
Increase in Project Revenue (i.e. Recovered Used SF_6)	155.46%	0.00
Reduction in Investment Costs (i.e.DILO Compressor)	-184.83%	0.00
Decrease in Operating Costs (i.e. Labour Costs in SFK)	-93.81%	0.00

Project revenue: Project revenues come from the savings on raw materials (sulphur and AHF) and energy (electricity and steam) achieved by injecting used SF_6 rather than producing it from raw materials.

[24] Calculated. See reference "SFK_FinancialAnalysis"
[25] See reference 7-25 in LIST OF , Annex 6
[26] See reference "SFK_FinancialAnalysis".
[27] See reference "SFK_FinancialAnalysis".

The project activity does not result in an increase in production capacity at Solvay plant and hence there is no revenue from additional SF_6 production. Solvay is currently not operating at full capacity because of low demand of SF_6.

Project revenues are therefore dependent on:

- The savings realised per tonne of used SF6 injected. These are not likely to increase because this savings is dependent on the price of raw materials to produce SF6 which is also dependent on the price of SF_6 in the market. The average prices of SF6 have remain within the same range from 2007 to 2009 (9.5-10.5 USD)[28] which means that the price of raw material (i.e. AHF and S) will also remain at a certain range, thus, increasing the project revenue beyond the variation presented in the table above is unlikely.
- The amount of used SF6 injected. Increasing the volume of used SF_6 is not likely to happen because it is dependent on how much gas is used for the testing of GIEEs at KERI. This is currently estimated at 9.7 tonnes per year only based on the recovery records for the period July 2008 to March 2009. More used SF_6 could be recovered if more equipment was tested at KERI but there is no indication of such link as modern GIEEs tend to use less SF_6 to comply with the demands of end users.

Investment costs: Investment costs of the project comprise of the equipments and pipings installed both at the testing facility and the reclamation facility.

A decrease of around 184% in investment costs is very unlikely to happen, as the scenario used is very conservative (e.g. it has been assumed that equipments/piping will be retained for the project lifetime while it is expected that some equipment will have to be replaced because of potential corrosive impacts of SF_6).

Operating costs: Operating costs of the project comprise of labour costs in KERI and SFK, laboratory analysis of used SF_6, transport of used SF_6 from KERI to SFK, chemicals needed for the purification of used SF_6, additional operational costs for reprocessing used SF_6 and insurance.

The result of the sensitivity analysis means that even if the project reduces operating costs to almost zero (reduction of more than 90%), the NPV of the project remains negative. This is not feasible given the maintenance regime required on the equipments and qualified personnel required to ensure the adequate operations involved in the recovery and reclamation of used SF_6 in the project.

This sensitivity analysis clearly shows that the NPV of alternative 3 (project activity) remains negative, i.e. lower than that of alternative 1 (continued venting), for any realistic variation of the key variables. Therefore alternative 1 is identified as the baseline scenario due to its higher economic attractiveness.

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[28] See reference 7-28 in LIST OF , Annex 6.

STEP 4. Common Practice Analysis

The common practice analysis considered whether similar activities are occurring. Similar activities are defined as those taking place on a similar scale, in a comparable environment with respect to the regulatory framework and are undertaken in the relevant geographical area. The relevant geographical area is defined as South Korea, Japan and Taiwan, since all the equipment tested at KERI in 2007 came from one of these locations. Testing facilities that utilise SF_6 gases and located in this area are listed in Table B.5.5. Since Japan is an Annex 1 country, activities there cannot be considered to exist in a comparable environment; as a result, its facilities are excluded from consideration. Testing facilities that are not accredited for high-power testing are excluded, since these do not routinely undertake tests that contaminate SF_6. This therefore excludes the Power Testing & Technology Institute (Korea), which is affiliated with LS Industrial Systems. It has high-power testing capabilities, but uses this for product research and not independent, third party testing. Its scale of operation is small and not comparable to the project site.

Table B.5.5. Testing Facilities that utilise SF_6 gases in the relevant geographical area

Name	Location	Similar?	Comments
KERI– Korea Electrotechnology Research Institute	Korea - Changwon	Project site	www.keri.re.kr
PT&T Power Testing & Technology Institute	Korea	Excluded – Not Accredited High Power Testing Facility	http://eng.lsis.biz/rnd/rnd_02.asp
Mitsubishi Electric Corporation High Power Testing Laboratory	Hyogo, Japan	Excluded – regulatory framework	
Toshiba Corporation Hamakawasaki High Voltage and High Power Testing Laboratory	Kanagawa, Japan	Excluded – regulatory framework	http://www.toshiba.co.jp/f-ene/hvhp/english/index.htm
Central Research Institute of Electric Power Industry High Power Testing Laboratory, Electric Power Engineering Research Laboratory	Kanagawa, Japan	Excluded – regulatory framework	http://criepi.denken.or.jp/jp/hptl/index.html
NGK High Voltage Laboratory	Japan	Excluded – regulatory framework, not High Power Testing Facility	www.ngk.co.jp
Taiwan Electric Research & Testing Center	Taiwan	Excluded – Not High Power	www.tertec.org.tw/_english/index.htm

		Testing Facility	

In conclusion, after excluding the testing facilities that are not similar to the project facility, KERI is the only third party independent High Power High Voltage Testing Facility in the relevant geographical area that is using and venting SF_6 gas. There is only one facility in the Host Country that manufactures SF_6 gases and only one facility that is planning to introduce a reclamation process (in both cases, the project developer). The proposed project activity is the first SF_6 reclamation activity in the Host Country. As no similar activities to the project can be observed, step 4 is satisfied and the proposed project activity is additional.

Conclusion of Additionality Analysis
The analysis presented above shows that the proposed Project is additional due to its negative NPV (without considering CDM revenue), the absence of similar activities and the robust evidence of prior consideration of the CDM.

The baseline scenario identified is alternative 1: Continuation of current practice where used SF_6 gases are vented to the atmosphere at the testing facility after high power tests are performed to GIEEs.

B.6 Emission reductions

B.6.1. Explanation of methodological choices:

<u>Baseline emissions</u>

Step I. Baseline venting of SF_6

SF_6 relative cap

Baseline emissions are capped relative to the historic venting of SF_6, $V_{SF6,hist}$, which is estimated ex-ante.

Sub-Step 1(a): Determine $V_{SF6,hist}$ (historical annual venting of SF_6)

To determine the estimated historical annual SF_6 venting ($V_{SF6,hist}$) of the SF_6 recovery site, the most recent one year historical data was used, in this case calendar year 2007. $V_{SF6,hist}$ is calculated as the sum of the used SF_6 gas vented for each testing item t in the historical year. $V_{SF6,hist}$ is to be calculated *ex-ante*; and it is to be updated each year according to the monitoring of $w_{SF6,BL,y}$.

$$V_{\mathrm{SF6,hist}} = w_{SF6,BL,y} \sum_i TI_{SF6,used,t}$$

$V_{SF6,hist}$	Historical annual venting emissions of SF_6, in tonnes SF_6
$TI_{SF6,used,t}$	Used gas vented during eligible testing item *t*, tonnes gas (see Sub-step 1(b)
$w_{SF6,hist}$	Concentration of SF_6 expected in used gas in the historical period, tonnes

SF_6/tonnes gas

Sub-Step 1(b): Determine $TI_{SF6,used,t}$ (used gas vented during eligible testing items t)

Method 2, Reconstruction based on Manufacturer Specification/ Nameplate or estimated equipment capacity is applied to determine the used SF_6 gas vented, $TI_{SF6used,t}$, for each testing item *t*. The procedure is described in Annex A of AM0079. A database that complies with the requirements of Annex A was prepared and is summarised in Annex 3. The Annex A default *Decision flow chart for the destination of removed SF_6* has been used. In addition, based on '*Step 3: Establish SF_6 capacities*' of Annex A, a mixed approach has been followed to estimate the SF_6 capacities of the tested equipments. Where it was possible to identify the nameplate capacity that number was used. In the remaining cases the default values of Table B.1 and B.2 in Annex B of AM0079 were used. From a total of 56 equipments tested in 2007, 19 tests are calculated with the nameplate capacity and the rest with the default values.

Step 2. Annual SF_6 reclamation during the project activity

The amount of SF_6 reclaimed as a result of the project activity shall be monitored annually. For this purpose, monitored data from project year *y* to determine SF_6 reclaimed in that year shall be used. Given the nature of the project activity, the unit used as a basis for calculation is the recovery-reclamation cylinder *i*. Note that recovery-reclamation cylinder *i* refers to each cycle that a cylinder goes through (i.e. from the moment the cylinder is taken to the recovery site until the moment the gas contained in the cylinder has been injected into the reclamation facility) and not the physical cylinder. The Project uses bundles of two interconnected gas cylinders as its unit of transport; therefore one cylinder *i* for the purposes of the methodology refers to a "bundle", or two connected physical cylinders, also referred to as the "cylinder bundle".

Only those cylinder bundles that complete the recovery-reclamation process in year *y* can be included in the calculation of emissions avoided in year *y*. If a recovery cylinder bundle has not completed the recovery reclamation process in the crediting year *y*, then it must be included in the year *y+1*. The emissions avoided in year *y* from each cylinder *i*, $CA_{i,y}$ is determined ex-post based on the minimum among the following:

$MR_{Gas,i,y}$	Mass of used gas recovered into cylinder *i* at the SF6 recovery site in year y
$MS_{Gas,i,y}$	Mass of used gas stored in recovery cylinder *i* in year y, tonnes gas
$MI_{Gas,i,y}$	Mass of used gas from cylinder *i* which is injected for reclamation process in year y, tonnes gas
i	Sub-index used for each cylinder that completed a recovery-reclamation cycle included in the estimation of emissions avoided for the year y

The minimum of the three is taken to determine the cylinder minimum for each cylinder *i*:

$CA_{i,y} = MIN\ \{ MR_{Gasi,}\ , MS_{Gas,i,y,} MI_{Gas,i,y}\}$ 2

Where,
$CA_{i,y}$ Cylinder minimum for cylinder *i* in year y, tonnes gas

To determine the quantity of SF_6 reclaimed during the year *y*:

$$EA_y = \sum_i CA_{i,y} * w_{SF6,i}$$

Where,
EA_y Quantity of SF_6 reclaimed during the year *y*, tonnes SF_6
$w_{SF6,i}$ Concentration of SF_6 in the cylinder *i*, tonnes SF_6/tonnes gas

Step 3. Establish the discount factor for number of testing

The cylinder minimum obtained as per Step 2 shall be discounted for any possible increase in the number of testing per equipment compared with the historic baseline period. In order to address this, the following steps shall be taken.

Sub-step 3 (a)

Define the maximum number of equal range, in kV, categories that contain at least 5 equipments both of the historic and project samples. In the proposed project, there are 56 equipments for 2007 that were tested. The capacity of these equipments ranges from 72kV to 800kV and organized in the following two *k* categories. Two categories have been defined because this is the maximum number for which each category contains at least 5 equipments.

	Historic	**Project**
12 – 405 kV	46	46
406 – 800 kV	10	10
Total number of tested equipment	56	56

For the *ex-ante* estimation, it is assumed that the number of testing items over a project year would be similar as the number of testing items under a baseline year.

Sub-step 3 (b)

The average number of eligible testing items where venting occurred per equipment in category k in the baseline ($NT_{BL,k}$) are derived by using the database compiled when determining $TI_{SF6,used,t.}$

Sub-step 3 (c)

The average number of total testing items where recovery was done per equipment in the project in category *k* in the year *y*, ($NT_{PJ,k,y}$) are derived by using the testing records from the project year. For the *ex-ante* estimation, it is assumed that the number of total testing items in the project scenario is the same with the number of total testing items in the baseline scenario.

Sub-step 3 (d)
Ratio of number of eligible testing items for each category *k* is calculated as follows:

$$RT_{k,y} = \frac{NT_{BL,k}}{NT_{PJ,k,y}}$$

Where,

$RT_{k,y}$	Ratio of number of eligible testing items in category *k* (maximum value is set at 1)
$NT_{BL,k}$	Average number of eligible testing items where venting occurred per equipment in the baseline, for category *k*
$NT_{PJ,k,y}$	Average number of total testing items where recovery was done per equipment in the project, for category *k*

Discount factor for testing, DFT_y will be obtained via the formulae below,

$$DFT_y = \frac{\sum_k (Q_{SF6,k,y} * RT_{k,y})}{Q_{SF6,y}}$$

$$Q_{SF6,k,y} = \sum_j Q_{SF6,k,j,y}$$

$$Q_{SF6,y} = \sum_k Q_{SF6,k,y}$$

Where,

DFT_y	Discount factor for testing in year y
$Q_{SF6,k,y}$	Total amount of SF_6 filled in the testing of equipments in category *k* in year *y*, tonnes SF_6
$Q_{SF6,y}$	Total amount of SF_6 filled in testing of all equipments in the project activity in year y, tonnes SF_6
$RT_{k,y}$	Ratio of number of eligible testing items in category *k* (maximum value is set at 1)
$Q_{SF6,k,j,y}$	Amount of SF_6 that is filled into equipment *j* of category *k* in year *y* at the SF_6 recovery site, tonnes SF_6

Step 4. Calculate the baseline emissions
Calculate baseline emissions as the minimum between the quantity of SF_6 reclaimed during the year *y*, discounted for number of testing and the best estimate of historical annual venting emissions $V_{SF6,hist}$, determined in Step 1.

$$BE_y = MIN\{V_{SF6,hist}, DFT_y * EA_y\} * GWP_{SF6}$$

Where,

BE_y	Baseline emissions year y, tCO_2e
DFT_y	Discount factor for testing in year y
EA_y	Quantity of SF_6 reclaimed during the year y, tonnes SF_6
$V_{SF6,hist}$	Historical annual baseline venting of SF_6, tonnes SF_6
GWP_{SF6}	Global warming potential of SF_6, tCO_2e / tonnes SF_6

Project emissions

Step I: Used SF_6 emitted during reclamation

Project participants shall identify all plausible point in the production line of SF_6, after the point of injection of used SF_6, where SF_6 gas is emitted (for example, a purge gas outlet), and provide the historical SF_6 loss rate per unit SF_6 produced from that point *j* based on a 3-year historical average data of the SF_6 production facility. Where 3 year data does not exist, shorter periods can be used, up to the point where data is available, as follows.

$$R_{SF6,hist,j} = \frac{L_{SF6,hist,j}}{P_{SF6,hist}} \quad \textbf{(7)}$$

$R_{SF6,hist,j}$	=	Historical rate of SF_6 loss from point *j*, %
$L_{SF6,hist,j}$	=	Historical amount of SF_6 loss from point j, tonnes SF_6
$P_{SF6,hist}$	=	Production of SF_6 during the historical period, tonnes SF_6
j	=	Sub-index used for SF_6 emission points

The SF_6 emissions through the point(s) *j* should be monitored during the project activity, and the corresponding rate of loss per unit SF_6 produced, $R_{SF6,y,j}$, should be determined. $R_{SF6,y,j}$ and $R_{SF6,hist,j}$ must both be determined under the same measurement protocol, which must be in place.

$$R_{SF6,y,j} = \sum_i \frac{L_{SF6,y,j,i}}{P_{SF6,y,i}} \quad \textbf{(8)}$$

$R_{SF6,y,j}$	=	Rate of SF_6 loss from point *j* in year *y*, %
$L_{SF6,y,j,i}$	=	Amount of SF_6 loss from point *j* during the reclamation period of cylinder *i* in year *y*, tonnes SF_6
$P_{SF6,y,i}$	=	Production of SF_6 during the reclamation period of cylinder *i*, in year *y*, tonnes SF_6
j	=	Sub-index used for SF_6 emission points

At the end of each year of the project activity, compare the $R_{SF6,y,j}$ with the $R_{SF6,hist,j}$. If $R_{SF6,y,j}$ is larger than $R_{SF6,hist,j}$, project emissions from the emission of SF_6 during reclamation in the year *y* shall be calculated by the following equation:

$$PE_{RCL,y} = GWP_{SF6} * \sum_{j,i} (R_{SF6,y,j,i} - R_{SF6,hist,j}) * P_{SF6,y,i} \quad \textbf{(9)}$$

$PE_{RCL,y}$	=	Project emissions from the emission of SF_6 during reclamation in the year *y*, tCO_2e
GWP_{SF6}	=	Global warming potential of SF_6, tCO2e / t SF6
$R_{SF6,y,j,i}$	=	Rate of SF_6 loss from point *j* during the reclamation period of cylinder *i*, in year *y*, %
$R_{SF6,hist,j}$	=	Historical rate of SF_6 loss from point *j*, %
$P_{SF6,y,i}$	=	Production of SF_6 during reclamation period of cylinder *i* in year *y*, t SF6

Step II. Electricity use of recovery equipment

Emissions as a result of electricity consumption at the testing facility ($PE_{TF,y}$) and reclamation facility ($PE_{RF,y}$) due to the use of recovery equipment shall be taken into account, according to "Tool to calculate baseline, project and/or leakage emissions from electricity consumption". Since emissions due to electricity consumption of these facilities are assumed to be small, electricity consumption will be approximated by the rated capacity of the operating equipment multiplied by operating hours of the facility.

Scenario A: Electricity consumption from the grid applies.

$$PE_{EC,y} = \sum_{j} EC_{PJ,j,y} * EF_{EL,j,y} * (1 + TDL_{j,y})$$

$PE_{EC,y}$	=	Placeholder for $PE_{TF,y}$ and $PE_{RF,y}$
$PE_{TF,y}$	=	Project emissions as a result of increased electricity consumption at the testing facility attributable to project activity in year *y*
$PE_{RF,y}$	=	Project emissions as a result of increased electricity consumption at the reclamation facility attributable to project activity in year *y*
$EC_{PJ,k,y}$	=	Quantity of electricity consumed by the project electricity consumption source *j* in year *y* (MWh/yr)
$EF_{EL,j,y}$	=	Emission factor for electricity generation for source *j* in year *y* (tCO2/MWh)
$TDL_{j,y}$	=	Average technical transmission and distribution losses for providing electricity to source *j* in year *y*
j	=	Sources of electricity consumption in the project, *j* = TF, RF
y	=	Year

Option A2 is selected for $EF_{EL,j,y}$, a conservative default value of 1.3 tCO_2e/MWh is applied, since Scenario A applies only to project electricity consumption sources but not to baseline electricity consumption sources.

Step III. Exceptional Project Emissions

It is unlikely but not impossible that an exceptional event at the SF_6 reclamation site, for example an accident or emergency plant shutdown, could lead to the emission of SF_6 injected for reclamation. The project participant must record the date and time of any such exceptional event that occurs in year *y* that results in the exceptional emission of SF_6. The SF_6 quantity ($EXC_{SF6,y}$) from any reclamation that coincides with the event must be considered as project emissions ($PE_{EXC,y}$). For example, if a recovery cylinder of used gas was being reclaimed when the event occurred, then the amount of gas extracted from the cylinder between 5 hours prior to the exceptional event and the time that the injection line was closed must be considered as $EXC_{SF6,y}$.

$$PE_{EXC,y} = GWP_{SF6} \times EXC_{SF6,y}$$

Where,

$PE_{EXC,y}$	Project emissions from exceptional event(s) at the SF_6 reclamation site in year *y*, tCO_2e
GWP_{SF6}	Global warming potential of SF_6, tCO_2e / tSF_6
$EXC_{SF6,y}$	Quantity of SF_6 which was being injected to the reclamation facility during exceptional events occurred in year *y*, tonnes SF_6

Step IV. Total Project Emissions

The project emissions in year y are the sum of the potential sources.

$$PE_y = PE_{RCL,y} + PE_{TF,y} + PE_{RF,y} + PE_{EXC,y}$$

Where,

PE_y	Project emissions in year *y*, tCO_2e
$PE_{RCL,y}$	Project emissions from emission of SF_6 during reclamation in year *y*, tCO_2e
$PE_{TF,y}$	Project emissions as a result of increased electricity consumption at the testing facility attributable to project activity in year y, tCO_2e (refer the “data monitored” section)
$PE_{RF,y}$	Project emissions as a result of increased electricity consumption at the reclamation facility attributable to proejct activity in year y, tCO_2e (Refer the “data monitored” section)
$PE_{EXC,y}$	Project emissions from exceptional event(s) at the SF_6 production facility in year *y*, tCO_2e

Leakage

Leakage emissions attributable to the project activity could result from:
Transportation of the cylinders from the SF_6 recovery site to the SF_6 reclamation site ($LE_{trans,y}$)

When the estimated leakage emissions fulfil the following condition,

$$\frac{(LE_{Trans,est})}{BE_y - PE_y} \leq 0.1\%$$

Then the leakage emissions associated with the Project are deemed to be negligible compared to the range of uncertainty of the GWP estimate, and they can be ignored during the crediting period ($LE_y = 0$).

Otherwise, the formula below is used to calculate LE_y

$LE_{Trans,est}$	Estimated annual emissions from transport of the cylinders from the SF_6 recovery site to the SF_6 reclamation site, tCO_2e based on the “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion”

$$LE_y = LE_{Trans,y}$$

LE_y	Leakage emissions in year *y*, tCO_2e
$LE_{Trans,y}$	Emissions from transport of the cylinders from the SF_6 recovery site to the SF_6 reclamation site in year y, tCO_2e

Emissions reductions

The emission reductions in each year of the project activity are the baseline emissions minus any project emissions and leakage emissions.

$$ER_y = BE_y - PE_y - LE_y$$

ER_y	Emission reductions due to the project activity in year *y*, tCO_2e
BE_y	Baseline emissions year *y*, tCO_2e
PE_y	Project emissions in year *y*, tCO_2e
LE_y	Leakage emissions in year *y*, tCO_2e

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

Parameter:	**GWP_{SF6}**
Data unit:	tCO_2e/tSF_6
Description:	Global warming potential of SF_6
Source of data used:	IPCC 2nd assessment report
Value applied:	23,900
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC 2nd assessment report
Any comment:	Shall be updated according to any future COP/MOP decisions

Parameter:	**-**
Data unit:	MW
Description:	Rated capacity of the operating equipment used for project activity of the testing facilities at recovery site and reclamation site in year y
Source of data:	Records at recovery and reclamation sites
Value applied:	At recovery site = 0.0169; At reclamation site = 0.000006
Justification of the choice of data or description of measurement methods and procedures actually applied:	At recovery site, corresponds to Total capacity of following corresponding equipments, 1. Two Compressors – 10kW 2. Suctioning Pump – 0.6 kW 3. Vaccum Pump – 1.5kW 4. Evaporator – 4.8kW Total: 16.9kW = 0.0169MW At reclamation site, corresponds to following equipment, 1. One flowmeter – 6 W
Any comment:	-

Parameter:	**$EF_{elec,j,y}$**
Data unit:	tCO2e/MWh
Description:	Emissions factor for electricity consumed by process “j” in year “y”
Source of data:	
Value applied:	1.30
Justification of the choice of data or description of measurement methods and procedures actually applied:	Tool to calculate baseline, project and/or leakage emissions from electricity consumption Emission factor of grid electricity in Korea is around 0.56tCO2e/MWh. Hence, 1.3 is considered to be a conservative assumption Value to be fixed during all the crediting period
Any comment:	All the “*j*” processes consume electricity from the same source, thus the same value applies to all the processes “*j*”. “*j*’ = TF (test facility) or RF (Reclamation facility). All the years “y” of the crediting period will apply the same value presented here.

Parameter:	**$TDL_{j,y}$**
Data unit:	-
Description:	Average technical transmission and distribution losses for providing electricity to source j year y
Source of data:	
Value applied:	20%
Justification of the choice of data or description of measurement methods and procedures actually applied:	Tool to calculate baseline, project and/or leakage emissions from electricity consumption Since Scenario A applies for calculating project emission sources, default value of 20% is applied
Any comment:	-

Parameter:	**$TI_{SF6,used,t}$**
Data unit:	tonnes gas
Description:	Used gas vented during eligible testing item t for the historical baseline year
Value applied:	6.9452
Source of data:	records of the SF_6 recovery site
Justification of the choice of data or description of measurement methods and procedures actually applied:	Method 2: Followed procedures described in Annex A and provided all "CDM Records" as required by the procedure Testing records with amount of used gas vented (using default and equipment name plate values) for the total eligible testing items per receipt number are available for the calendar year 2007 summarised in Table 3.1, Annex 3. Sample analysis of tests using default capacity and nameplate capacity can be found in Annex 3.
Any comment:	When using manufacturer specification/nameplate as the source of SF6 capacity, manufacturer specifications imply the minimum gas required to meet equipment performance requirements. Consequently, the use of this method implies a low estimate. Therefore uncertainty of the SF6 quantity per equipment is low

Parameter:	**Decision flow chart for the destination of removed SF_6 specific for the project**
Data unit:	Dimensionless
Description:	A decision flow chart to determine instances where used gas was legitimately vented in the past
Value applied:	AM0079 version 2 "Default decision making flow chart"
Source of data:	
Justification of the choice of data or description of measurement methods and procedures actually applied:	Default applied
Any comment:	-

Parameter:	***k***
Data unit:	Dimensionless
Description:	Sub-index used for equipment categories
Value applied:	Two categories: i) 12-405 kV and ii) 406-800 kV
Source of data:	N/A
Justification of the choice of data or description of measurement methods and procedures actually applied:	Equipment is assigned to a category according to historical testing records of the equipment voltage rating, for the year 2007.
Any comment:	-

Parameter:	$NT_{BL,k}$
Data unit:	Dimensionless
Description:	Average number of eligible testing items where venting occurred per equipment in the baseline, for category *k*
Source of data:	Records of the SF_6 recovery site
Value applied:	For k category 12 - 405kV: 2.76 For k category 406 - 800 kV: 1.90
Justification of the choice of data or description of measurement methods and procedures actually applied:	Used the database compiled when determining $TI_{SF6,used,t}$ summarised in Annex 3. For each equipment in the database, the equipment was assigned to a category *k* and the number of eligible testing items where venting occurred for each equipment was counted.
Any comment:	-

Parameter:	$LE_{Trans,est}$
Data unit:	tCO_2e
Description:	Estimated annual emissions from transport of the cylinder bundles from the SF_6 recovery site to the SF_6 reclamation site
Source of data:	Project proponent
Value applied:	0.59
Justification of the choice of data or description of measurement methods and procedures actually applied:	Estimated based on the Tool to calculate project or leakage CO2 emissions from fossil fuel combustion
Any comment:	-

Parameter:	EF_{diesel}
Data unit:	tCO_2e/GJ

Description:	Diesel Emission Factor
Source of data:	IPCC 2006
Value applied:	0.0741
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	-

Parameter:	**NCV_{diesel}**
Data unit:	GJ/T
Description:	Coefficient of diesel
Source of data:	IPCC 2006 Energy Volume 2
Value applied:	43.00
Justification of the choice of data or description of measurement methods and procedures actually applied:	-
Any comment:	-

Parameter:	**$FC_{i,j,y}$**
Data unit:	Tonnes
Description:	Is the quantity of fuel type i combusted in process j during the year y
Source of data:	Project proponent
Value applied:	0.19
Justification of the choice of data or description of measurement methods and procedures actually applied:	Calculated as described in section B.6.3
Any comment:	-

Parameter:	$L_{SF6,hist,j}$
Data unit:	tonnes SF_6
Description:	Historical amount of SF_6 loss from point j, tonnes SF_6
Source of data:	Records of the SF_6 reclamation site
Value applied:	0.434
Justification of the choice of data or description of measurement methods and procedures actually	Based on continuous flow measurements of gas flow from point *j* and measurements of the SF_6 content of the flow taken daily, 01/11/2007 - 30/06/2008

applied:	
Any comment:	-

Parameter:	$\boldsymbol{P_{SF6,hist}}$
Data unit:	tonnes SF_6
Description:	Production of SF_6 during the historical period, tonnes SF_6
Source of data:	Records of the SF_6 reclamation site
Value applied:	748.608
Justification of the choice of data or description of measurement methods and procedures actually applied:	Production records 01/11/2007 - 30/06/2008
Any comment:	-

Parameter:	***j***
Data unit:	-
Description:	Sub-index used for SF_6 emission points
Source of data:	Technical documents if the SF_6 reclamation site
Value applied:	One SF_6 emission point: purge gas outlet
Justification of the choice of data or description of measurement methods and procedures actually applied:	Demonstrated from SF_6 plant process diagram
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

Baseline emissions

Step I. Baseline venting of SF_6

SF_6 relative cap

Baseline emissions are capped relative to the historic venting of SF_6, $V_{SF6,hist}$, which is estimated ex-ante.

Sub-Step 1(a): Determine $V_{SF6,hist}$ (historical annual venting of SF_6)

The estimated historical annual SF_6 venting ($V_{SF6,hist}$) of the SF_6 recovery site for one year historical data, the data used is from January to December 2007. $V_{SF6,hist}$ is calculated as the sum of the used SF_6 gas vented for each testing item *t* in the historical year. $V_{SF6,hist}$ is calculated *ex-ante*; however, it is to be updated each year according to the monitoring of $w_{SF6,BL,y}$.

Based on the historical data from the recovery site, the following values were computed.

Parameter	Value	Unit
$V_{SF6,hist}$	6.9238	tonnes of SF_6
$\sum TI_{SF6,used,t}$	6.9452	tonnes of gas
$w_{SF6,hist}$	99.69%	SF_6/tonne

As the SF6 recovery does not have records of the concentration of SF6 in the gas vented in the baseline ($w_{SF6,hist}$), $w_{SF6,BL,}$y is used as a substitute in line with the methodology. Concentration of SF6 was determined based on lab-analysis for each cylinder gas. The 50% of cylinder bundles i of gas reclaimed during the first 8 months of the start of the project activity (Cylinder bundles CDM-08001 to CDM-08006 & CDM-09001 collected during 1/06/2008 and 20/01/2009) that represent the most conservative (contaminated) measurements is used for the parameter definition.

Sub-Step 1(b): Determine $TI_{SF6,used,t}$ (used gas vented during eligible testing items t)

To determine or estimate the used SF_6 gas vented, $TI_{SF6,used,t}$, for each testing item *t, Method 2. Reconstruction based on Manufacturer Specification/ Nameplate or estimated equipment capacity* was used. Since SF_6 recovery site does not have monitored data of used gas vented for testing item *t*, $TI_{SF6,BL,t}$ was reconstructed using the procedure described in Annex A of the methodology. Reconstruction of $TI_{SF6,BL,t}$ is presented in Annex 3 of the PDD, where results for each testing item *t* are aggregated per equipment. The reconstruction per testing item t is presented in Table 3.1, Annex 3 of the PDD.

In addition, based on ‘Step 3: Establish SF6 capacities’ of Annex A of the methodology, a mixed approach has been followed to estimate the SF6 capacities of the tested equipments. From a total of 56 equipments tested in 2007, 19 tests are calculated with the nameplate capacity where it was possible to identify the nameplate capacity and the remaining capacities were determined based on default values of Table B.1 and B.2 in Annex B of the methodology.

Step 2. Annual SF_6 reclamation during the project activity

Annual SF6 reclamation during the project activity is the amount of SF6 reclaimed as a result of the project activity and shall be monitored annually ex-post. The calculation of $CA_{i,y}$ for purposes of estimating ex-post Emission Reductions is summarised below, based on the existing reclamation data for the period June 01.2008 to January 20.2009 (8 months):

Bundle / Cylinder No	Recovery mass (recovery site, flow meter) MR_{Gas} [kg]	Recovery mass (recovery site, weighting) MS_{Gas} [kg]	Reclamation (reclamation site, flowemeter) MI_{Gas} kg]	CAi,y (tonnes of gas)	wsf6,i (tonnes of SF6/ tonnes of gas)	EAy [kg]
CDM-08001	657.0	657.0	478	478.0	99.5234%	475.7
CDM-08002	1,139.0	1,139.0	1026	1,026.0	99.9249%	1,025.2
CDM-08003	983.5	983.5	895	895.0	99.8352%	893.5
CDM-08004	1,099.5	1,099.5	1028.59	1,028.6	99.8146%	1,026.7
CDM-08005	1,189.0	1,189.0	845.72	845.7	99.6244%	842.5
CDM-08006	1,162.5	1,162.5	1093.95	1,094.0	99.8412%	1,092.2
CDM-09001	1,198.0	1,198.0	1121.97	1,122.0	99.8030%	1,119.8

For the period June 01.2008 to January 20.2009 (8 months) it is:

SF_6 bundles *i*	**EAy (kg)**
7	6,475.7

For a period of 12 months it is expected that it is:

SF_6 bundles *i*	**EAy (kg)**
10.5	9,713.5

Therefore, EA_y = 9.7135 tonne of SF_6.

Step 3. Establish the discount factor for number of testing

This step applies a one-year data from January 2007 to December 2007 from historical records at KERI consistent with Step 1. This parameter is dependent on a number of eligible testing items where venting occurred per equipment in the baseline, which is determined ex-ante. The cylinder minimum obtained as per Step 2 shall be discounted for any possible increase in the number of testing per equipment compared with the historic baseline period. In order to address this, the following steps shall be taken.

Sub-step 3 (a)
Define the maximum number of equal range, in KV, categories that contain at least 5 equipments both of the historic and project samples. In the proposed project, there are 56 equipments for 2007 that were tested. The capacity of these equipments ranges from 72kV to 800kV and organized in the following two *k* categories.

	Historic	**Project**
12-405 kV	46	46
406-800 kV	10	10
Total number of tested equipment	56	56

For the *ex-ante* estimation, it is assumed that the number of testing items over a project year would be similar to the number of testing items under a baseline year.

Sub-step 3 (b)
The **average** number of eligible testing items where venting occurred per equipment in category k in the baseline ($NT_{BL,k}$) are derived by using the database compiled when determining $TI_{SF6,used,t}$.

Category	Eligible testing items where venting occurred	Average number of eligible testing items where venting occurred per equipment
12-405 kV	127	2.76
406-800 kV	19	1.90

Sub-step 3 (c)

The average number of total testing items where recovery was done per equipment in the project in category *k* in the year *y*, ($NT_{PJ,k,y}$) are derived by using the testing records from the project year. For the *ex-ante* estimation, it is assumed that the number of total testing items in the project scenario is the number of total testing items where venting occurred in the baseline scenario.

Category	Eligible testing items where venting occurs in year y	Average number per equipment in year y
412-405 kV	168	3.65
406-800 kV	21	2.10

Sub-step 3 (d)

The result of the calculation of the ratio of the average number eligible testing items per equipment is shown in the following table.

Category	$NT_{BL,k}$	$NT_{PJ,k,y}$	$RT_{k,y}$
12-405 kV	2.76	3.65	0.756
406-800 kV	1.90	2.10	0.905

Obtain discount factor for testing, DFT_y:

The monitoring of SF_6 filled into the testing equipment has not yet started so the amount of SF_6 captured in the recovery site is used for $Q_{SF6,k,y}$ and Q_{SF6} to compute the discount factor for testing in year y which is shown in the following table.

Category	$Q_{SF6,k,y}$ (tonnes of SF6)	$RT_{k,y}$ (ratio)	$Q_{SF6,k,y}$ * $RT_{k,y}$	Sum	DFTy
12-405 kV	4.857	0.756	3.671	8.066	0.830
406-800 kV	4.857	0.905	4.394		

Step 4. Calculate the baseline emissions

The baseline emissions is calculated as the minimum between the quantity of SF_6 reclaimed during the year, discounted for number of testing, and the best estimate of historical annual emissions $V_{SF6,hist}$, determined in Step 1.

Using the following values:

Parameter	Value	Unit
DFTy	0.830	tonnes of SF_6
EAy	9.714	tonnes of SF_6
$V_{SF6,hist}$	6.924	tonnes of SF_6
GWP_{SF6}	23,900	tCO_2e / tonnes SF_6

BE_y is therefore equal to $V_{SF6,hist}$ * GWP_{SF6} or 6.924 * 23,900 = 165,478 tonnes of SF_6

Therefore,

BE_y = 165,478 tonnes of SF_6

Project emissions

Step 1. Used SF_6 emitted during reclamation

Parameter	Value	Units
$R_{SF6,y,j}$	0.058	%
$L_{SF6,hist,j}$	0.434	tSF_6
$P_{SF6,hist}$	748.608	tSF_6
j	1	N/A
GWP_{SF6}	23,900	tCO_2e/tSF_6

Reclamation Period *i*	*P SF6 y,i*	*L SF6 y,j,i*	*R SF6,y,j,i*
-	tSF6	tSF6	%
1	24.9543	0.011944	0.04786
2	33.7657	0.014834	0.04393
3	32.1086	0.014110	0.04394
4	20.8849	0.037208	0.17816
5	21.2539	0.015994	0.07525
6	20.9923	0.010685	0.05090
7	27.4048	0.016328	0.05958

Parameter	Value	Units
$R_{SF6,y,j}$	0.069	%

$R_{SF6,y,j} > R_{SF6\ hist,j}$

$$PE_{RCL,y} = GWP_{SF6} * \sum_{j,i} (R_{SF6,y,j,i} - R_{SF6,hist,j}) * P_{SF6,y,i} \quad (9)$$

Parameter	Value	Units
$PE_{RCL,y}$	382	tCO_2e

Step 2. Electricity use of recovery equipment
The "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" is applied and $EC_{PJ,j,y}$ is approximated by the rated capacity of the operating equipment multiplied by operating hours of the facility, as permitted by AM0079 version 2.

Calculation of $PE_{TF,y}$
Rated capacity of the operating equipment: project operating equipment at the Testing Facility comprises two Compressors – 10kW; Suctioning Pump – 0.6 kW; Vaccum Pump – 1.5kW; and Evaporator – 4.8kW, or 16.9 kW total.

Operating hours: Estimated as follows:

Quantity of contaminated gas compressed per year	**9,714**	kg of recovered gas/year
Compressor-rate of compression (from technical specification)	**11.40**	m^3/hour
Density of recovered gas (calculated)	**6.149**	kg/m^3
Hours of operation per year	**139**	hours/year

$$PE_{TE,y} = \sum_j EC_{PJ,j,y} * EF_{EL,j,y} * (1 + TDL_{j,y})$$

Rated capacity of all equipment	0.0169	MW
Operating hours	139	Hours
$EF_{EL,j,y}$	1.3	tCO_2e/MWh
$TDL_{j,y}$	20%	-
$PE_{TE,y}$	3.6	tCO_2e/yr
j	Testing Facility	-

Calculation of $PE_{RF,y}$
Rated capacity of the operating equipment: project operating equipment at the Reclamation Facility comprises one mass flowmeter – 6 W.
Operating hours: Conservatively estimated as 8760 hr/yr

$$PE_{RF,y} = \sum_j EC_{PJ,j,y} * EF_{EL,j,y} * (1 + TDL_{j,y})$$

Rated capacity of all equipment	0.000006	MW
Operating hours	8760	Hours
$EF_{EL,j,y}$	1.3	tCO_2e/MWh
$TDL_{j,y}$	20%	-
$PE_{RF,y}$	0.08	tCO_2e/yr
j	Reclamation Facility	-

All the "*j*" processes consume electricity from the same source, thus the same value applies to all the processes. , *j* = TF (test facility) or RF (Reclamation facility). All the years "y" of the crediting period will apply the same EF_{EL} and TDL, as presented above given both parameters are fixed ex-ante.

Step III. Exceptional Project Emissions
As exceptional events cannot be predicted, it is assumed that

$PE_{EXC,y} = 0\ tCO_2e$.

In case an exceptional event occurs, this will be monitored and recorded as required by the methodology and any SF_6 emitted will be counted as project emissions.

Step IV. Total Project Emissions
The project emissions in year y are the sum of the two potential sources.

$$PE_y = PE_{RCL,y} + PE_{TF,y} + PE_{RF,y} + PE_{EXC,y}$$

or PE_y = 382 + 3.6 + 0.08 + 0 therefore PE_y = 386 tCO_2e.

Leakage

$LE_{Trans,est}$, the estimated Leakage Emissions, are estimated according to the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion," as follows:
$LE_{FC,j,y} = \sum FC_{i,j,y} * COEF_{i,y}$

$LE_{FC,j,y}$	=	Are the CO2 emissions from fossil fuel combustion in process j during the year y (tCO2/yr)
$FC_{i,j,y}$	=	Is the quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)
$COEF_{i,y}$	=	Is the CO2 emission coefficient of fuel type i in year y (tCO2/mass or volume unit)

For this estimate, COEFi,y will be calculated using Option B, based on net calorific value and CO2 emission factor of the fuel type i, as follows:
$COEF_{i,y} = NCV_{i,y} * EF_{CO2,i,y}$

$NCV_{,j,y}$	=	Is the weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$	=	Is the weighted average CO2 emission factor of fuel type i in year y (tCO2/GJ)
i	=	Fuel types combusted in process j during the year y

$LE_{FC,j,y}$	0.59	tCO_2e	Calculated
$FC_{i,j,y}$	0.19	t	Calculated
$COEF_{i,y}$	3.19	tCO_2e/ t	Calculated
$NCV_{,j,y}$	**43.00**	GJ/t	IPCC 2006
$EF_{CO2,i,y}$	**0.0741**	tCO_2e/GJ	IPCC 2006
i	**Diesel**	N/A	

$FC_{i,j,y}$ is calculated for the ex-ante estimate as follows:

$$FC_{i,j,y} = \text{11 round trips} * \text{208 km/round trip} * \text{0.1 L/km} * \text{0.85 kg/L / 1000kg/t} = 0.19$$

Vehicle Fuel Consumption (from truck	**0.1**	litres/km	Truck specification

specification)			
Fuel Density (standard fuel density for diesel)	**0.85**	kg/litre	http://en.wikipedia.org/wiki/Diesel_Fuel
Quantity of round trips expected	**11**	-	Estimated from recovery amount
Distance between KERI and SFK sites	**208**	Km (round trip)	GPS

Since

$$\frac{(LE_{Trans,est})}{BE_y - PE_y} = (0.59) / (165,478 - 386) = 0.0004\%, \text{ which is} < 0.1\%$$

The leakage emissions associated with the Project are very marginal as to be negligible compared to the range of uncertainty of the GWP estimate, and they can be ignored during the crediting period.

Therefore,

$LE_y = 0$.

<u>Emissions reductions</u>

The emission reductions in each year of the project activity are the baseline emissions minus any project emissions and leakage emissions.

$$ER_y = BE_y - PE_y - LE_y$$

Where

$BE_y =$ 165,478 tonnes of CO_2e.

PEy = 386 tCO_2e.

$LE_y = 0$ tCO_2e.

Therefore,

$ER_y =$ 165,092 tCO_2e.

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

Years	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of emission reductions (tonnes of CO_2e)
2011	165,478	386	0	165,092
2012	165,478	386	0	165,092
2013	165,478	386	0	165,092
2014	165,478	386	0	165,092
2015	165,478	386	0	165,092
2016	165,478	386	0	165,092
2017	165,478	386	0	165,092
2018	165,478	386	0	165,092
2019	165,478	386	0	165,092
2020	165,478	386	0	165,092
Total (tonnes of CO_2)	1,654,780	3,860	0	1,650,920

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

B.7.1. Data and parameters monitored:

Parameter:	**GWP_{SF6}**
Data unit:	tCO_2e/tSF_6
Description:	Global warming potential of SF_6
Source of data used:	IPCC
Value of data applied for the purpose of calculating expected emission reductions in section B.5	23,900 (for the first commitment period. Shall be updated according to any future COP/MOP decisions)
Description of measurement methods and procedures to be applied:	-
QA/QC procedures to be applied:	-
Any comment:	-

Data / Parameter:	**$w_{SF6,BL,hist,y}$**
Data unit:	tonnes SF_6/ tonnes gas
Description:	Concentration of SF_6 in used gas in the baseline, to be used as a substitute for $w_{SF6,hist}$ where the record of the concentration of SF_6 in the gas vented in the baseline is not available
Source of data to be used:	Laboratory test results
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.9969
Description of measurement methods and procedures to be applied:	Estimated for each project year y using the average concentration of SF_6 in the gas recovered in year y. The 50% of cylinder bundles *i* that represent the most conservative (contaminated) measurements will be used to the parameter definition. The gas sample will be collected every time a cylinder arrives in SFK plant. This sample will be analyzed in SFK laboratory using Gas Chromatography tests in accordance with the internal Standard Operational Procedure (SOP). The detection limit of all the gases analysed will be at least 50 ppm.
QA/QC procedures to be applied:	The SOP uses ASTM D 2685, ASTM D 2029, ASTM D 2284, Din IEC 60376, VDE 0373, ASTM 2472 and/or other sector, national or international Standards.
Any comment:	This variable does not exist in equations, however provided in monitoring table to be used as substitute to the variable $w_{SF6,hist}$, for the cases where the record of the concentration of SF_6 in the gas vented in the baseline is not available

Data / Parameter:	**$Q_{SF6,k,j,y}$**
Data unit:	tonnes SF_6
Description:	Mass of SF_6 that is filled into equipment j of category k in year y at the SF_6 recovery site
Source of data to be used:	Records from the SF_6 recovery site
Value of data applied for the purpose of calculating expected emissions reductions in section B.5:	9.714 The monitoring of SF_6 filled into equipment has not started yet. It is assumed that this will be almost equal with the amount of the SF_6 captured at the recovery site.
Description of measurement methods and procedures to be applied:	To be measured with a mass flow meter, the quantity of gas filled into each equipment *j* tested under the project activity. The equipment will have an accuracy of at least 2%.
QA/QC procedures:	Meter subject to calibration according to sector, national or international Standards
Any comment:	The equipment records associated with the test records are used to determine to which category k the filling measurement corresponds.

Data / Parameter:	**$MR_{Gas,i,y}$**
Data unit:	tonnes gas
Description:	Mass of used recovered into cylinder bundle i at the SF_6 recovery site in year y
Source of data to be used:	Records from the SF_6 recovery site
Value of data applied for the purpose of calculating expected emissions reductions in section B.5:	11.143
Description of measurement methods and procedures to be applied:	To be measured with a mass flow meter, the quantity of gas from the tested equipment going to the recovery cylinder bundle i For each gas recovery associated with cylinder bundle i, the project proponent shall keep records with respect to equipment type, manufacturer, kV voltage rating, equipment compartments, phase, and reference to records that show the test was performed at the request of a client
QA/QC procedures:	Flow meter shall be subjected to calibration according to national or international standards as specified by the manufacturer Data must be recorded in such a way that it can be determined which quantity of gas was recovered for each testing item resulting in SF_6 being recovered.
Any comment:	-

Data / Parameter:	**$MS_{Gas,i,y}$**
Data unit:	Tonnes of gas
Description:	Mass of used gas stored in recovery cylinder bundle *i* in year *y*

Source of data to be used:	Records from SF_6 recovery site
Value of data applied for the purpose of calculating expected emissions reductions in section B.5:	11.143
Description of measurement methods and procedures to be applied:	To be measured with a weighing scale, the net weight of cylinder bundle *i* filled with used SF_6 in the recovery site ready to be transported to the reclamation site
QA/QC procedures:	Weigh scale shall be subjected to calibration according to national or international standards as specified by the manufacturer. Data must be recorded in such a way that it can be determined which quantity of gas was recovered for each testing item resulting in SF_6 being recovered. The monitored values should be kept along with: a) Date and time when the measurement was taken b) Cylinder bundle *i* identification information
Any comment:	-

Data / Parameter:	$MI_{Gas,i,y}$
Data unit:	Tonnes gas
Description:	Mass of used gas from the cylinder bundle i injected into the production process for reclamation process in year y
Source of data to be used:	Records from SF_6 reclamation site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	9.734
Description of measurement methods and procedures to be applied:	To be measured with a mass flow meter measuring the quantity of gas coming from the recovery cylinder bundle *i* to the SF_6 production process (injection)
QA/QC procedures to be applied:	Flow meter shall be subjected to calibration according to national or international standards as specified by the manufacturer Data must be recorded in such a way that it can be determined which quantity of gas was recovered for each testing item resulting in SF_6 being recovered
Any comment:	

Data / Parameter:	$L_{SF6,y,i,j}$
Data unit:	Tonnes SF_6
Description:	Amount of SF_6 loss from point j during the reclamation period of cylinder *i* in

	year *y*
Source of data to be used:	Onsite measurements at the SF_6 reclamation site
Value of data applied for the purpose of calculating expected emissions reductions in section B.5:	See table in section B.6.3
Description of measurement methods and procedures to be applied:	The measurement period is the period in which cylinder *i* is connected for gas reclamation, as measured daily. This parameter will follow the Specific Operational Procedure (SOP) SFK-SOP-CDM-002, where is defined the detailed procedure for measuring it, the responsible for measuring it, the reporting system and the equipment used to measure. Flow measurements of gas flow from point *j* using continuous flow measurements, with accuracy of at least 2% Analyze samples of the gas flow for SF_6 Concentration will be made according using a similar method to the $\mathbf{w_{SF6,i}}$.
QA/QC procedures:	Flow meter shall be subjected to calibration according to national or international standards as specified by the manufacturer. SF_6 content: similar QC/QC procedures as the $\mathbf{w_{SF6,i}}$.
Any comment:	

Data / Parameter:	$P_{SF6,y,i}$
Data unit:	Tonnes SF_6
Description:	Production of SF_6 during the reclamation period of cylinder *i*, in year *y*
Source of data to be used:	Records from regular production monitoring at SF_6 reclamation site
Value of data applied for the purpose of calculating expected emissions reductions in section B.5:	See table in section B.6.3
Description of measurement methods and procedures to be applied:	The measurement period is the period in which cylinder *i* is connected for gas reclamation, as measured in days. Production to be measured daily. The production measurement will follow the Specific Operational Procedure (SOP) SFK-SOP-SF6-086, where is defined the detailed procedure, the responsible for measuring it, the reporting system and the equipments(Level gauge, pressure, temperature of daily tank) used to measure. The accuracy of each monitoring equipment will be at least: • Level gauge : ±50mm • Pressure gauge : ± 0.5% • Temperature : ± 0.5 %
QA/QC procedures:	Existing procedures shall be followed
Any comment:	

Data / Parameter:	***$P_{SF6,y}$***
Data unit:	Tonnes SF_6
Description:	Production of SF_6 during the reclamation year *y*
Source of data to be used:	Records from regular production monitoring at SF_6 reclamation site
Value of data applied for the purpose of calculating expected emissions reductions in section B.5:	*Confidential – provided to validating DOE*
Description of measurement methods and procedures to be applied:	The production measurement will calculated as the sum of PSF6,i,y.
QA/QC procedures:	Existing procedures shall be followed
Any comment:	This parameter is it not utilized in any calculation, but is monitored for reference for fulfilment of the applicability conditions

Data / Parameter:	**$NT_{PJ,k,y}$**
Data unit:	N/A
Description:	Average number of total testing items where recovery was done per equipment in the project, for category *k*
Source of data to be used:	Records from the SF_6 recovery site
Value of data applied for the purpose of calculating expected emissions reductions in section B.5:	For *k* category 12 – 405 kV: 168 For *k* category 406 – 800 kV: 21
Description of measurement methods and procedures to be applied:	Determined by EcoSecurities and/or SFK once annually. Count the number of testing items where gas was recovered for the year y, by referring to the testing records compiled during the project year at the SF_6 recovery site. Count the number of equipment in each category for the year y, by referring to the testing records compiled during the project year at the SF_6 recovery site. For each category *k*, make an average of the counts for equipment in that category to derive $NT_{PJ,k,y}$
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	**i**
Data unit:	N/A
Description:	Sub-index used for each cylinder bundle that completed a recovery-reclamation cycle included in the estimation of emissions avoided for the year y
Source of data to be used:	Records from the SF_6 recovery site and SF_6 reclamation site
Value of data applied	N/A

for the purpose of calculating expected emissions reductions in section B.5:	
Measurement procedures (if any):	Each recovery cylinder bundle should be clearly identified and marked so that it can be uniquely identified and associated with gas recovery operations ($MR_{gas,i}$), gas weight ($MS_{gas,i}$), $w_{SF6,i}$, and gas injected ($MI_{gas,i}$)
QA/QC procedures:	When used gas is filled into a recovery cylinder bundle, weighed, and sent for reclaiming, the activity should be noted using the cylinder bundle identification information
Any comment:	Recovery cylinder bundles must be visibly distinguishable from new gas cylinder bundles. Records from both sites should coincide An individual cylinder bundle may be used more than one time per year, i.e. it may go through the recovery-reclamation process more than once. However, the labelling will show the unique identity of each cylinder bundle as it is involved in one recovery- reclamation process

Data / Parameter:	**n**
Data unit:	N/A
Description:	Number of cylinder bundles that completed a recovery-reclamation cycle in the year *y*. Only these cylinder bundles are eligible to be included in the estimation of emissions avoided for the year *y*
Source of data to be used:	Records from the SF_6 recovery site and SF_6 reclamation site
Value of data applied for the purpose of calculating expected emissions reductions in section B.5:	N/A
QA/QC procedures:	The site will keep records of each cylinder bundle i for which recovery and reclamation has been completed. All individual identification and dates information will be available for a clear definition of each year y the process was finished.
Any comment:	Records from both sites should coincide. In the case in which a cylinder bundle has not completed reclamation in year *y*, it will have to be accounted in year *y+1* as mentioned in Step 2 of baseline emissions

Data / Parameter:	$\mathbf{w_{SF6,i}}$
Data unit:	Tonnes SF_6/ tonnes gas
Description:	Concentration of SF_6 in the cylinder bundle *i*
Source of data to be used:	laboratory test result

Value of data applied for the purpose of calculating expected emissions reductions in section B.5:	CDM-08001 99.5234% CDM-08002 99.9249% CDM-08003 99.8352% CDM-08004 99.8146% CDM-08005 99.6244% CDM-08006 99.8412% CDM-09001 99.8030%
Description of measurement methods and procedures to be applied:	The proportion must be measured for each cylinder bundle of used gas collected, using a laboratory test The gas sample will be collected every time a cylinder arrives in SFK plant. This sample will be analyzed in SFK laboratory using Gas Chromatography tests in accordance with the internal Standard Operational Procedure (SOP). The detection limit of all the gases analyzed will be at least 50 ppm.
QA/QC procedures:	The SOP uses ASTM D 2685, ASTM D 2029, ASTM D 2284, Din IEC 60376, VDE 0373, ASTM 2472 and/or other sector, national or international
Any comment:	Given that the recovery and reclamation process are batch processes, and that the Concentration of SF_6 in the used gas remains constant after recovery and before reclamation, $w_{SF6,c}$ needs to be measured only once per cylinder bundle to determine the proportion of SF_6 in the gas contained in that cylinder bundle. The PDD includes the Annex 5 the specifications for used SF_6

Data / Parameter:	$\mathbf{PE_{TFy}}$
Data unit:	tCO_2e
Description:	Project emissions as a result of increased electricity consumption at the testing Facility attributable to project activity in year *y*
Source of data to be used:	Records from SF_6 testing facility
Value of data applied for the purpose of calculating expected emissions reductions in section B.5:	3.6
Description of measurement methods and procedures to be applied:	Calculated annually Follow the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
QA/QC procedures:	-
Any comment:	Electricity consumption approximated by the rated capacity of the operating equipment multiplied by operating hours of the equipment. If the operating hours of the equipment cannot be precisely defined, a conservative approach of 8760 hours per year will be used.

Data / Parameter:	**PE_{RFy}**
Data unit:	tCO_2e
Description:	Project emissions as a result of increased electricity consumption at the reclamation Facility attributable to project activity in year *y*
Source of data to be used:	Records from SF_6 reclamation facility
Value of data applied for the purpose of calculating expected emissions reductions in section B.5:	0.08
Description of measurement methods and procedures to be applied:	Calculated annually Follow the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
QA/QC procedures:	-
Any comment:	Electricity consumption approximated by the rated capacity of the operating equipment multiplied by operating hours of the equipment. If the operating hours of the equipment cannot be precisely defined, a conservative approach of 8760 hours per year will be used.

Data / Parameter:	**$EXC_{SF6,y}$**
Data unit:	tCO_2e
Description:	Quantity of SF6 which was being injected to the reclamation facility during exceptional events occurred in year y
Source of data to be used:	Records from SF_6 reclamation facility
Value of data applied for the purpose of calculating expected emissions reductions in section B.5:	0
Description of measurement methods and procedures to be applied:	The project proponent must record the date and time of any exceptional event that occurs in year *y* that results in the unusual emission of SF_6 The SF_6 quantity ($EXC_{SF6,y}$) from any reclamation that coincides with the event must be considered as project emissions ($PE_{EXC,y}$) For example, if a cylinder bundle of used gas was being reclaimed when the event occurred, then the total amount of gas from the cylinder bundle between 5 hours prior to the event and until the time that the injection line was shut off must be considered as $EXC_{SF6,y}$. The total amount of gas is to be taken from the continuous measurement of the flow meter on the injection line used to determine $MI_{Gas,i}$
QA/QC procedures:	-
Any comment:	-

B.7.2 Description of the monitoring plan:

The monitoring plan details the actions necessary to record all the data parameters required by the proposed methodology AM0079 version 1.

1. Monitoring organisation

Each of the Project sites, the SF_6 user site (KERI) and the SF_6 reclamation site (SFK), will designate an on-site CDM coordinator. The CDM coordinators will have the overall responsibility for the relevant monitoring of emissions reductions of the project activity according to the monitoring plan. This includes data quality checking for any anomalies. The CDM coordinators will report monthly to their respective senior management. All other technical staff which is involved in the data collection process will have defined roles and responsibilities. Staff will be trained on CDM monitoring requirements. Records of trained CDM staff will be retained. The overall monitoring responsibility for both the SFK and KERI sites will be with the CDM coordinator of the SF_6 reclamation site (SFK).

2. Monitoring equipment

The primary equipment used for the monitoring of CDM parameters project is the following:

(i) Weighing scale: Scales will be used for weighing the cylinders in a bundle both at the SF_6 recovery and reclamation sites. The scales will be appropriately calibrated.

(ii) Flow meter: Flow meters will be used to quantify the SF_6 both at the SF_6 recovery and reclamation sites. The flow meters will be appropriately calibrated.

(iii) Gas chromatograph: The SF_6 content of used gas in each cylinder bundle will be analyzed using gas chromatography. The equipment will be appropriately calibrated

Two cylinders filled with used SF_6 will be transported in one cylinder bundle to the reclamation site with each cylinder bundle clearly identified and marked. Each cylinder bundle will be weighed both at the SF_6 recovery site and the SF_6 reclamation site. Upon arrival at the SF_6 reclamation site, each cylinder bundle will be analysed, to determine the proportion of SF_6 gas and the proportion of impurities.

3. Data and records management

Data monitored for CDM purposes will be recorded once the two cylinders in a bundle is filled with SF_6 and filed electronically. All relevant data will be archived electronically, and backed up regularly. Moreover, it will be kept for the full crediting period, plus two years after the end of the crediting period or the last issuance of CERs for this project activity (whichever occurs later). The electronic files will be

backed up. The CDM Coordinators will be responsible for checking the data quality and will be responsible for managing the collection, storage and archiving of all data and records.

4. Quality Assurance

All data collected will be checked by the CDM coordinators. Procedures will be developed to ensure consistent quality of all data collection, recording, storage, reporting and possible monitoring data adjustments and uncertainties as well as emergencies. EcoSecurities will perform a regular final check of the data and analyse project performance prior to any verification. Moreover, regular internal audits will be conducted to assure that the project is in compliance with operational and CDM requirements.

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

The baseline study and the monitoring methodology were concluded on 22/05/2009. The entity determining the baseline study and the monitoring methodology and participating in the project as the Carbon Advisor is EcoSecurities International Limited. Full contact details can be found in Annex 1.

Detailed baseline and monitoring information is contained in Annexes 3 and 4.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

23/11/2007.

The above date corresponds to the date of signing of ‘Purchase Order for the Project Equipment (Compressor)’[29]. The benefits of the CDM were seriously considered prior to the above starting date as explained in section B.5.

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

20 years 0 months

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

C.2.1. Renewable crediting period

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

[29] See reference 1-5, Annex 6

Not applicable.

C.2.1.2. Length of the first crediting period:

Not applicable.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/01/2011 or the date of registration of the Project, whichever is later

C.2.2.2. Length:

Ten (10) years zero (0) months.

SECTION D. Environmental impacts

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

The implementation of the proposed project activity will cause minimal negative environmental impacts. Any additional piping at the reclamation plant and the testing facility sites will have minimum impacts and will be within existing industrial compounds.

The testing facility does not require any environmental specification to utilise SF_6 gases. There is no legislation in the Host Country that dictates the way SF_6 should be managed in the testing facility and the baseline activity of venting of SF_6 is a legal activity.

The SF_6 reclamation plant has all the necessary permits required by the Host Country regulations (Permit for emissions of Air Pollutants, Permit for non-point waste water Pollutants, and Permit for toxic chemical usage, manufacture and sale).

The project will have very limited impacts in terms of transportation of the SF_6 gas cylinder bundles to the reclamation facility (estimated at around 11 return trips per year).The risk of transporting SF_6 is minimal and is regulated by existing health and safety operational procedures and standards.

The project will have positive environmental impacts:

1. Reduce venting of SF_6 which could lead to a reduction of greenhouse gases
2. Improve health and safety conditions at the testing facility
3. Reduce the consumption of raw materials and energy use for the manufacturing of new SF_6

The proposed project does not require an Environmental Impact Assessment under the regulations of the Host Country ('Assessment of Impacts of Works on Environment, Traffic and Disasters' Law).

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

Not applicable.

SECTION E. Stakeholders' comments

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

Comments from local stakeholders have been invited through the following channels:

1. Public announcement in a local newspaper – 'Kyungsang Daily' Newspaper of April 15th, 2009.
2. Public announcement on KERI's website – from April 22nd, 2009
3. Media coverage in an internet newspaper[30] – 'ETNews' of April 20th, 2009
4. Meetings with the DNA of Korea and CDM division of Ministry of Environment (ME) and Ministry of Knowledge Economy (MKE) on April 22-23, 2009.
5. A local stakeholder event[31] on April 30th, 2009 held in Ulsan.

The local stakeholder consultation Event was held on 30 April 2009 at the facilities of Solvay Fluor Korea Co., Ltd. in Ulsan, South Korea. The event was organized and conducted by SFK, KERI and EcoSecurities. A range of stakeholders with a potential material interest in the development of the project were included in the invitee list including local and central government officials, SF6 client companies, neighbouring chemical companies and local environment NGO. The invitation was carried out via the electronic mail of each invitee. An announcement of the consultation was placed in one local newspapers on 15/04/2009, two weeks prior the event's date. The event was attended by 21 participants. Of these four were from neighbouring companies and one person from the Onsan Environmental Management Association. Also, twelve people from SFK, two from KERI and two EcoSecurities were present at the event.

Mr Sung-bong Choi, Plant Manager of SFK started the meeting by welcoming the participants and introducing KERI and EcoSecurities. In his opening speech he explained briefly the background of the project and the benefits of the project in terms of reduce greenhouse gas emissions. Ms. Lise Lee from EcoSecurities introduced the participants to the Clean Development Mechanism and the benefits it brings

[30] cited at: http://www.etnews.co.kr/news/detail.html?id=200904220260

[31] See reference 3-1 in LIST OF , Annex 6

to the proposed project. A presentation on the technology of the project and the details of the operation and maintenance of the technology followed. After the presentation, an open forum was carried out to elicit comments from the various stakeholders.

E.2. Summary of the comments received:

Comments raised by the stakeholders are summarised below:

Question/Comment and Stakeholder	Answer/Comment
Was there any increase on employment related to the CDM project development? And, has SFK already had a plan with the extra revenue to be made by the project? *Mr Hyun-chul Park, HSE Director of Rhodia Polyamide*	SFK has not increased additional employment yet directly related to the CDM project, but been utilizing internal staff in the form of CDM TFT. SFK is considering appointing someone who can dedicate one's full capacity to the process management. Regarding a plan with the extra revenue expected from the project, it is too early to make a concrete plan yet since the project is still in an early stage. *Mr. Sung-bong Choi, Plant Manager of SFK*
Carbon market has been quite down since last year and accordingly the CER price is low. Does SFK have a risk management plan for the sales of its carbon credits to be created by the project? *Mr. Hyun-chul Park, HSE Director of Rhodia Polyamide*	SFK and KERI made an ERPA with EcoSecurities in the early stage of developing the project, which has become a risk management plan. However, the details of the contract are beyond the boundary of this meeting. *Mr. Sung-bong Choi, Plant Manager of SFK & Mr. Daejun Han, Team Manager, CDM TFT of SFK*
Seen in the video clip, safety discretion in the process happening in KERI (i.e., "recovery" process) needs to be improved; for example, the staff who is handling the recovery-related activity did not wear a safety helmet. *Mr Hyun-chul Park, HSE Director of Rhodia Polyamide*	KERI answered that the activity directly related to the "recovery" process is a small/short part out of a long and complicated testing process, and the recovery related activity is not considered as a hazardous process. However, KERI admitted to pay more attention to further safety management plan such as wearing a safety helmet and goggles in the recovery process. *Mr Yong-han Lee, Manager, High Power Voltage Testing & Evaluation Division of KERI*
Was there a new facility investment for the reuse system of the CDM project? *Mr Byeong-su Min, Senior Researcher, Energy & Environment Research Department, Hyundai Industrial Research Institute*	Yes, there was a new investment for the facility. When the plant was originally planned and constructed, it was before the discussion of developing a CDM project. The design on the plant followed a design of a similar plant Solvay has in Germany which included some elements of a reuse system. When the CDM project was decided to implement, the rest elements of the reuse system (compressors, pipings, cylinders, flowmeters, filters etc) were added.

	Mr Sung-bong Choi, Plant Manager of SFK & Mr. Daejun Han, Team Manager, CDM TFT of SFK
The concept of the reuse system sounds far advanced and fascinating than “incineration” solution. Can there be any possibility to do similar projects with Hyosung, KEPCO or other overseas organizations? *Mr Byong-su Min, Senior Researcher, Energy & Environment Research Department, Hyundai Industrial Research Institute; Mr. Aidan Lee, Manager of Electronics Division*	In terms of considering the technology itself, it would be possible. There are many SF6 end users and companies. However, CDM process is a very complicated one and a technology cannot just be automatically applied to another project. How to objectify the past data, procedures, project boundary and more specific variables should be considered. *Mr. Daejun Han, Team Manager, CDM TFT of SFK; Ms. Lise Lee, Country Representative of EcoSecurities*
A specific example of KEPCO (Korea Energy and Power Corporation), which is one of the biggest SF6 users in Korea and has a recovery technology (but not reclamation technology yet), can be considered to originate a similar CDM project with SFK in order to greatly contribute to GHG reduction in Korea. *Mr. Jaejin Shin, Senior Manager of Dongyang Vacuum Tech*	Again, it is possible in terms of the concept itself. However, it is said that KEPCO is trying to develop own reuse system independently as an internal project. *Mr. Daejun Han, Team Manager, CDM TFT of SFK; Mr. Hojin Jeon, Manager, CDM TFT of SFK*

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

As shown in Section E.2, the Project Activity received positive comments which led to no changes of the initial project planning. The reuse system technology applied at the project drew positive feedback both from the governmental side (positive sustainability aspects) and industrial sector (focusing on a new technology). As recommended by an attendee, KERI is going to ensure that the existing safety management plan of the site is enforced. This requires technician to wear a safety helmet and goggles during the recovery process at the test site.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Solvay Fluor Korea Co., Ltd
Street/P.O.Box:	383, Daejung-Ri, Onsan-Eup
Building:	
City:	Ulsan
State/Region:	Ulju-Kun
Postfix/ZIP:	689-892
Country:	South Korea
Telephone:	82-52-231-0001
FAX:	82-52-231-0094
E-Mail:	
URL:	www.solvay.com
Represented by:	
Title:	CEO
Salutation:	Mr
Last Name:	Nothomb
Middle Name:	-
First Name:	Andre
Department:	
Mobile:	82-11-9551-2305
Direct FAX:	82-02-756-0354
Direct tel:	82-02-756-7225
Personal E-Mail:	andre.nothomb@solvay.com

Project Annex 1 participant:

Organization:	EcoSecurities International Limited
Street/P.O.Box:	40 Dawson Street
Building:	
City:	Dublin
State/Region:	
Postfix/ZIP:	02
Country:	Ireland
Telephone:	+353 1613 9814
FAX:	+353 1672 4716
E-Mail:	info@ecosecurities.com
URL:	www.ecosecurities.com
Represented by:	
Title:	Director
Salutation:	Mr
Last Name:	Brown
Middle Name:	
First Name:	Patrick James
Mobile:	-
Direct FAX:	-

Direct tel:	-
Personal E-Mail:	cdm@ecosecurities.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

This project will not receive any public funding from Annex 1 parties.

Annex 3

BASELINE INFORMATION

Step 1 – Consolidation of eligible tests performed by KERI (known as *Creation of CDM Records*):

A list with the 56 tests performed by KERI with equipments eligible under the meth conditions was prepared (see table Annex 3.1). On this list the details of the equipment such as Receipt No., Test No., equipment manufacturer, Kv rating, equipment specifications, source of information for amount gas vented, amount of gas vented, etc were consolidated.

Table Annex 3.1. Summary of the reconstruction of the baseline at KERI for 2007

Serial No.	Receipt No.	Test No.	Start Date	End Date	Manufacturer	kV Rating	No. of Phases	Dead/ Live	No. of Ventings	Amount of Gas Vented (Based on NamePlates & Defaults)	Equipment Type	Calculation Base	Number of total Testing Items	Number of eligible testing items
1	TRD05C00496	106275	05/12/2006	22/01/2007	HICO	245	3	Dead	1	63		Defaults	3	1
2	TRD06C00365	107020	24/01/2007	14/02/2007	LSIS	145	3	Dead	4	84		Defaults	12	4
3	TRD06C00368	107003	05/01/2007	16/02/2007	LSIS	362	1	Dead	1	26.2		Defaults	13	1
4	TRD06C00553	106179	22/08/2006	13/02/2007	HICO	252	1	Dead	2	42		Defaults	5	2
5	TRD06C00565	106222	04/10/2006	15/01/2007	HICO	300	1	Dead	1	21.4		Defaults	4	1
6	TRD06C00566	106290	18/12/2006	08/02/2007	HHI	420	1	Dead	1	9.9	550SR	Defaults	3	1
7	TRD06C00619	106281	08/12/2006	25/01/2007	HHI	420	1	Dead	3	255.6		Defaults	9	3
8	TRD06C00635	107021	24/01/2007	05/02/2007	HICO	420	1	Dead	2	170.4	420 HCB 50	Defaults	10	2
9	TRD06C00727	106296	21/12/2006	24/01/2007	LSIS	170	3	Dead	4	364	GEDB 1752-AI	Name Plate	21	4
10	TRD06C00840	107043	21/02/2007	21/03/2007	DongNam	170	3	Dead	1	71.3	AE 1750-LED/	Name Plate	7	1
11	TRD06C00843	107008	11/01/2007	11/01/2007	HHI	170	3	Dead	1	6.3	70SR-DS L209	Defaults	3	1
12	TRD07C00006	107024	31/01/2007	06/02/2007	TaTung	170	3	Dead	3	459	170SR-N	Name Plate	7	3
13	TRD07C00048	107042	14/02/2007	15/02/2007	HICO	145	3	Dead	1	21		Defaults	3	1
14	TRD07C00085	107030	07/02/2007	02/04/2007	HICO	420	1	Dead	7	452.4	420HGS50	Defaults	42	7
15	TRD07C00089	107032	08/02/2007	09/02/2007	TaTung	170	3	Dead	1	153	170SR-N	Name Plate	5	1
16	TRD07C00090	107033	09/02/2007	19/03/2007	TaTung	170	3	Dead	5	765	170SR-N	Name Plate	22	5
17	TRD07C00107	107045	23/02/2007	26/02/2007	LSIS	170	3	Dead	1	21		Defaults	3	1
18	TRD07C00147	107077	09/04/2007	12/04/2007	HICO	300	1, 3	Dead	1	8.4		Defaults	6	1
19	TRD07C00153	107070	28/03/2007	04/04/2007	HHI	420	1	Dead	1	9.9	550SR 0101	Defaults	12	1
20	TRD07C00154	107134	10/07/2007	10/07/2007	HICO	245	3	Dead	1	63		Defaults	2	1
21	TRD07C00156	107072	02/04/2007	06/04/2007	LSIS	145	3	Dead	2	42		Defaults	5	2
22	TRD07C00157	107052	06/03/2007	28/03/2007	CGL	170	3	Live	4	44	150-SFM40B	Name Plate	46	4
23	TRD07C00160	107054	13/03/2007	26/03/2007	CGL	145	1	Live	4	32	120-SFM32B	Name Plate	12	4
24	TRD07C00168	107082	11/04/2007	11/04/2007	HHI	550	1	Dead	1	87.4		Defaults	2	1
25	TRD07C00191	107063	16/03/2007	19/03/2007	TaTung	170	3	Dead	1	6.3	SR-N 016161	Defaults	4	1
26	TRD07C00192	107146	19/07/2007	06/08/2007	LSIS	72.5	2	Dead	4	123.2	GESG NO720	Name Plate	24	4
27	TRD07C00194	107093	04/06/2007	05/06/2007	TaTung	170	3	Dead	2	9.6	170-SR-LES	Defaults	6	2
28	TRD07C00195	107065	22/03/2007	11/04/2007	TaTung	170	3	Dead	2	9.6		Defaults	8	2
29	TRD07C00246	107079	10/04/2007	27/09/2007	LSIS	362	1, 3	Dead	5	99.2		Defaults	28	5
30	TRD07C00253	107085	30/05/2007	05/07/2007	LSIS	170	3	Dead	8	557.1	GEDB 1752-AI	Name Plate	39	8
31	TRD07C00263	107238	15/10/2007	15/10/2007	HICO	800	2	Dead	1	219	800HCB50	Name Plate	3	1
32	TRD07C00272	107056	12/03/2007	11/10/2007	HICO	245	1	Dead	10	210	HY980128	Defaults	37	10
33	TRD07C00294	107125	28/06/2007	16/07/2007	IlJin	145	3	Dead	1	21		Defaults	8	1
34	TRD07C00329	107109	19/06/2007	20/09/2007	HHI	245	1	Dead	5	105		Defaults	24	5
35	TRD07C00337	107149	24/07/2007	24/07/2007	NISSIN	161	3	Dead	1	3.9	GD14-5B	Defaults	2	1
36	TRD07C00341	107227	02/10/2007	02/10/2007	HICO	245	1	Dead	1	21		Defaults	2	1
37	TRD07C00390	107156	25/07/2007	14/09/2007	HICO	145	3	Dead	3	207	HCSP-144A	Name Plate	17	3
38	TRD07C00420	107241	17/10/2007	28/11/2007	HICO	145	3	Dead	3	108	HCSP-144B	Name Plate	23	3
39	TRD07C00468	107145	19/07/2007	25/01/2008	LSIS	145	3	Dead	6	126		Defaults	28	6
40	TRD07C00469	107189	29/08/2007	25/04/2008	LSIS	245	1	Dead	2	42		Defaults	8	2
41	TRD07C00484	107127	02/07/2007	10/07/2007	TAKAOKA	72	3	Dead	2	38.4		Defaults	10	2
42	TRD07C00485	107128	11/07/2007	12/07/2007	TAKAOKA	72	2	Dead	1	12.8	FAO25TD5-12	Defaults	5	1
43	TRD07C00490	107150	23/07/2007	23/08/2007	DongNam	170	3	Dead	7	593.3	1750-CB/LE	Name Plate	39	7
44	TRD07C00527	107207	10/09/2007	13/09/2007	HHI	420	1	Dead	1	85.2	550-SR-K 001	Defaults	9	1
45	TRD07C00544	107166	09/08/2007	04/09/2007	HICO	245	3	Dead	2	192	245 HCBH 50	Name Plate	11	2
46	TRD07C00606	107216	14/09/2007	21/09/2007	IlJin	145	3	Dead	1	21		Defaults	4	1
47	TRD07C00696	107271	19/11/2007	30/11/2007	LSIS	362	1	Dead	2	238.4	GEDB-3654NR	Name Plate	12	2
48	TRD07C00705	107217	17/09/2007	18/09/2007	HHI	420	1	Dead	1	85.2	550SR-K 001	Defaults	7	1
49	TRD07C00710	107224	01/10/2007	07/12/2007	HICO	145	3	Dead	4	150	-144A HDMO-	Name Plate	36	4
50	TRD07C00826	107264	12/11/2007	09/06/2008	HICO	245	1	Dead	1	21	HMD-245	Defaults	6	1
51	TRD07C00885	107256	01/11/2007	24/12/2007	HICO	245	1, 3	Dead	7	163.4	245 HCB 50	Name Plate	33	7
52	TRD07C00936	107298	11/12/2007	26/12/2007	HICO	245	1	Dead	2	42	HSP-245	Defaults	6	2
53	TRD07C00959	107285	29/11/2007	10/12/2007	CGL	245	1	Live	2	42	200-SFM40S	Name Plate	27	2
54	TRD07C00961	107287	12/12/2007	13/12/2007	CGL	420	1	Live	1	80	400-SFM40A	Name Plate	5	1
55	TRD07C01020	107300	12/12/2007	27/12/2007	MITSUBISH	84	2	Dead	3	38.4	70-VPR-32C	Defaults	22	3
56	TRD07C01038	107306	14/12/2007	20/12/2007	CGL	145	1	Live	1	2		Defaults	3	1
										6,945.20			753	146

Sub-Step 1.1 – Details about the 56 tests of the reconstructed baseline, item by item: Each test was broken down in test items, and details of each item, such as, Item Description, Start time, End time, Test Compartments, etc were consolidated in a format similar to the one presented in table Annex 3.2.

Table Annex 3.2. Details of one of the 56 tests of the reconstructed baseline*

Receipt No.	Test No.	Testing Item	Start Time	End Time	Test Compartments	No. of Phases
TRD05C00496	106275	NLT	12/5/2006 20:33	12/5/2006 21:12	+2Bushin	3
TRD05C00496	106275	T100s	12/5/2006 21:34	12/6/2006 14:45	+2Bushin	3
TRD05C00496	106275	T100a	12/6/2006 16:00	12/6/2006 19:33	+2Bushin	3
TRD05C00496	106275	NLT	1/19/2007 10:46	1/19/2007 11:03	+2Bushin	3
TRD05C00496	106275	T100a	1/19/2007 14:42	1/22/2007 16:00	+2Bushin	3
TRD05C00496	106275	T100s	1/22/2007 16:11	1/22/2007 18:29	+2Bushin	3

* The items highlighted in blue were vented before or after 2007, thus any possible venting of these tests were not included in the calculation. Cases were highlighted in a transparent way.

Step 2 – analysis of the tests of the reconstructed baseline(known as *Use of Decision-making flowchart*): To analyse the eligibility of a venting, 4 sub-steps were defined:

Sub-step 2.1 (Does the Test Need to be repeated?): *Was testing item repeated?* 0 if not repeated and 1 if repeated. Repetition was defined by the occurrence of the same item more than once in the test.

Sub-Step 2.2 (Last testing item of the test?): Identification of the last item to be tested. 0 if not the last item and 1 if it is the last item.

Sub-Step 2.3 (Does equipment need to be dismantled before test item is repeated?): *Equipment dismantled?* Signal is "Yes" or "No". "Yes" is given for testing items with test finished in 2007 and testing item is different of "STC", with time distance to the next Test Item of at least 12 hours, and the Next Test Item defined as "NLT" or for testing items with test finished in 2007 that are the last one of the test.

Sub-Step 2.4 (eligible venting): 0 if venting is not eligible and 1 if it is eligible. To a venting be eligible it must be a testing item to be repeated and equipment dismantled or last test item and equipment dismantled.

The details of step 2 are presented in the Table Annex 3.3. The yellow and green columns are the input information coming from the step 1, while the orange columns are the calculations done to develop the sub-steps 2.1 to 2.4 in order to define the eligible amount of gas vented.

Table Annex 3.3. Analysis of one of the 56 tests of the reconstructed baseline

								Substep 2.3			Substep 2.2	SubStep 2.1	Substep 2.4	
Receipt No.	Test No.	Testing Item	Start Time	End Time	Test Compartments	No. of Phases	Next Item = "NLT" or "Last Item"?	Was equipment dismantled? (after testing)	Time Distance To Next Test Item (hrs)	Amount of Vented SF6 Gas (kg)	Last testing item of the test?	Was testing item repeated?	Eligible venting?	Eligible gas amount
TRD07C00195	107065	STC	3/22/2007 17:15	3/22/2007 17:47	+ 1 Bush	3	TRUE	No	169	0	0	0	0	0
TRD07C00195	107065	NLT	3/29/2007 19:27	3/29/2007 19:49	+ 1 Bush	3	FALSE	No	0	0	0	0	0	0
TRD07C00195	107065	Making	3/29/2007 19:50	3/29/2007 21:25	+ 1 Bush	3	TRUE	Yes	283	4.8	0	1	1	4.8
TRD07C00195	107065	NLT	4/10/2007 17:20	4/10/2007 18:23	+ 1 Bush	3	FALSE	No	0	0	0	0	0	0
TRD07C00195	107065	Making	4/10/2007 18:37	4/10/2007 19:07	+ 1 Bush	3	FALSE	No	0	0	0	1	0	0
TRD07C00195	107065	Making	4/10/2007 19:39	4/10/2007 22:19	+ 1 Bush	3	TRUE	No	0	0	0	0	0	0
TRD07C00195	107065	NLT	4/10/2007 22:38	4/10/2007 22:47	+ 1 Bush	3	FALSE	No	18	0	0	0	0	0
TRD07C00195	107065	STC	4/11/2007 17:31	4/11/2007 17:37	+ 1 Bush	3	TRUE	Yes	24	4.8	1	0	1	4.8

The table below describes the signals from the testing records that indicate when the conditions of the flow chart are fulfilled (to be used in the reconstruction), including the conditions that demonstrate that when a testing item was repeated and when equipment was dismantled. Following the methodology instructions, it can be assumed that gas is removed from equipment when a test is finished (all testing items of an equipment completed), or when a testing item is repeated and the equipment is dismantled prior to repetition.To summarize the conditions of the default decision-making flowchart is satisfied; refer to the Table Annex 3.4 below:

Table Annex 3.4. Signals used in satisfying conditions of the decision-making flowchart

Flow Chart Condition	Baseline Reconstruction Table Heading from Table 3.3	Conditions to Satisfy it	Signal
Testing Item	Test No. + Test Item	Each testing item identified by the “test No.”, “testing item” and “start/end time”.	N.A.
Does test need to be repeated	Was Test item repeated?	It’s repeated if the same testing item appears more than once in the same Test No.	***0*** if not repeated ***1*** if repeated
Does equipment need to be dismantled before test item is repeated	Was Equipment Dismantled?	“Yes” is given for items with test finished in 2007 and testing item is different of “STC” and with time distance to the next Testing Item of at least 12 hours, and the Next Testing Item defined as “NLT”.	***Yes*** if dismantled ***No*** if not dismantled.
Last Testing item of the test?	Last item of the Test	The last testing item based on start/end times.	***0*** if not the last testing item ***1*** if the last testing item
Eligible Venting	Eligible Venting?	To a venting be eligible it must be a testing item to be repeated and equipment dismantled or last test item and equipment dismantled.	***0*** if the venting is not eligible ***1*** if the venting is eligible

Step 3: Establish SF_6 capacities

The SF_6 capacities where all defined following the options (a) and (b) described in the methodology. In Table Annex 3.1 on column *“calculation base”* is defined the option used to establish the SF_6 capacity. In the same table, the column “*Amount of Gas Vented (Based on name plates and defaults)*” quantifies the SF_6 capacities of each equipment. All the guidelines presented in this step were strictly followed.

Table Annex 3.5. Default SF_6 filling amount of each compartment in kg per type of equipment.

(Dead Tank Type)

Rating	Compartments						
kV	CB	ES_DS	Bushing	2 Bushings	CB+2Bushings	DS+2Bushings	ES+1Bushing
72	6	0.3	0.2	0.4	6.4	0.7	0.5
84	6	0.3	0.2	0.4	6.4	0.7	0.5
145	6	0.3	0.5	1	7	1.3	0.8
170	6	1.1	0.5	1	7	2.1	1.6
245	18	1.1	1.5	3	21	4.1	2.6
252	18	1.1	1.5	3	21	4.1	2.6
300	18	1.1	1.7	3.4	21.4	4.5	2.8
362	18	1.1	4.1	8.2	26.2	9.3	5.2
420	72	3.3	6.6	13.2	85.2	16.5	9.9
550	72	3.3	7.7	15.4	87.4	18.7	11
800	115	5	18	36	151	41	23

(Live Type)

Rating	Compartment
kV	CB
72	1.5
84	1.5
145	2
170	2.5
245	4.8
252	4.8
300	5
362	8
420	8
550	10

Step 4: Obtain $TI_{SF_6,used,t}$, the used SF_6 gas vented during each testing item t

The result of this step is available in the table Annex 3.3 in the column called "*Eligible Venting?*". This step of the methodology is equivalent to sub-step 2.4 presented before.

Step 5: Assign an SF_6 capacity

The result of this step is available in the table Annex 3.3 in the column called "*eligible gas Amount*". It is result of interaction of eligible venting and the established SF_6 capacities for the equipment.

Step 6: Sum

All the "*eligible gas amounts*" presented in table Annex 3.3 are summed per Test No. and presented consolidated in table 3.1 column "*Amount of Gas Vented (Based on Name Plates & Defaults)*". The sum of it is presented in red in the bottom of the table Annex 3.1.

Annex 4

MONITORING INFORMATION

Annex 5

SF_6 RECLAMATION SPECIFICATIONS

Table 3.1. SF_6 Reclamation specifications, which define the maximum contamination that would allow the reclamation of SF_6.

Content	IEC 62271-303 Reclaimed SF6 Specification *(ppm by weight)*	Code of Testing Standard	Laboratory method
Air (N_2, O_2)	< 60000 (30 Vol %)	ASTM D2685	Gas Chromatography
CF_4	< 30000 (5 Vol %)	ASTM D2685	Gas Chromatography
Moisture	< 1000	ASTM D2029	Dew Point Meter
Oil	< 1000	Din IEC 60376	Gravimetric
HF	< 1000	ASTM D2284	Titration
Additional impurities	< 5% by weight	VDE 0373	

Annex 6

LIST OF REFERENCES

Below is the list of supporting documents for the project used in the footnotes.

Document name
1-1 EC Reg 842 2006- the European Parliament and of the Council of 17 May 2006
1-2 SF6 Quality standard IEC 60376
1-3 Enforcement Ordinance on High Voltage Gas. Safety Management Law. Article 3, 3-b. January 14, 2009.
1-4 Letter of Commitment between EcoSecurities Group PLC and Solvay Fluor Korea Co., LTD dated 12th October 2007
1-5 Purchase Order (PO) made by Solvay Fluor Korea Co., LTD to DILO Armaturen und Antagen GmbH dated 23rd November 2007
1-6 ERPA between EcoSecurities Group PLC and Solvay Fluor Korea Co., LTD dated 19th March 2008
2-1 KERI Guidance-SF6_Gas_Amount_Calculation
2-2 KERI pictures of tested equipment(2007)
2-3 KERI Type Test Certificate-example
2-4 KERI_raw_data test-example
2-5. Baseline reconstruction for 2007
3-1 SF6 Korea Stakeholder Report_(LL_NS)_14.05.09
4-1 KERI_Info about test services
4-2 KERI_Info about certification services
4-3 SFK Intro to the company
4-4 SFK SF6 project Introduction_26.08.08
4-5_12_Jul_05-SFK incorporated
4-6_May_06-Start of construction
4-7_May_07-Start of production
4-8 Standard specification for Sulfur Hexafluoride
5-1 SF6 process diagram including purge point
6-1 start date recovery and reclamation report_02Jun08

7-1-CDM Labour Cost
7-2-Lab Cost for Analysis
7-3-Transport Costs
7-4-Material Consumption for Purification of SF6_v2.xls
7-6-Cost of Destruction of SF6
7-8-Cost of Piping (Solvay)
7-9-Cost of Separation Filter
7-10-Cost of DILO Compressor
7-11-Cost of Piping (KERI)
7-12-Unit Price of Cylinders
7-13-Piping to Incineration Company Site
7-14-Monitoring Equipment for Incineration Piping
7-15-Price of Sulphur
7-16-Price of AHF
7-17-Electricity Tariff
7-18-Steam Tariff
7-19-Depreciacion
7-20-Income Tax
7-21-VAT
7-22-Interest Rate
7-23-Average SF6 price
7-24-Exchange Rate
7-25-Solvay SA WACC Bloomberg Q3 2007 Solvay SA's Weighted Average Cost of Capital. Bloomberg Finance LP. Bloomberg Professional Service. October 31, 2007.
7-26-Solvay_Plant Data Request
7-27-"SFK_FinancialAnalysis"
7-28-SF6_Korean Market Price Trend_2005-2009