Monitoring report form for CDM project activity
(Version 08.0)

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT			
Title of the project activity	Reducing Gas Leakages within the Bakhrabad Gas Distribution Network in Bangladesh		
UNFCCC reference number of the project activity	10559		
Version number of the PDD applicable to this monitoring report	Version 4		
Version number of this monitoring report	1		
Completion date of this monitoring report	22/09/2021		
Monitoring period number	2		
Duration of this monitoring period	27/11/2020 - 21/08/2021 including both days		
Monitoring report number for this monitoring period	1		
Project participants	EcoGas Asia Ltd.		
Host Party	People's Republic of Bangladesh		
Applied methodologies and standardized baselines	Leak detection and repair in gas production, processing, transmission, storage and distribution systems and in refinery facilities" AM0023 (Version 04.0.0) No standardized baseline was applied		
Sectoral scopes	Sectoral Scope 10 – Fugitive emissions from fuels (solid, oil and gas)		
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013 until 31 December 2020	Amount achieved from 1 January 2021
	0	130,692	870,038
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	1,792,609 (268 days)		

SECTION A. Description of project activity

A.1. General description of project activity

The CDM project reduces gas leakages from components[1] in the natural gas distribution system in Bakhrabad Gas Distribution Company Limited (BGDCL) in the People's Republic of Bangladesh. The length of the BGDCL natural gas distribution system is about 4000km. Construction began on the distribution system in the 1970s and over the years has not been adequately maintained. As a result, a significant percentage of the natural gas throughput which is more than 95% methane (CH_4) leaks from components in the system and is released into the atmosphere contributing to global warming. The project will lead to reductions of methane, a potent greenhouse gas (GHG).

Leaks in the distribution system are caused by normal component wear, thermal and vibrational stresses and seasonal expansion/contraction cycling from ambient air temperature changes. Natural gas leaks occur through various sources including, thread connections of gas pipes, broken gaskets and other broken parts of ball/plug valves, broken membranes of pressure regulators and connectors, etc. These components are not routinely checked for leaks under existing safety practices of BGDCL. The company operators lack the advanced leak detection equipment, advanced repair materials and trained workers to identify chronically leaking components, accurately measure the leak rates and make reliable repairs of the leaks.

The project has reduced methane emissions at valves, pressure regulators, insulating joints and other above ground gas transmission/distribution infrastructure.

Milestone of the project activity	Timeline
The start date of the project activity	21/06/2019
Registration of the project activity	31/07/2020
Crediting period	31/07/2020-30/07/2030 (Fixed)
1st monitoring period	31/07/2020- 26/11/2020 including both days
2nd monitoring period	27/11/2020- 21/08/2021 including both days

A.2. Location of project activity

The entire above ground gas distribution system found in the service and franchise area operated by the Bakhrabad Gas Distribution Company Limited including: Comilla District, Brahmanbaria District, Chandpur District, Lakshmipur District, Noakhali District, and the Feni District. With its Headquarters at Chapapur, Comilla-3500, Bangladesh (23.450457, 91.211199).

The exact details of the location of all the leaks identified in the system and repaired have been recorded in the monitoring system database.

[1] The selected methodology AM0023 (Version 04.0.0) defines a component as "above-ground process equipment in natural gas production, processing, transmission, storage, distribution systems", including valves, flanges and other connectors etc.

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
People’s Republic of Bangladesh (host)	EcoGas Asia Limited (Private Entity)	No

A.4. References to applied methodologies and standardized baselines

Approved baseline and monitoring methodology for large-scale CDM project activities: AM0023 (Version 04.0.0): “Leak detection and repair in gas production, processing, transmission, storage and distribution systems and in refinery facilities”.

The methodology above refers also to the latest “Combined tool to identify the baseline scenario and demonstrate additionality”.

A.5. Crediting period type and duration

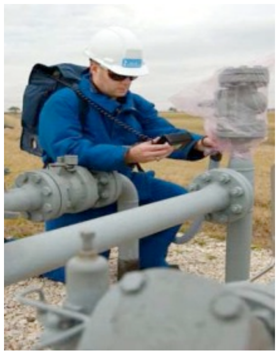
31/07/2020-30/07/2030 (10 years fixed crediting period).

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

This project has reduced methane leaks at above-ground infrastructure in the Bakhrabad Gas Distribution Company Limited (BGDCL) gas distribution system. BGDCL is the managing entity of the gas network under project activity. The project utilized various advanced leak detection equipment to identify leaks throughout the above ground infrastructure of BGDCL’s gas distribution system. The main leak detection and quantification technology used in the project is the “Hi-Flow Sampler” (HFS) which is a machine designed to detect and measure leaks in gas infrastructure. Gasurveyor 500s are used to help find leaks and check repairs as well. The baseline study to find and measure leaks using this equipment began December 1, 2018 and ended March 16, 2020.

High Flow Sampler



Gas Surveyor 500

Once a leak is found and measured, the project employs advanced leak repair materials to completely seal the leak and retain the repair indefinitely. In order to be sure, the leak repairs are not compromised, the project has an ongoing monitoring program to ensure leak repairs remain intact. In addition, BGDCL tracks the continued operation of all the various gas lines across its system. In the case where a particular section of the distribution system is not operational (for example during a large-scale repair), the hours during which the system is not operational are tracked. The total hours of operation of all the leaks affected by a given outage are then adjusted to reflect the reduced hours of operation.

B.2. Post-registration changes

No changes were made post-registration.

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents

No deviations have been applied.

B.2.2. Corrections

No corrections were required.

B.2.3. Changes to the start date of the crediting period

No changes in the start date of the crediting period have been made.

B.2.4. Inclusion of monitoring plan

No additional monitoring plan has been added to the PDD.

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

No changes have been made.

B.2.6. Changes to project design

There have been no changes to the design of the project.

B.2.7. Changes specific to afforestation or reforestation project activity Not

Not Applicable

SECTION C. Description of monitoring system

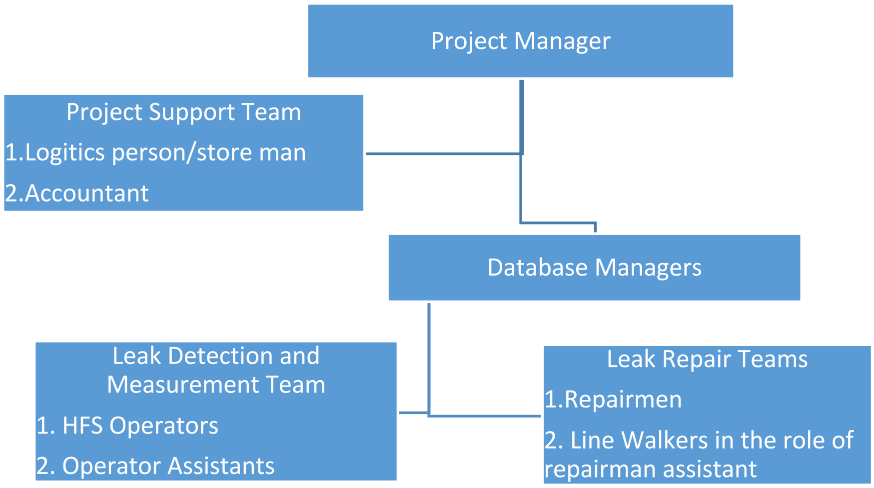
Summary of the Project Team and Roles.

The project takes place on the gas distribution system of BGDCL. Ecoeye Co., Ltd and the Korea Midland Power Co. Ltd. (KOMIPO), two corporate entities in Republic of Korea, have provided all the funds required to implement the Project. The Project is overseen by EcoGas Asia, which has hired Climate Compass LLC. to manage the project implementation including providing the survey equipment, repair materials, transportation for the project, and compliance with the approved PDD and methodology. Climate Compass has hired MBS as a 3rd party technical consultant to help confirm through regular inspections that the project is compliant with the methodology and PDD. Climate Compass hired Brawa Consulting to assist in the local project management. Climate Compass has also hired the Dhaka based company Prokaushali Sangsad Limited (PSL), to do much of the project implementation work on a day-to-day basis. The PSL team includes project managers to direct the daily workflow, database managers to ensure the data gathered from the project is recorded correctly, operators in the field who take the appropriate measurements and log the data, and repairmen. The roles and responsibilities of each of these parties is described in more detail below.

The flow of data in the project occurs as follows:


Baseline Study
HFS Operators find and measure leaks & Repairmen make repairs
HFS Operators confirm repairs are done properly (no leaks)
HFS Operators Enter Leak and Repair Data into the Database
Review/CER Calculations
M.B.S regularly spot-checks measurements, data entry, and the Database
Database Managers Check data entry from all the Operators
Climate Compass Reviews the Database, Calculates CERs and Prepares Monitoring Report
Monitoring
HFS Operators monitor repaired leaks to ensure there are still no leaks. Any reappeared leaks or new leaks are repaired.
HFS Operators confirm any re-repairs are done properly (no leaks)
HFS Operators Enter Monitoring Data into the Database

CDM Team Organization Chart



THE CDM TEAM -

The CDM Project team consists of by key staff from the Dhaka based company Prokaushali Sangsad Limited (PSL).

The **Project Manager** responsible for PSL's CDM team is Asma Huque. She has been involved in the project since its inception.

Another important role within the BGDCL CDM team is that of the **Database Manager**. The Main Database Manager oversees the Project database, which includes all baseline, measurement, repair and monitoring data provided by the **Leak Detection and Measurement Team (LDMT)** Hi-Flow Sampler operators. The Database Manager for the duration of this monitoring period was Belayet Hossain of PSL. Climate Compass (CC) and MBS (third party consultants) have maintained their involvement and oversight during the entire monitoring period. In addition, both Climate Compass and MBS have undertaken a full review of the database.

The LDMT gather data for entry into the Project Database from their own field observations and input from the Repair Team. The LDMT are responsible for leak detection and measurement, subsequent measurement of repairs, and ongoing monitoring of repairs using sophisticated leak detection and measurement equipment – the Gas Surveyor and the Hi-Flow Sampler (HFS). Operators from the LDMT take written field notes, draw schematics and take pictures, which they then transcribe into excel format. The excel forms are delivered to the Database Managers, who review the data for errors before entering it into the Project Database.

The **Repair Team** was organized and trained for the purpose of executing the CDM Project. Members of the Repair Team are comprised, for the most part, of experienced BGDCL and PSL employees who were trained in the use of modern repair materials and repair techniques. While the numbers varied based on availability of staff across the project, the typical LDMT Cell was linked with repairmen tasked with completion of repairs. In addition, often local line walkers were

temporarily included on the team to provide access in cases where cabinets were locked and at times these people served as repair assistants.

The inventory of modern repair materials supplied by EcoGas Asia, as well as secure storage of the expensive Hi-Flow Samplers, is the responsibility of the PSL **Store Men**, Tariqul Islam and Saidur Rahman Milton.

RESPONSIBILITIES OF DIFFERENT PARTIES AND COMPARISON WITH THE MONITORING PLAN CONTAINED IN PDD VERSION 4.

The Leak Detection and Measurement Team

Responsibilities:

- **LDTM** units undertook an initial baseline study across the gas distribution system.
- Once a new leak was encountered and measured, thereby generating a baseline reading, operators from the LDMT informed the Repair Team whose responsibility was to repair the leak.
- Throughout the duration of the monitoring period of the Project, the LDMT has checked existing repairs for the re-appearance of leaks.

Certification of members of the LDMT by MBS

The following members of the LDMT are certified as competent to perform leak measurement using the Hi-Flow Sampler and related techniques by MBS. All certificates are available upon request.

M.B.S certified as Operating Managers:

1. Md. Belayet Hossain at November 2016
2. Nasrullah Bin Anower at November 2016

Those 2 people did Database Managers' job for this project.

M.B.S certified as Operating Manager:

3. Md. Hannan Kawsar at November 2016
4. Md. Shakhowt Hoshain at November 2016
5. Md. Golam Mourtuza at November 2016
6. Md. Atik Shahriar at April 2019
7. Md. Abdul Barek at November 2016
8. Mr. Tanvir Ahmed at April 2016
9. Md. Mohi Uddin at April 2019
10. Habib Sheikh at November 2016
11. Md. Kowser Ali at November 2016
12. Mostafizur Rahman at November 2016
13. Md. Sazzad Hossain at November 2016
14. Md. Mahabubur Rahman at April 2019
15. Zahid Hasan at April 2019
16. Tanvir Ahammad Hero at April 2016
17. Md. Kausar Ali at October 2019
18. Nazmul Hasan at October 2019
19. Mr. Subashis Chandra Das, at November 2016

Ongoing Training by MBS and Experienced Operators
Ongoing training in the use of the Hi-Flow Samplers is provided by MBS during inspection visits during the Baseline Study period. The LDMT maintains proficiency in the use of Hi-Flow Samplers through training from MBS, given on an as-needed basis, and learning from the more experienced Hi-Flow Sampler operators within the group.

Table showing time spent doing remote field inspection with PCL by M.B.S staff during the Baseline Study period:

Date	M.B.S Staff	Working Days
25/03/2021 21/08/2021	V. Potapenko O. Potapenko	2 2
Total MBS' days spent remotely inspecting PGCL CDM Project		4

Baseline Selection:
In selecting leaks to be included in the baseline, the LDMT followed the Decision Tree contained on **page 24 of the PDD**. When deciding whether or not a leak could be added to the baseline, the LDMT first had to determine whether or not it constituted an Emergency Repair. If the repair involved equipment that had ceased to function altogether, then the repair was deemed an Emergency Repair, and therefore, the repair did not qualify to be included in the Project Database. To be clear, an emergency repair will not ever be added to the CER Master file used to calculate CERs. This is the case because this work is done by completely separate staff that has no access to the CER database. Additionally, the BGDCL staff do not measure the leaks for an emergency repair and would have none of the accompanying paperwork that is required to upload the leak into the database and cross check the results (paper file, excel sheet with photos, etc). In fact, the emergency repair teams do not have Hi-Flow samplers and so no record of a measurement could ever be taken. Finally, if a piece of leaking equipment that is in the database is replaced on account of an emergency leak at a later date, this would be noted during the subsequent monitoring visit (the equipment would be changed and not match the picture and technical drawings of the site) and any additional CER calculations would be terminated in the database as with any cut-off point. Therefore, the CER Master File database has no leaks that result from emergency repairs.

The next branch of the Decision Tree considers the schedule for equipment replacement. If the equipment has been scheduled for replacement, then the leak is only included up until the actual time of equipment replacement. The company maintains a record of all the equipment that has been replaced and the project's database of leak locations is checked against these records for the verification time period. During each monitoring visit the operator checks the current configuration of the equipment against the photographs and technical schematics completed during the baseline study. Database entries representing leaks that have been shut off are no longer used to calculate CERs. As documented on page 23 of the validated PDD, BGDCL does not replace equipment based on age. In fact, as was confirmed during validation, there is no average lifetime of equipment as most of the equipment is still in use as during the last 20 years no major replacements have occurred. Therefore, the expected lifetime of non-replaced equipment will exceed the crediting period.

Lastly, if the leak can be identified and repaired with materials and know-how available prior to the CDM Project—such as a simple tightening of a loose fitting or connection **-** then such a leak has not been included in the Project Database. The decision process described above was implemented through intensive training given to all operators before they collected baseline data. To be clear, the operator who has identified and measured the leak with the Gas Surveyors and Hi-Flow Samplers only includes the leak in the database if the leak could not be immediately repaired

in the field by simply tightening the fittings. The repair team that fixes the leak uses advanced repair materials provided though the CDM project to make the repairs.

Recording of Leaks

For each leak that satisfied the test for inclusion in the Project Database, the LDMT recorded the information as directed on page 22 of the PDD. The information was recorded as follows:

- The date of leak detection (dd-mm-yyyy)
- The date of leak repair (dd-mm-yyyy)
- The exact location of the leak including GPS coordinates
- The leak flow rate prior to repair (l/m)
- The measurement method (Leaks may have been initially detected using Gas Surveyors. Once a leak was detected, all measurements for leak flow rate were taken using Hi-Flow Samplers, each Hi-Flow Sampler unit was assigned a number and the unit responsible for each measurement was thereby recorded. Furthermore, Hi-Flow Samplers recorded each measurement with a number between 1 and 999; the number corresponding to each measurement of leak flow rate is recorded in the Project Database. After the leak was repaired, the Repair Team used a soap solution to check the quality of the repair.
- The nature of the repair made (whether or not it involved replacement of equipment, use of advance repair material or another method).

In addition to what was described in Appendix 5 of the PDD, the LDMT followed additional quality control and assurance measures to better record and permit future rigorous monitoring of each leak. These measures were:

- A weatherproof tag was attached to each leak with the measurement date, the Hi-Flow Sampler number, the name of the measured point and the leak flow rate all recorded on the tag.
    - It should be noted that many of these tags have been stolen or removed by a member of the curious public. There is an ongoing effort to replace tags that have been removed. As envisioned, however, the other back-up methods have proved sufficient for the purpose of recording and identifying leak locations.
- Digital photos were taken of the tag and immediate area of the leak to permit future identification of both the leak and its location. Digital photos have been numbered, and recorded. Smartphones with cameras were supplied.
- A schematic was drawn in the Excel Form (Described below), showing the location of the leak on a raiser and the method used to repair it, which serves to simplify the detail shown on the photographic record.

Field observations were recorded using common format written field reports. The field reports include details on the location and date, the readings from the Hi-Flow sampler, the Hi-Flow sampler serial number, a schematic drawing of where the leak was found on the gas equipment, notes on the repair required and other key details described above. These reports are kept on file and can be easily cross referenced by the operators at any time with electronic files.

Members of the LDMT are responsible for transcribing all details noted above from the hard copies into a common format Excel Form and inserting the aforementioned photographs, schematics. The Excel sheets include the information that is included on the hard copy reports and are saved in multiple places to ensure their continued safety.

These Hi-Flow Sampler readings transcribed onto the Excel sheets are cross referenced with the actual Excel data files that are generated by the Hi-Flow Samplers to ensure accuracy. The data files from the Hi-Flow Samplers contain up to 999 measurements and are downloaded before they exceed this number. The data is cross-referenced using the Hi-Flow Sampler serial number and date of measurement with the manually input spreadsheet.

Once all the information above is transcribed into an Excel Form and checked, this Excel Form is sent to a Database Manager, who is responsible for entering the data into the Project Database. A column in the Project Database is devoted to each of the data fields noted above. This master database provides the CER calculations and the data can be transparently traced back through each of the other data records.

Monitoring of Repaired Leaks

The task of monitoring leaks requires the LDMT to perform the following steps, many of which are outlined in Annex 5 of the PDD:

- Finding the repaired leak: The HFS Operator returned to the address of a repaired leak using primarily the GPS coordinates and the leak tag to locate and identify the leak (The precise location of each repaired leak is indicated by a tag; and contained on the Excel Form are a schematic diagram, and a digital photograph). In a number of instances, the leak tag was absent, presumably removed by children (Much of the gas infrastructure is within easy reach of children). In such instances, the schematic diagram and photograph served as a precise record for the location of the repaired leak and a new tag was attached to the site of the leak. The CDM Team has been supplied with the necessary replacement tags.
- Once the repaired leak was located, the following information was recorded:
    - Date of monitoring (dd-mm-yyyy)
    - Measurement method (Initially the LDMT used Gas Surveyors to establish whether a leak in the Project Database had begun leaking again, if it was shown to be leaking, then it employed a Hi-Flow Sampler to measure the leak flow rate and the responsible Hi-Flow Sampler's unit number was recorded)
    - Leak flow rate (if any) (l/m)
    - Measurement number in the Hi-Flow Sampler memory
- If the leak required re-repair, then a repair team was dispatched and the following was recorded:
    - Date of re-repair (dd-mm-yyyy)
    - The repair materials

The LDMT recorded the information above on common form Field Notes and transcribed the data into the same Excel spreadsheet that was used when the leak was entered into the Project Database

Equipment Provided to Leak Detection and Measurement Team

Each unit of two HFS operators was supplied, with the following equipment. The equipment provided proved sufficient for the LDMT to perform all of its aforementioned tasks.

- Hi-Flow Sampler
- Rental cars
- Smartphone with GPS
- Gas Surveyor
- Tags
- Personal computer

Quality Control and Quality Assurance

- **Hi-Flow Sampler Digital Records:** All leak flow rate measurements present in the Project Database were compared by members of the LDMT against the Hi-Flow Sampler record to double check them for accuracy. In all instances when a Leak Flow Rate measurement in the Excel Notes taken by the LDMT differed from the downloaded data taken from the Hi-Flow Sampler, the measurement's record in both the Project Database and the Excel Forms was changed to reflect the download taken from the memory of the Hi-Flow Sampler. The step was taken because the data downloaded from the Hi-Flow Sampler is

not subject to manual transcription error. As a final check we ran an electronic cross-reference search between the Hi-Flow Sampler records and the master datasheets to confirm consistency between the two separate data repositories. Any discrepancies were manually checked and errors corrected.

- It should be noted that some of the Hi-Flow Sampler Records were corrupted during the download from the machine to PC. We have been working with the LDMT staff to eliminate human error factors in the download process but as a result we have some problems with data quality during data transfer that were recorded. Some records contained a minor error such as dates or HFS number being entered incorrectly. While these missing records are inconvenient, we still have all the other pertinent sources of data (manual hard-copy, photo, tags, excel file copies and master data logs) to confirm and cross check data as per the monitoring plan.

  Unfortunately, there is not much that can be done to fix this technical issue. The Hi-Flow Sampler is no longer being sold, there is no similar machine on the market and there are no spare parts available to fix this fault. The team worked with a computer expert to determine that the time/date chip in these particular HFS units is malfunctioning. However, no replacement parts or service is available from the HFS manufacturer to solve this problem, as it no longer is supporting this product.

  The methodology, however, clearly envisaged situations exactly like this where one source of data is corrupted as it asks for redundant data recording techniques to be applied just in case such an error in one data source is found. The leak data for every individual leak is included: in the electronic database by the operator, on unique hard copies created by the operator at the time of measurement, within the downloadable electronic memory of the HFS, and on tags attached at the site of each leak. In this case, due to an unrepairable system error in these particular machines, the downloadable electronic database is simply providing the wrong year. This error is easily recognized and the other, redundant data sources, can confirm the correct date. As a further source of accurate data, all errors are kept in an error log that documents all the data errors found, explains the reason for the errors, and explains the action taken to address the problem. In this case, going forward, we will attempt to use other HFSs with operational date/time functions to monitor results whenever possible, as the monitoring requires fewer HFSs.

  HFS memory files for some reason due to coding error are found in both the following date format mm/dd/yyyy or mm.dd.yyyy or mix of those two formats. Both types of dates convert into Excel improperly. Excel also does not recognize date as a date after the conversion. Edits were made, and these date formatting errors now conform to the format dd.mm.yyyy that is recommended in the PDD.

Database Managers

Responsibilities

The Database Manager supervises on a daily basis the Operating Managers' work of entering all baseline, measurement, repair and monitoring data into an excel spreadsheet, known as the Project Database. In addition, the Database Manager performs a Quality Assurance and Quality Control function. They check for reasonableness and accuracy of all data entered by Operating Managers into the Project Database using Excel Forms transcribed by members of the LDMT from their Field Notes.

Detailed Description of the Work Performed by Database Managers

Data entry

Most of the Database Managers' information was supplied by the LDMT. The information was contained within an Excel form transcribed from a Field Report. For the purpose of recording a leak and its ongoing monitoring, data for the following fields was entered into the Project Database:

- Number and location of the regulator system (street address and building number & GPS Coordinates)
- Region within BGDCL
- Name of operator in Leak Detection and Technical Measurement Team.
- Name of responsible person on the Repair Team
- Leak number (code)
- Type of facility surveyed (Residential or Commertial Gas Metering System)
- Component that was leaking
- The leak flow rate
- Hi-Flow Sampler instrument number
- Leak record number in the Hi-Flow Sampler memory (1-999)
- Date and time of measurement / repair (dd-mm-yyyy)
- Digital photo number(s)
- The date of leak detection (dd-mm-yyyy)
- The date of leak repair (dd-mm-yyyy)
- The date of each monitoring action (dd-mm-yyyy)
- The date of leak re-repair (If necessary) (dd-mm-yyyy)
- The measurement method (Leaks were first sought using a Gas Surveyor. When leaks were present, all measurements of actual leak flow rates were taken using Hi-Flow Samplers. The HFS number responsible for each measurement was recorded)
- The nature of the repair made (Whether or not it involved replacement of equipment, usage of PTFE tape or another method)
- Form of re-repair (If necessary)
- Note about any removal of equipment with leaks and any shut off occurrences.

As the average lifetime of the equipment was determined during validation to be beyond the duration of the crediting period, all non-replaced equipment is eligible for credits from repairs.

Quality Control and Quality Assurance

- **Reasonableness:** The Database Manager checked all data for reasonableness before it was entered into the Project Database. For example, if an operator entered a date incorrectly, such as an illogical time series, then the Database Manager spotted the error and asked the operator to check his field notes for manual transcription error. The minor error caused by inconsistent date conventions would be quickly caught and addressed through the QA/QC steps.
- **Materiality:** All baseline leak flow rate measurements that were recorded in excess of 20 litres CH_4 per minute were subject to additional scrutiny: The Database Managers requested that members from the LDMT check all data fields for any transcription error before adding such data to the Project Database.
- **Tracking by HFS and LDMT unit:** Each measurement of a leak flow rate entered into the Project Database can be associated with a given unit from the LDMT and a given Hi-Flow Sampler unit. Such granularity helps the Database Managers isolate problems in data entry to one two-person unit or associate faulty measurements with one Hi-Flow Sampler unit. The Database Management Team did not identify any systemic problems with any particular unit or Hi-Flow Sampler unit.

Data Protection and Storage

The protection of data is vital to the Project. Parties involved in the Project have followed the three guidelines described, namely:

- MBS has, during their visits to BGDCL, returned to their offices in Kyiv with digital copies of BGDCL Project Data. All the data was stored by PSL as well. Then the data was kept on individual computers at the PSL offices. Climate Compass has also stored backup files.

Repair Team

Responsibilities
The Repair Team was responsible for repairing leaks identified by the LDMT. All members of the Repair Team were trained in the use of modern repair materials and techniques. The Repair Team was in place during the initial repair period and continues to be available to redo repairs that have started to leak again during part of the measurement period.

Training
The project manager trained each member of the Repair Team, with assistance from MBS. Members from the Repair Team were forbidden to use anything other than the modern repair materials listed below.

Modern Repair Materials and other equipment supplied to the Repair Teams
- Rental car
- Tags (To replace missing tags and indicate repair information on tags)
- Modern Repair Materials such as:
  - **Tangit thread** – Thin synthetic thread absorbed by silicon for sealing pipe threads of 15-25 mm diameter.
  - **O-rings –** Made of high quality nitrile rubber for replacement in leaky gaskets made of rubber
  - **Paste** – High quality made for sealing conical connections of low pressure valves
  - **Valves** – For replacement broken high and low pressure valves
  - **Pressure regulators** - to replace broken bodies of such regulators
  - **Membrane material sheets** – For making new membranes
  - **Teflon tape –** High density Gas PTFE tape for sealing pipe threads (Pipe diameter – 15-50 mm).
  - **Fittings and pieces of pipes with gas threads** – for replacement broken components
  - **Insulating Joints** – to replace broken leaky IJ
  - **Repair tools** – good quality gas wrenches to do repair

Description of Repair Process and Interaction with Leak Detection and Measurement Team
Once a qualifying leak was detected by the LDMT (Regardless of whether it was a leak that qualified to be added to the Project Database or a re-appearance of a leak already present in the Project Database), a LDMT unit interacted with a Repair Team unit by first recording the leak's location, exact description, and other relevant information in a Field Report and upon its return to PSL, submitting a copy of its Field Report to the Repair Team unit. Each Cell from the LDMT were typically assigned to the same unit of the Repair Team to facilitate communication, familiarity with a given district of BGDCL, as well as fulfil a QA/QC function (described below). The Repair Team unit subsequently visited the leak described in the Field Report and was responsible for implementing the repair and recording its work.

Rental Car Service

BGDCL lacks appropriate transportation for the CDM Project. Hence, for the duration of the Baseline Study and monitoring period, PSL hired vehicles, complete with drivers, of sufficient size and specification to allow members of the Repair Team and LDMT to fulfil its roles.

EcoGas Asia Project Team

Ecoeye Co., Ltd., and KOMIPO through EcoGas Asia have provided the capital necessary via Climate Compass to purchase equipment used to implement the Project, including purchasing modern repair materials, provided training in the use of modern repair materials and measurement equipment, rented vehicles, and purchased computers and software for the Project Database.

Climate Compass with its partners MBS Services and Brawa Consulting, provide project management, quality control and ongoing training of PSL Employees.

MBS

MBS Ltd., a Ukraine-based technical consultancy, has significant experience and expertise concerning the preparation and execution of gas leak reduction projects in transmission and distribution systems. MBS Ltd. has more than 6 fully trained and certified staff able to operate, calibrate, and manage the data outputs of Hi-Flow Samplers and other leak detection tools such as the Gas Surveyor. Certification was attested to by Heath Consultants the sole distributor of the Hi Flow Sampler.

MBS ltd. staff have logged thousands of hours taking leak measurements, assisting in database development and management and directing the day-to-day management of leak detection and repair programs. It has hands on experience working with many of the advanced repair materials required to eliminate leaks. Its team has surveyed gas systems and compressor stations for companies in Ukraine, Uzbekistan, Georgia, Egypt, Bangladesh and Pakistan.

MBS Ltd. was responsible during the monitoring period for quality control of the Project. MBS Ltd. was present in the field with PSL during parts of the monitoring period. During its visits MBS:

- Verified that maintenance and monitoring of leaks was being conducted in accordance with the monitoring plan.
    - MBS found that maintenance and survey of leaks was in compliance with the PDD requirements.
- Observed the project database manager work to ensure that data was being recorded and handled as per the requirements of the PDD requirements.
    - MBS found that the database manager's work was in compliance with the PDD requirements.
- Conducted audits of the data to ensure that adequate records were being kept, and that leaks found and leaks repaired were accurately documented in the database.
    - MBS concluded that adequate records were being kept and that leaks found and repaired were documented in hard form and then after some delay were transferred to the electronic database.
- Observed technical teams to ensure that they operated equipment and conducted leak detection, survey and repair work in the correct manner, and advised on any training needs required.
    - MBS concluded that the LDMT operated equipment and conducted leak detection and survey in the correct manner.
- Conducted on-the-ground assessments to verify that project implementation was on schedule and highlighted any risks of delay.
    - MBS tracked progress on-the-ground as the Project developed. Its presence ensured that members of the LDMT understood that their work was being externally audited.
- Verified repair/replacement schedule of any regulators that are due to be replaced or repaired for the coming year.

MBS verified historical data about replacements that corresponded to leaks in the Database.

Calibration of Monitoring Instruments

Calibration of Hi-Flow Sampler Equipment

PSL was provided with made-for-purpose calibration kits purchased from the Calibration Gas supplier Ukrmetrteststandard. The kit was used in conjunction with two specially manufactured gas mixtures at highly accurate known concentrations of methane (high and low concentrations) according to the HFS manual. Using the calibration kits and known methane concentrations in air inside the gas mixture cylinders to control the variable parameters, the operators enter into the Hi-Flow Sampler all the controlled and known parameters. Then they separately allow the known CH_4/air mixture at both high and low concentrations to flow into each Hi-Flow Sampler device. The device then automatically calibrates both of the hydrocarbon detectors (main and background) based on the entered input parameters.

The Hi-Flow Samplers supplied by EcoGas Asia were regularly calibrated while in use to ensure accurate measurements and to conform to the QA/QC procedure described in Appendix 5. All the measurements taken during the monitoring period were supported by the calibration efforts of Tuhin Shuvra Ghosh, Saifur Rahaman and Hosain Belayet. They have been fully trained in calibration techniques and logbook management by MBS.
MBS confirmed their qualifications for this task as part of their training function and the performance of the calibration supervisor is regularly checked as part of MBS's ongoing project review. They performed this task every month during the monitoring period when the units were in use, as is suggested by the Hi-Flow Sampler manual and as noted in the calibration section of Annex 5 of the PDD. In cases where use of the HFS was not needed for more than a month, they recalibrated the unit immediately prior to the equipment being used for the project. No measurements this monitoring period were taken by an HFS outside the manufacturers recommended calibration schedule. In the case where the Hi-Flow Sampler fell out of calibration, it remained unused during the impacted period. The date on which each Hi-Flow Sampler was calibrated is shown in the separate Calibration Log file that also demonstrates that every Hi-Flow Sampler measurement was taken with a unit that was calibrated within at least 30 days prior to that measurement.

Serial Numbers of the Hi-Flow Samplers used in this project and dates of calibration:

LP1002:	05/02/2021, 03/03/2021, 31/03/2021, 01/05/2021, 29/05/2021, 10/08/2021
NQ1000:	05/02/2021, 03/03/2021, 31/03/2021, 01/05/2021, 29/05/2021, 10/08/2021
NQ1002:	05/02/2021, 03/03/2021, 31/03/2021, 01/05/2021, 29/05/2021, 10/08/2021
NQ1009:	05/02/2021, 03/03/2021, 31/03/2021, 01/05/2021, 29/05/2021, 10/08/2021
LU1001:	05/03/2021
LX1011:	05/03/2021
MN1018:	05/03/2021
NQ1007:	05/03/2021

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

(Copy this table for each data or parameter.)

Data/parameter:	**GWP_{CH4}**
Unit	tCO2e/tCH4
Description	Global warming potential
Source of data	The Fourth Assessment Report of the Intergovernmental Panel on Climate Change

Value(s) applied)	GWP_{CH4} = 25 for the commitment period
Choice of data or measurement methods and procedures	4th Assessment Report of the IPCC
Purpose of data/parameter:	Convert tCH_4 to tCO_{2e}
Additional comments	This value applies for the calculation of the baseline and project emissions.

Data/parameter:	ConvFactor
Unit	tCH4/ Nm3 CH4
Description	The factor to convert Nm3 CH4 to tCH4
Source of data	-
Value(s) applied)	0.0007168
Choice of data or measurement methods and procedures	The leak flow rate (FCH4,j) and conversion factor (ConvFactor) should be reduced to the same reference conditions. As noted from correspondence by Heath Consultants the Hi-Flow™ sampler automatically accounts for standard temperature and pressure (i.e., 0 degree Celsius and 101.3 kPa) in its leak flow rate (FCH4,j) measurements. As such, a conversion factor (ConvFactor) of 0.0007168 reflects the methane density at 0 degree Celsius and 101.3 kPa, which is derived by dividing the methane density at standard conditions by Avogadro constant (22.414 l/mol). This value is taken from literature, and is applied to convert Nm3 CH4 to tCH4
Purpose of data/parameter:	This value applies for the calculation of the baseline and project emissions
Additional comments	The Hi-Flow™ Sampler automatically adjusts readings to standard temperature and pressure (0°C and 101.3 kPa) so conversion rate for these conditions is applied.

D.2. Data and parameters monitored

(Copy this table for each data or parameter.)

Data/parameter:	$T_{j,y}$
Unit	Hours
Description	The time the relevant component, in which physical leak j, occurred, would leak in the baseline scenario and would be eligible for crediting during the crediting year y (hours)
Measured/calculated/default	Measured and calculated
Source of data	Operational logs. The time period of any shutdown is subtracted from the CER calculation.
Value(s) of monitored parameter	Multiple Values for each leak ‘j’ (see CER calculation sheets for each leak including shut-offs where applicable)

Monitoring equipment	The dates of the various measurements are recorded directly by the operators on handwritten files and are captured electronically in the Hi-Flow Samplers and cameras.
Measuring/reading/recording frequency:	The measuring is ongoing throughout the monitoring period.
Calculation method (if applicable):	Hours of system operation are tabulated with any system shut offs affecting a leaking repair subtracted from the total hours of operation
QA/QC procedures:	Any outages resulting from system repairs will be documented and logged in the project database in the form of a reduction in the time of operation. To be clear, if an unrelated activity requires the shut-down of an already repaired piece of component, the hours of operation for every piece of affected component with be reduced in the database for the entire duration of the shut-down. Any other unscheduled shutdown will also be timed and accounted for through a reduction of operating hours
Purpose of data/parameter:	This value applies for the calculation of the baseline emissions
Additional comments:	Repaired equipment that is replaced before monitoring occurs will be excluded from CER calculations even if it was operational for some time during monitoring period.

Data/parameter:	T_z
Unit	Hours
Description	The time (in hours) the relevant component has been leaking during the crediting year y
Measured/calculated/default	Measured and calculated
Source of data	Operational logs and dates of repairs
Value(s) of monitored parameter	Multiple Values for each leak ‘j’ (see CER calculation sheets for each leak)
Monitoring equipment	The dates of the various measurements and repairs are recorded directly by the operators on handwritten files and are captured electronically in the Hi-Flow Samplers and cameras.
Measuring/reading/recording frequency:	The measuring is ongoing throughout the monitoring period.
Calculation method (if applicable):	Sum of the hours between the discovery of any new leak or reappeared leak and the date of repair. In the case the repair is made immediately upon discovery of the leak, the value will be zero.
QA/QC procedures:	Any outages resulting from system repairs will be documented and logged in the project database in the form of a reduction in the time of operation. To be clear, if an unrelated activity requires the shut-down of an already repaired piece of component, the hours of operation for every piece of affected component with be reduced in the database for the entire duration of the shut-down. Any other unscheduled shutdown will also be timed and accounted for through a reduction of operating hours
Purpose of data/parameter:	This value applies for the calculation of the project emissions
Additional comments:	To be conservative, it is assumed that any reappeared leak found in a given monitoring period occurred immediately after the previous monitoring period (or repair).

Data/parameter:	**Temperature and pressure of natural gas**
Unit	°C and bar
Description	Conditions observed at the point and time of the leak rate measurement
Measured/calculated/default	Included in the HFS measurement
Source of data	The Hi-Flow™ Sampler automatically adjusts readings to standard temperature and pressure (0°C and 101.3 kPa) and this is reflected in the machine's margin of error. Therefore, there is no need to monitor these parameters separately. They are integrated in the measurement results
Value(s) of monitored parameter	Included in the HFS reading of leak-rate. (See the CER calculation sheets)
Monitoring equipment	Temperature and pressure measurements are taken into account by the hi-flow sampler at the time of measurement and are integrated into the results from the hi-Flow sampler device.
Measuring/reading/recording frequency:	Measuring
Calculation method (if applicable):	Not applicable
QA/QC procedures:	The high flow sampler is calibrated and double checked every 30 days while in use with the date and signature of the person in-charge of the calibration recorded in a calibration log.
Purpose of data/parameter:	This value applies for the calculation of baseline and project emissions.
Additional comments:	Values accounted for in the HFS measurement.

Data/parameter:	UR_j
Unit	Fraction
Description	The uncertainty range for the measurement method applied to leak j
Measured/calculated/default	Calculated
Source of data	The manufacturer's documented margin of error ±10% per measurement and the data of each measurement.
Value(s) of monitored parameter	0.00146251 (see CER calculation sheets for complete calculation)
Monitoring equipment	Leaks are identified and measured using the Hi-Flow sampler. The serial numbers, calibration dates are listed above. The calibrations as per manufacturer's recommendation are valid for one month. The readings as per the operator's manual are ±10% accurate.
Measuring/reading/recording frequency:	Periodically
Calculation method (if applicable):	Estimated using a 95% confidence interval per guidance provided in Chapter 6 of the 2000 IPCC Good Practice Guidance. The URj is calculated using leakage flow rates and the respective UR of the Hi-Flow sampler used for the leak. The uncertainty calculations are included in the CER calculations spreadsheet.

QA/QC procedures:	The high flow sampler is calibrated and double checked every 30 days while in use with the date and signature of the person in-charge of the calibration recorded in a calibration log.
Purpose of data/parameter:	This value applies for the calculation of the baseline emissions
Additional comments:	Assures to a 95% level of confidence as per methodology that the measurement values used in the calculations are conservative.

Data/parameter:	$F_{CH4, j}$/$F_{CH4, z}$/
Unit	m³CH4/h
Description	The leak flow rate of methane for leak (j, z) from the leaking component
Measured/calculated/default	Measured
Source of data	From Hi-Flow™ sampler readings during on-site measurements
Value(s) of monitored parameter	See CER calculation sheet for the values of each j and z.
Monitoring equipment	Manufacturer procedures applied. Measurements with Hi-Flow™ Sampler are automatically adjusted to the methane content, temperature and pressure and, thus, will directly yield methane leak flow rates.
Measuring/reading/recording frequency:	At least once per monitoring period
Calculation method (if applicable):	Not Applicable
QA/QC procedures:	The high flow sampler is calibrated and double checked every 30 days while in use with the date and signature of the person in-charge of the calibration recorded in a calibration log.
Purpose of data/parameter:	This value applies for the calculation of baseline and project emissions
Additional comments:	Values taken from Hi-Flow sampler measurements.

Data/parameter:	BE_{CAP}
Unit	tCO2e
Description	Capped quantity of the baseline emissions, defined as the baseline emissions for the first year of the crediting period
Measured/calculated/default	Measured and calculated
Source of data	Monitored baseline emissions during the first year of the first crediting period
Value(s) of monitored parameter	1,387,409 per year 1,018,701 (268 days)
Monitoring equipment	Measurements of leaks taken with Hi-Flow Samplers
Measuring/reading/recording frequency:	Calculated after the baseline leak detection and repair period is completed for first monitoring period
Calculation method (if applicable):	Summing all baseline emissions repaired before the conclusion of the first monitoring period
QA/QC procedures:	Calculations crosschecked on the CER calculation sheet

Purpose of data/parameter:	Used in place of actual CERs calculated as they exceed the BE_{Cap} value.
Additional comments:	Capped value of CERs that can be claimed in any full 365-day monitoring period adjusted based on actual monitoring period.

D.3. Implementation of sampling plan

The project as registered does not use a sampling plan.

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

See the calculations in the CER calculation spreadsheet attached.

The fundamental calculation of baseline CERs for every leak as per the methodology is as follows:

The baseline leak flow rate (F_{CH4}) is measured using a HiFlow Sampler and converted from litres of CH_4 / minute to m³ CH_4 / h (ConvFactor) for each leak included in the baseline (j). Any reappeared leakage found during the subsequent monitoring is measured using the HiFlow Sampler in the same way and subtracted from the initial measurement. The calculated uncertainty (UR) of the measurement using the guidelines in the methodology is deducted from this leak rate to ensure a conservative result. This conservative leak rate value for each leak during the monitoring period is then multiplied by the hours of operation (t) of the same leak between the baseline measurement and the monitoring measurement taking into account any temporary shut-offs of the equipment. Finally, the number of tonnes of CO2e emission reductions generated in the monitoring period by each leak is calculated using the GWP of methane. The values for all the leaks monitored are then added together to get the CER amount. The calculations are found in more detail in the CER calculation spreadsheet provided. The formulas that the baseline calculations are based on are as follows:

$$BE_y = \min\left\{BE_1, ConvFactor \times \sum_j \left[F_{CH4,j} \times T_{j,y} \times \left(1 - UR_j\right)\right] \times GWP_{CH4}\right\}$$

With,

$$BE_1 = ConvFactor \times \sum_j \left[F_{CH4,j} \times T_{j,y=1} \times \left(1 - UR_j\right)\right] \times GWP_{CH4}$$

Where:

BE_1 = Baseline emissions for the first crediting year of the crediting period (tCO_2e).

BE_y = Baseline emissions for crediting year *y* (tCO_2e)

ConvFactor = Conversion factor to convert Nm³ CH_4 into tCH_4. The Hi-Flow sampler automatically accounts for standard temperature and pressure in data readings; as such this factor amounts to 0.0007168tCH_4/Nm³ CH_4 (i.e., 0 degree Celsius and 101.3 kPa).

j = All physical leaks that are included in the project activity for which physical leaks were detected and repaired and which would leak in the baseline scenario during the crediting year *y*.

$F_{CH4,j}$ = Measured flow rate of methane for the physical leak *j* from the leaking component (Nm³ CH_4/h)

UR_j = Uncertainty range for the flow rate measurement method applied to physical leak *j*. The uncertainty of the measurement is taken into account by using the flow rate at the lower end of the uncertainty range for the measurement at a 95% confidence interval for baseline emissions from leaks
$T_{j,y}$ = The time the relevant component, in which physical leak *j* occurred, would leak in the baseline scenario and would be eligible for crediting during the crediting year *y* (hours)
GWP_{CH4} = The global warming potential for methane valid for the commitment period (tCO_2e/tCH_4). After the commitment period, this value may be revised based on any decision by the CMP.

Uncertainty is calculated using the following formula:

$$UR_j = \frac{\sqrt{(UR_1 * x_1)^2 + (UR_2 * x_2)^2 + ... + (UR_n * x_n)^2}}{x_1 + x_2 + ... + x_n}$$

Where
UR_j = the percentage uncertainty in the sum of the quantities (half the 95% confidence interval divided by the total (i.e. mean) and expressed as a percentage);
x_n and UR_n = the uncertain quantities and the percentage uncertainties associated with them, respectively.
(Note: "n" in this case refers to each recorded leak rate of each component surveyed)

E.2. Calculation of project emissions or actual net removals

There are no project emissions

E.3. Calculation of leakage emissions

NA

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or baseline net GHG removals ($t CO_2e$)	Project GHG emissions or actual net GHG removals ($t CO_2e$)	Leakage GHG emissions ($t CO_2e$)	GHG emission reductions or net anthropogenic GHG removals ($t CO_2e$)			
				Before 01/01/ 2013	From 01/01/ 2013 until 31/12/ 2020	From 01/01/ 2021	Total amount
Total	1,000,730	0	0	0	130,692	870,038	1,000,730

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period ($t CO_2e$)	Amount estimated ex ante for this monitoring period in the PDD ($t CO_2e$)
1,000,730	1,792,609 (268 days)

E.5.1. Explanation of calculation of "amount estimated ex ante for this monitoring period in the PDD"

The estimated annual PDD volume adjusted for 268 days instead of 365. (2,441,426 *(268/365))

E.6. Remarks on increase in achieved emission reductions

The calculation of CERs has been done in an accurate, reliable and conservative way and in accordance with the monitoring plan established in approved PDD. The higher actual CER value is a result in part of leaks being found with higher leak rates than anticipated and more leaks being found than anticipated. The value estimated in the PDD was based on an extrapolation from a small sample done as part of a project feasibility study. Only by actually undertaking a full leak identification study across the entire set of equipment can the true leak reduction potential of the system be established since leak frequency and leak rates varies across this large gas distribution system.

E.7. Remarks on scale of small-scale project activity

Not Applicable.

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Document information

Version	Date	Description
08.0	6 April 2021	Revision to: • Reflect the “Clarification: Regulatory requirements under temporary measures for post-2020 cases” (CDM-EB109-A01-CLAR).
07.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Add a section on remarks on the observance of the scale limit of small-scale project activity during the crediting period; • Add "changes specific to afforestation or reforestation project activity" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R project activities between two commitment periods; • Make editorial improvements.
06.0	7 June 2017	Revision to: • Ensure consistency with version 01.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.

Version	*Date*	*Description*
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.

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