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

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Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

>>Leak Reduction in Above Ground Gas Distribution Equipment in the KazTransgaz-Tbilisi Gas Distribution System- Tbilisi, Georgia
Version 1
20/03/2008

A.2. Description of the project activity:

Even extremely well maintained gas distribution systems that invest heavily in maintenance suffer from leakage. Georgia has suffered through a lengthy economic transition period following the break-up of the Soviet Union. This has caused numerous public works systems to fall into disrepair. Funds, equipment, trained staff have all been in short supply in the Tbilisi gas distribution system leading to high leakage rates.

This project will aim to reduce leaks at above-ground infrastructure in the Tbilisi gas distribution system specifically gas leaks at gate stations and pressure regulator stations, valves and fittings, as well as connection points with industries and residential buildings. In addition to reducing gas losses (and thus financial losses), this project will help improve the company's standing in terms of corporate sustainability and environmental management.

Gate stations and surface facilities contain equipment components such as pipes, valves, flanges, fittings, open-ended lines, meters, and pneumatic controllers to monitor and control gas flow. Over time, these components can develop leaks in response to temperature fluctuations, pressure, corrosion and wear. In general, the size of the facility and the facility leak rate correspond to the inlet or upstream gas pressure; the higher the inlet pressure, the larger the gate station and the greater the number of equipment components that may develop leaks.

Direct inspection and maintenance (DI&M) is a cost-effective way to reduce natural gas losses from equipment leaks. A DI&M program begins with a comprehensive baseline survey of all surface facilities in the distribution system. Operators identify, measure, and evaluate all leaking components and use the results to direct subsequent inspection and maintenance efforts.

This project will survey all surface facilities in the Tbilisi area and repair the leaks that are generating the greatest level of fugitive emissions. The project will survey stations, identify and tag leaks, repair those leaks and conduct re-screening in accordance with UNFCCC guidelines to ensure the leak repairs have been maintained. Emission reductions can then be calculated and eventually CERs issued on that basis. The main leak detection and quantification technology used will be the high-flow sampler (or "Hi-Flow Sampler"), which is an advanced way to detect and measure leaks in gas infrastructure.

Steps in Project:

1. The Detailed Baseline Survey/Leak Screening, Measurement and Repair: The baseline survey is designed to determine the level of leaks and emissions - against which emission reductions will be calculated. During the baseline survey, a technical expert will walk through the entire surface facility with the appropriate equipment to identify leaks. For each leak, the following will be done:

- note the date of leak detection;
- note the date of leak repair (some leaks may require additional equipment replacement);
- note the exact location of the leak;
- measure the leak flow rate (volume per time);
- note the measurement method in order to determine the uncertainty range.

All data collected during the baseline and project implementation will be entered into a database. The database will be continuously updated during the crediting period, including when new leaks are detected and repaired.

2. On-Going Monitoring Plan: The on-going monitoring plan is perhaps the most important part of the project. Because the CDM process is so highly regulated, monitoring reports are scrutinized very closely by the independent verifier. Thus all data will be collected and the monitoring plan must be implemented in exact accordance with the methodology.

3. Training of Staff and Equipment: As part of a project, experts can provide the equipment to conduct on-going leak measurements and the necessary training for staff in how to use the equipment.

Contribution to Sustainable Development: In addition to reducing emissions of a potent greenhouse gas, this project will also help preserve a finite resource (natural gas). The reduction in gas losses will mean that the same amount of service can be provided to customers of KazTransgaz-Tbilisi but with a lesser amount of gas required. Stretching the use of a finite resource by using it more efficiency – and preventing the waste of that resource – is an important example of sustainable development.

Since, Georgia has very small indigenous fossil fuel resources. It has a harsh winter and needs to heat homes and businesses. Fuel costs present a substantial problem as regional gas prices have greatly increased as Georgia's main gas supplier Russia has raised rates. Every m3 of gas that is lost through leaks is a drain on Georgia's economy. Reducing waste such as leaking natural gas from pipes is a critical step in increasing efficiency and reducing dependence on expensive and volatile foreign sources of energy.

A.3. Project participants:

Name of Party Involved	Private or Public Entities	Indicate if the Party wishes to be considered a project participant (Yes/No)
Government of Georgia (Host)	☑ KazTransGaz-Tbilisi	No
No Annex 1 Party yet identified	☑ Climate Change Capital Fund II s.a.r.l.	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

The project is located in the Gas Distribution System in Tbilisi Georgia. The system extends through most of the city. The exact details of the location of all the leaks identified in the system and repaired will be recorded in the monitoring system database.

A.4.1.1. Host Party(ies):

Georgia

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

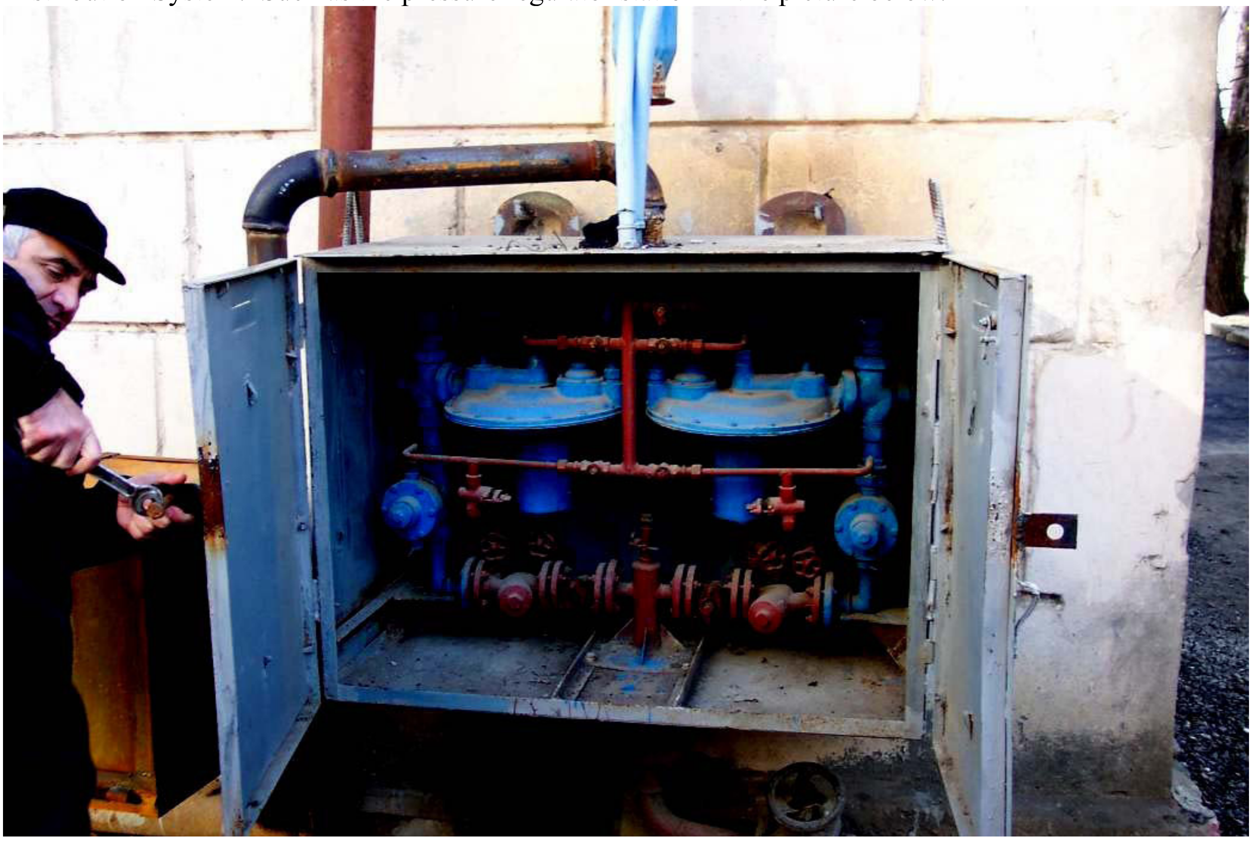
Capital City

A.4.1.3. City/Town/Community etc:

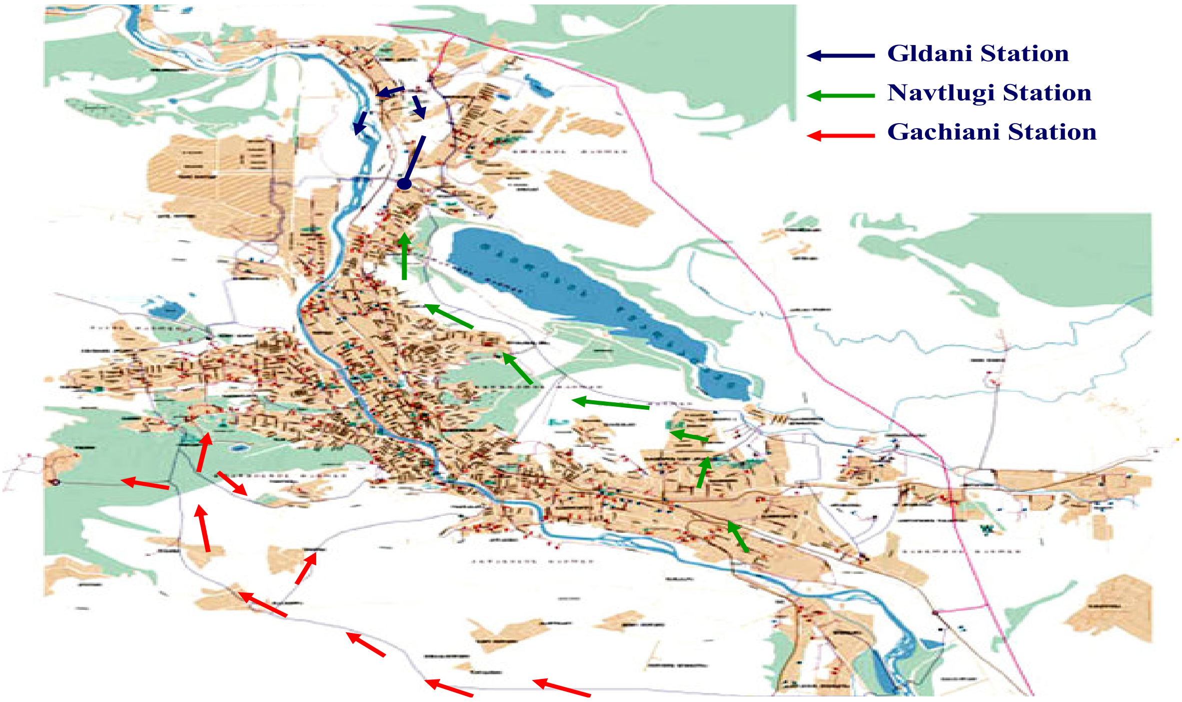
Tbilisi

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

The physical location for this project activity will be all of the surface facilities included in the Tbilisi Gas Distribution System. Such as the pressure regulator station in the picture below.



Tbilisi Gas Distribution System



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

Sector Scope 10 Fugitive Emissions of Methane from Natural Gas Leaks

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

This project will use a high volume sampler to identify and measure leaks in surface facilities. High Volume Samplers capture all of the emissions from a leaking component to accurately quantify leak emissions rates. Leak emissions, plus a large volume sample of the air around the leaking component, are pulled into the instrument through a vacuum sampling hose. Sample measurements are corrected for the ambient hydrocarbon concentration, and mass leak rate is calculated by multiplying the flow rate of the measured sample by the difference between the ambient gas concentration and the gas concentration in the measured sample. High volume samplers measure leak rates up to 8 cubic feet per minute (scfm), a rate equivalent to 11.5 thousand cubic feet (Mcf) per day. Two operators can measure 30 components per hour using a high volume sampler, compared with two to three measurements per hour using bagging techniques.

After the leak is detected, the actual materials and equipment used to repair the leaks can vary from replacing seals, fittings, valves and other leaking components or replacing entire equipment sets.

The advanced technology including the hi-flow sampler used to identify and quantify leaks has been provided to the gas distribution company. The gas utility has been trained on the use of the equipment. Six teams of three staff are now certified on the equipment and have been trained as leak reduction experts. This training has been supplemented with a return visit by the trainers to ensure accurate and appropriate measurements have been taken.

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

Please indicate the chosen crediting period and provide the total estimation of emission reductions as well as annual estimates for the chosen crediting period. Information on the emission reductions shall be in indicated using the following tabular format.	
Year	Annual estimation of emission reductions in tonnes of CO2 e
2009	350,000 (est.)
2010	350,000
2011	350,000
2012	350,000
2013	350,000
2014	350,000
2015	350,000
2016	350,000
2017	350,000
2018	350,000
Total estimated reductions (tonnes of CO2 e)	3,500,000
Total number of crediting years	10 years
Annual average over the crediting period of estimated reductions (tonnes of CO2 e)	350,000

A.4.5. Public funding of the project activity:

No Public funding has been provided.

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:

AM0023- Leak reduction from natural gas pipeline compressor or gate stations --- Version 2.

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

The Tbilisi Gas distribution system as per the requirements of the methodology has numerous surface facilities subject to leaks including pressure regulation stations.

The project is fundamentally the establishment of an advanced leak detection and repair practice at the gas distribution company. Due to the economic hardship caused first by the transition from Soviet control to an independent state and then difficulties with payment collections, brain-drain, and budget shortages, the Tbilisi gas distribution utility has lacked resources to purchase leak detection equipment, train staff, and other systems required to systematically identify and repair leaks. Using the hi-flow sampler and other advanced technology provided by the project, the project developers have been able to identify and accurately measure leaks. Finally, the project has resulted in the establishment of a system to ensure leaks repaired remain repaired.

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

	Source	Gas	Included?	Justification / Explanation
Baseline	Fugitive emissions	CO_2	No	Not relevant
		CH_4	Yes	This project activity will reduce emissions of methane from gas distribution facilities, which are above-ground. This project covers only methane, and the baseline will measure these emissions.
		N_2O	No	Not relevant
Project Activity	Fugitive emissions	CO_2	No	This project activity will use a device to measure and repair leaks. This device does not use any significant energy, and there is no leakage from these types of projects. Thus, there should be no project activity emissions from this project activity.

		CH_4	No	The monitoring function of this methodology is designed to ensure no methane is escaping from repaired leaks. If repairs cease to function for any reason, they are thrown out of the baseline for any time period the repair is not functioning. No new methane emissions will occur.
		N_2O	No	Not relevant

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

The project developer has undertaken to determine the baseline scenario and distinguish the baseline scenario from among other plausible scenario alternatives. This has been done by identifying alternatives that would yield the same or similar results as the proposed CDM activity and determine which would be the most plausible scenario. Given this kind of project, which is very specific to gate and pressure-regulating stations and other above ground equipment, the alternatives are very few:

A. Would this Project Happen Without CDM?:
This is a plausible alternative scenario since if KazTransGaz-Tbilisi had the resources, expertise, knowledge of leak detection technologies, etc outside the involvement of CDM, KazTransGaz-Tbilisi could implement the project without CDM to capture the benefits associated with reduced gas leakage.

While theoretically plausible, this scenario is not very realistic. As described in the additionality section below, no such technology or program has been used by KazTransGaz-Tbilisi in the past and very few utilities world-wide even in developed countries utilize the critical high-flow technology without the involvement of CDM. In fact, when this project was first proposed in Tbilisi, there was no organized leak detection and repair program. The distribution company had no access to leak detection and quantification equipment and in fact had never heard of the high-flow sampler technology. The staff of the company had experienced brain-drain which meant the operators in available to fulfill this type of project needed to be trained and fully equipped in order to undertake this effort and funds had to be found to pay for repairs. Given the historical track record of the Tbilisi gas distribution company since the fall of the Soviet Union indicating a lack of any kind of systematized repair program prior to CDM project implementation and the lack of resources and trained staff, it does not seem that this scenario is the most plausible.

B. Would Equipment be scheduled for replacement anyway?
Factoring Equipment Replacement:

It is a plausible scenario that the equipment that currently is leaking would be replaced over time anyway. Equipment in gas distribution systems typically is replaced after a given period of time.

While theoretically possible, this scenario is not highly plausible given the historical trends and current financial situation of the company. Fundamentally, the gas company lacks the resources to undertake any major investment in new above ground equipment so this is not a realistic scenario. For example, the company recently laid off a significant portion of staff assigned to maintain equipment. These critical staff members are being brought back through CDM tied resources to perform the basic leak identification staff. In addition, without the resources provided through a CDM related deal, the key personnel remaining would lack basic tools including consistent transportation to the field, leak detection equipment, and repair materials. In fact, the leaking equipment included in this project will continue to be used. The equipment being repaired still functions properly within the scope of the requirements of the gas system. It just is not properly maintained and repaired with appropriate new seals, fitting, valves, etc., so it leaks. The company is in a position where it has to continue to operate with its existing aging infrastructure for the foreseeable future.

C. *Continuation of the current operational situation:*
This is a plausible scenario. The current situation has existed at least since the breakup of the Soviet Union. The company has lacked the financial, technical, and human resources to undertake the kind of systematic leak detection and repair program undertaken through the CDM project.

This scenario, based on the factual evidence seen on the ground in the company seems the most plausible by far. Only with the initiation of the discussions around developing a CDM project and the initiation of a baseline study as part of the CDM process has KazTransGaz-Tbilisi gained knowledge of and access to advance leak detection and measurement technologies, had key staff members trained in the operation and implementation of a systematic leak reduction program, and had access to the funds required to execute the activities.

This is deemed the most plausible baseline scenario.

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): >>

To determine additionality, AM0023 uses a slightly-amended version of the Tool for the Demonstration and Assessment of Additionality ("Additionality Tool"), which will be used here. It includes the following steps:

Step 1: Have Similar Efforts Been Done at KazTransGaz's Facilities Before:

No leak detection using this kind of advanced technology (the hi-flow sampler) has taken place at KazTransGaz's facilities (inside the project boundaries) in the past. The introduction of the hi-flow sampler was a direct result of the goal to identify GHG-reduction projects and potentially use CERs to advance projects forward, and according to the manufacturer of this leak detection device, no hi-flow samplers have ever been sold in Georgia and have only entered the region through other JI/CDM projects. The technical partners from CCC who identified this opportunity, were specifically charged to help identify GHG-reduction opportunities, which would not have occurred without direct impetus of CDM.

No such leak detection, which will take place under this project activity, is required under Georgian law.

Step 2: Financial Incentive:

If the gas company has no financial incentive to reduce gas leaks – eg: if it is simply a transporter of gas that does not benefit from reducing losses – then additionality can be demonstrated. This is not the case for KazTransGaz; if it saves gas, it reduces its purchases from the transmission company GIC or can sell that gas to customers. Given this situation, the project participants have to use Step 3, described below.

Step 3: Barriers Analysis

Institutional Barriers: The kind of leak detection, repair *and* monitoring which will be required to generate CERs will be quite labor intensive. Given the other significant problems facing the distribution company including non-technical leakage and poor payment collection, leak reduction has not been a priority.

The labor, training and capital costs required to implement a successful leak identification and repair program is significant. A successful program does not simply involve surveying the stations and repairing them but *re-screening* each leak every year. If a leak is entered into the database and included in the baseline, that leak must be re-screened in order to ensure the leak remains fixed. This re-screening is a vital part of the monitoring of this project activity and critical to any systematic leak reduction and repair activity. To cover 2500-plus stations, this will require a number of trained staff members at KazTransGaz-Tbilisi that would not likely be available if KazTransGaz were not generating CERs. In fact, without the impact of the incentive, KazTransGaz-Tbilisi would not have any staff trained to undertake this project. Training on the hi-flow sampler and other critical leak detection approaches has been undertaken via the investment brought by CDM. In fact, several of the key staff have in fact had been laid-off prior to the kick-off of the CDM activity and are only being brought back to implement this project. Given the fact that no such leak management program for the target above ground equipment has taken place to date outside of CDM induced activities (using resources, training, equipment, expertise, etc. through CDM tied resources) and the company has subtracted the human resources required to implement these projects rather than add the skilled people required to do the project, it is clear that the goal of generating CERs – which initiated the first introduction baseline analysis – has created the awareness, capacity and incentive to begin such an intensive effort.

Financial Barriers: One of the main additional barriers to KazTransGaz-Tbilisi and in fact, many gas distribution companies in the Former Soviet Union, is a lack of access to capital to properly equip and train staff and purchase materials required to undertake repairs. The case of KazTransGaz in this regard is clear. KazTransGaz-Tbilisi, while the daughter company of a fiscally sound parent KazTransGaz, itself fundamentally lacks the resource to retain and train staff in the most advanced leak detection and quantification practices. Only through the involvement in CDM has a critical team of personnel been trained and retained within the company to undertake the project. The office that was nominally responsible for this activity prior to the involvement of CDM lack basic equipment such as transportation (they had intermittent access to cars- maybe only a few times a week, so at best only some of the team actually go into the field on any given day), they lacked leak identification and measuring equipment including the hi-flow sampler (discussed in more detail below), and other basic tools including ladders, cameras (to document leaks), etc. In addition, even if leaks had been identified, there were no materials to make the repairs. Any efforts and investment that are planned to upgrade the system have been focused on management issues and underground pipes.

One anecdotal piece of evidence from the initial study of the system done by Heath Consulting (U.S.A.) clearly demonstrates this point. During a leak identification and measurement exercise done by Heath, a man in an adjacent apartment building came out to speak with the team. He was excited because he thought the team was there to fix a gas leak that was so pronounced that the residents of the building had complained on numerous occasions for the leak to be fixed. He was frustrated to learn that the leak was just to be measured that day and not repaired. Clearly a major leak that had been repeatedly identified had not been repaired given the lack of materials and qualified staff to make repairs.

Technology Barriers: One of the chief reasons why this project is additional is because it involves the transfer of a state of the art new technology, a high-flow sampler, which has not been used by KazTransGaz-Tbilisi before and is just beginning to be used in developed country systems. In fact, Heath Consulting (the patent holder for the hi-flow sampler) is continually doing training for companies in the US, Canada, and Europe who are just being introduced to the hi-flow sampler. Additionally, repair materials such as Gore-Tex tape that will be used in some repair activities is 20 times as expensive as local products which have included temporary cloth based fittings that have been used in the past but is much more effective in reducing leaks.

During the initial leak survey, leak detection at the facilities was conducted using a combination of catalytic oxidation/thermal conductivity detectors (Heath Gasurveyors 6-500) and the Heath Remote Methane Leak Detector (RMLD), which operates by a Tunable Diode Laser Spectroscopy specifically for Methane gas. The RMLD was calibrated daily using a sample of 850 PPM Methane gas contained in a hermetically sealed calibration cell. All identified leaks (those that screened above 0.5% methane in air) were tagged and numbered.

Once leaks were identified, leak rate measurements were made using the Hi-Flow Sampler. The Hi-Flow Sampler makes leak rate measurements with the same accuracy as enclosure measurements but at a speed approaching that of leak detection screening instruments (Howard et al., 1994; Lott et al., 1995 Howard, 1995). The Hi-Flow Sampler uses a high flow rate of air to completely capture the gas leaking from the component. A catalytic oxidation/thermal conductivity sensor is used to measure the sample concentration in the air stream of the high flow system. The Hi-Flow Sampler essentially performs an enclosure measurement using the flow regime induced by the sampler instead of a physical enclosure. A description of the Hi-Flow Sampler and its advantages over typical screening and enclosure measurements is provided below.

Advantages of the Hi-Flow Sampler: Screening techniques, correlation equations, and enclosure (bagging) measurements have long been the standard techniques to measure fugitive emissions from leaking process components such as valves, flanges, and open-ended lines. Screening techniques originally started as a leak detection method only. Correlations were then developed to relate the concentration measured using a leak detection instrument to the leak rate. These correlations compare leak rates measured using enclosure methods to the maximum concentrations measured either 1 cm or 1 mm from the components using a leak detector such as organic vapor analyzer (OVA) (CMA, 1989; Webb and Martino, 1992). Although these correlations make it easy to estimate leak rates, the inaccuracies are unacceptable for true leak measurements. For any given leak, the estimated leak rate can vary from the actual leak rate by as much as a factor of 1,000. With these uncertainties, it is impossible to use screening techniques to determine which leaks are large enough to justify repair on a cost-effective basis.

The most serious drawback of using screening concentrations and correlation equations is their inability to accurately characterize leaks that are beyond the scale of typical leak detectors ("pegged sources"). The most common leak detector used when correlations are applied is the Foxboro OVA-108 (and a recent version, the TVA-1000), which uses a flame ionization detector. The sampling flow rate of the OVA-108 is approximately 1,000 ml/min, so if as little as 10 ml/min of methane is captured, the resulting concentration will be 10,000 ppm (1%) which is the upper limit of the instrument. Wind speed, distance of the probe from the leak, and characteristics of the leak such as exit velocity affect how much of the leak actually is captured by the sample probe. These uncertainties explain the large scatter in estimating leak rates using screening concentrations.

It is the pegged sources that contribute most to the facility emissions and losses. In our experience, 3% - 6% of the components in a natural gas transmission facility will leak and approximately 0.5 % will exceed the range of the leak detection instrument. One approach would be to repair all of the pegged source leaks, or repair a percentage of these leaks that is equal to the percent reduction of emissions that has been set as a goal. Unfortunately, this can be a costly and ineffective strategy. Because of their inaccuracy, screening measurements cannot be used to determine which leaks should be fixed first or what the leak reduction would result.

Bagging measurements are accurate but are too expensive and time consuming to measure every leak at a facility. In this method, the leaking component is wrapped with a nonpermeable material (such as Tedlar or Mylar) and a clean purge gas (such as nitrogen) sweeps through the enclosure at a measured flow rate. Vacuum bagging may also be performed.

To overcome the shortcomings of current leak measurement methods discussed previously, Indaco developed a system that is able to make measurements with the same accuracy as enclosure measurements but at a speed approaching that of leak detection screening measurements. The Hi Flow Sampler uses a high flow rate of air and a modified enclosure to completely capture the gas leaking from the component. Catalytic oxidation and thermal conductivity hydrocarbon sensors are used to measure the exit concentration in the air stream of the system. The Hi Flow Sampler essentially makes rapid vacuum enclosure measurements.

The Hi Flow Sampler is packaged inside a backpack, leaving the operator's hands free for climbing ladders or descending into manholes. The instrument is controlled by a handheld LCD with an integral 4-key control pad, which is attached to the main unit via a 6' coiled cord. The gas sample is drawn into the unit via a flexible 1 ½" I.D. hose. Various attachments connect to the end of the sampling hose providing the means of capturing all the gas that is leaking from the component under test.

The main disadvantage of the Hi-Flow Sampler is (1) the cost and (2) availability. The device is made only by one company in the US, and has never been used outside the US (with the exception of a donor-funded program in Ukraine and other CDM/JI projects). The device is very new to the market, and very few US gas companies use it. In addition, at a cost of $15,000 per unit, most gas companies – particularly distribution companies where the leaks would be lower than transmission companies – the potential level of leaks would not justify such a cost. This is particularly true if there are cheaper, albeit less accurate, alternatives.

Step 4: Common Practice Test: As stated above, all evidence indicates that no hi-flow sampler has been used in Georgia prior to the Project, demonstrating that this level of leak detection is certainly not common practice in Georgia. Evidence to support this assertion has been provided by the manufacturer of the hi-flow sampler. This project type in the Former Soviet Union is to the best of our knowledge, non-existent outside of CDM/JI. There are in fact, numerous examples of this technology and methodology being exploited in the former Soviet Union through JI and CDM.

Step 5: Impact of CDM Registration: This CDM project activity is bringing experts and technology to the table that would not exist otherwise. Specifically, this project has brought the hi-flow sampler to Georgia for the first time, along with one of the few experts in the world that know how to use it – Heath Consultants. Heath has trained the local KazTransGaz-Tbilisi staff in how to use the technology, which will be important to screen the entire population of pressure-regulator stations – as well as to carry on the monitoring each year. Climate Change Capital, a CDM developer, has also been brought in to assist in the monitoring plan and other aspects of CDM certification and eventual CER issuance. Without any of these partners, this leak detection program would not be taking place. In addition, CDM has brought direct upfront finance to the table to overcome lack of trained personnel, basic equipment (hi-flow samplers, transportations, ladders, etc.) and the materials required to repair the leaks.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Baseline Emissions: Baseline emissions are calculated in the following manner. For each leak identified, the high volume sampler captures all emissions from a leaking component to accurately quantify leak flow rates. Leak emissions, plus a large volume sample of the air around the leaking component, are pulled into the instrument through a vacuum sampling hose. High volume samplers are equipped with dual hydrocarbon detectors that measure the concentration of hydrocarbon gas in the captured sample, as well as the ambient hydrocarbon gas concentration. Sample measurements are corrected for the ambient hydrocarbon concentration, and the leak rate is calculated by multiplying the flow rate of the measured sample by the difference between the ambient gas concentration and the gas concentration in the measured sample. Methane emissions are obtained by calibrating the hydrocarbon detectors to a range of concentrations of methane-in-air. High volume samplers are equipped with special attachments designed to ensure complete emissions capture and to prevent interference from other nearby emissions sources. The hydrocarbon sensors are used to measure the exit concentration in the air stream of the system. The sampler essentially makes rapid vacuum enclosure measurements. The leak flow rate of methane is calculated as follows:

$$F_{CH4,i} = F_{sampler,i} \text{ x } (C_{sample,i} - C_{back,i})$$

where:

$F_{CH4,i}$ = the leak flow rate of methane for leak i from the leaking component (m^3/h),
$F_{sampler,i}$ = the sample flow rate of the sampler for leak i (m^3/h),
$C_{sample,i}$ = the concentration of methane in the sample flow from leak i (volume percent), and
$C_{back,i}$ = the concentration of methane in the background near the component (volume percent).

For each leak that is detected and repaired as part of the project activity, project participants will

- apply the established criteria in step 1 in order to identify whether the leak would also have been detected and repaired in the absence of the project activity;
- note the date of leak detection;
- note the date of leak repair;
- note the exact location of the leak;
- measure the leak flow rate (volume per time), as described further below;
- note the measurement method in order to determine the uncertainty range of the measurement;
- in cases where the repair involves a replacement of any equipment: note the date when the equipment would be replaced if the leak would not have been detected, using either the planned replacement schedule by the company or the difference between the average lifetime and the age of the equipment, whatever is earlier.

All data collected during project implementation should be entered into a database. The database should be continuously updated during the crediting period, including new leaks detected and repaired during the crediting period. The data in the database should also be included in each monitoring report.

Leakage: No leakage or project emissions are expected from this project

Emission Reductions

Emission reductions are calculated as follows:

$$ER_y = ConvFactor \times \sum_i \left[F_{CH4,i} \times T_{i,y} \times (1 - UR_i)\right] \times GWP_{CH4} \qquad \textbf{(4)}$$

where:

ER_y	=	the methane emission reductions of the project activity during the period y (tCO_2 equivalents)
$ConvFactor$	=	the factor to convert m^3 CH_4 into t CH_4. At standard temperature and pressure (0 degree Celsius and 1,013 bar) this factor amounts to 0.0007168 t CH_4/m^3 CH_4.
i	=	all leaks eligible towards accounting of emissions reductions, taking into account the guidance described above.
$F_{CH4,i}$	=	the leak flow rate of methane for leak i from the leaking component (m^3CH_4/h).
UR_i	=	the uncertainty range for the measurement method applied to leak i, determined, where possible, at a 95% confidence interval, consulting the guidance provided in chapter 6 of the 2000 IPCC Good Practice Guidance. If leak measurement equipment manufacturers report an uncertainty range without specifying a confidence interval, a confidence interval of 95% may be assumed.
$T_{i,y}$	=	the time (in hours) the relevant component for leak i has been operating during the monitoring period y, taking into account the guidance described above (e.g. regarding deductions for broken leaks)
GWP_{CH4}	=	the global warming potential for methane (tCO_2eq/tCH_4)

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

All parameters to be discussed are in Section B.7.1. It could be argued that the number of leaks is static and should be included in this table. However, the additional leaks may be discovered during the crediting period, and in any event, not all of the leak data may be available by the time of validation. Thus, in accordance with the *Guidelines for Completing the Project Design Document (CDM-PDD),* data not available at validation shall be put in Section B.7.1.

(Copy this table for each data and parameter)

Data / Parameter:	
Data unit:	
Description:	
Source of data used:	
Value applied:	
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

A total of 41 sites (1 gate station, 25 regulator stations, 15 private regulator facilities) and 25 area shut-off valves were surveyed during this work. At these facilities, a total of 1557 components were surveyed. During this survey, 165 leaks were identified and measured, amounting to a total leak rate of 353,100 m^3/yr, equivalent to 5296 metric tonnes/year of CO2 equivalent. The count of leaks includes six leaks that each measured less than 100 m^3/yr. This occurrence of leaks equates to a leak frequency of 10.6%, which is larger than the high end of the leak frequency range (3 to 7%) observed in similar studies at regulator stations in the North American natural gas industry. This data extrapolated over the entire system gives an estimated 350,000 tonnes of CO2 eq emissions reduced per year. More detail on each leak, including its location and leak rate will be provided to the validator.

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

Year	**Estimation of project activity emission (tonnes of CO2 e)**	**Estimation of baseline emission (tonnes of CO2 e)**	**Estimation of leakage (tonnes of CO2 e)**	**Estimation of emission reductions (tonnes of CO2 e)**
Year 1	0	350,000	0	350,000
Year 2	0	350,000	0	350,000
Year 3	0	350,000	0	350,000
Year 4	0	350,000	0	350,000

Year 5	0	350,000	0	350,000
Year 6	0	350,000	0	350,000
Year 7	0	350,000	0	350,000
Year 8	0	350,000	0	350,000
Year 9	0	350,000	0	350,000
Year 10	0	350,000	0	350,000
Total (tonnes of CO2 e) For 1st Crediting Period	0	3,500,000	0	3,500,000

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

B.7.1 Data and parameters monitored:

(Copy this table for each data and parameter)	
Data / Parameter:	1 *(i)* Total number of leaks
Data unit:	Number
Description:	Number of leaks identified, repaired and then resurveyed
Source of data to be used:	KazTransGaz-Tbilisi
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The number of leaks will be summed – with the leak rate of each added together as well – to determine the total amount of baseline emissions (and how much is reduced each year)
Description of measurement methods and procedures to be applied:	KazTransGaz-Tbilisi will count the number of leaks that it finds and enter them into a database.
QA/QC procedures to be applied:	Each leak will be tagged with a number and monitored after repair for any additional leaks.
Any comment:	

Data / Parameter:	2 *T(i)* Hours of operation, during which time the leak is venting gas
Data unit:	Time in hours
Description:	Hours of equipment operation for each leak
Source of data to be used:	KazTransGaz-Tbilisi
Value of data applied	The hours of operation is key because the leak survey itself is a snap-shot. That

for the purpose of calculating expected emission reductions in section B.5	leak rate will be multiplied by the hours the piece of equipment that has the leak is in operation for a year. Thus, if a leak rate is measured in m3 of CH4 per hour, multiplying by the hours of operation will give a total leak rate per year – for that leak. Many regulator stations will be continuously in service.
Description of measurement methods and procedures to be applied:	Data loggers will be installed wherever possible for machines that turn off frequently to measure hourly usage.
QA/QC procedures to be applied:	Data loggers will be installed wherever possible for machines that turn off frequently to measure hourly usage.
Any comment:	Hours of operation will end when the equipment concerned is replaced for a non-leak related reason (i.e. it breaks down), or when the date of predicted replacement as identified in the PDD is reached (whatever is earlier).

Data / Parameter:	3: Date of leak repair
Data unit:	Date
Description:	Date of when leak was repaired
Source of data to be used:	KazTransGaz-Tbilisi
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The date of the leak repair is important because that is the point at which emission reductions can be counted. If a leak is repaired in on day 120 of the year, the other 245 days can count for leak reductions, but obviously not the day before the leak rate. The emission reductions are calculated for each leak by taking the date of leak repair, multiplying by the hours of operation for the rest of the year FROM that date.
Description of measurement methods and procedures to be applied:	The date of repair will be entered into a database. Date of repair will be used along with hours of operation of equipment\ to determine total hours. In cases of re-emerging leaks, the re-emerging leak will be assumed to have occurred the day after the most recent check which showed no leak.
QA/QC procedures to be applied:	Work orders, receipts and other records will be kept in addition to repair logs
Any comment:	

Data / Parameter:	4: Leak Rate $F_{CH4,i}$
Data unit:	M_3 CH_4/hr
Description:	Leak rate of CH_4 for each leak detected
Source of data to be used:	KazTransGaz-Tbilisi
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The leak rate is the key baseline figure for this methodology. If the leak rate is X m3 of CH4/hour, that rate is multiplied by the hours of operation for the rest of the crediting period to determine baseline emissions. The reduction in the leak rate each year the leak is repaired is what is used to calculate emission reductions.

Description of measurement methods and procedures to be applied:	KazTransGaz-Tbilisi will use the high-flow sampler to measure leak rates; the procedure is described in previous sections.
QA/QC procedures to be applied:	Leak rates will be measured and double checked before repair-major discrepancies will warrant a third test. In other words, if a hi-flow sampler is used to measure the rate of a leak, if the results of two tests are far apart, the testing should continue until two measurements have results very close together (to reduce any inaccuracies in the testing process). Should the hi-flow sampler or other equipment need recalibration or adjustment to ensure their accuracy, the project participants will take the necessary action to do so.
Any comment:	Recorded at the high end of the leak detection equipment's margin of error. (if equipment measure .070 m^3/hr and has a ± ten percent margin of error then the project developer would use .063 m^3/hr)

Data / Parameter:	5: Temperature and Pressure
Data unit:	Degrees Celsius and Bar
Description:	Temperature and pressure of the gas when it is leaked – required to determine the density of the methane.
Source of data to be used:	KazTransGaz-Tbilisi
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The density of methane is required to convert a volume (m3) into a mass (kg of CH4) to eventually become TCO2-eq. The way to measure density is to take the volume, along with temperature and pressure. Density can be determined if these variables are known.
Description of measurement methods and procedures to be applied:	Temperature and pressure will be measured at the time of the leak screening and re-screening.
QA/QC procedures to be applied:	Data recording equipment will be calibrated and double checked on a regular basis.
Any comment:	Although these variables will be measured, it is not expected that there will be much variance because the pressure and temperature within stations are expected to be basically constant.

Data / Parameter:	6: Uncertainty factor
Data unit:	Fraction (eg: equipment is .95 or 95% accurate)
Description:	This variable reflects the fact that the leak measurement equipment is not 100% accurate
Source of data to be used:	Manufacturer of the high-flow sampler
Value of data applied	The uncertainty factor is discounted from the total leak rate. So if a sampler is

for the purpose of calculating expected emission reductions in section B.5	rated 95% accurate, all of the emission reductions would be discounted by 5% in order to be conservative.
Description of measurement methods and procedures to be applied:	The manufacturer will provide the rated accuracy, along with instructions about how to maintain the accuracy of the equipment.
QA/QC procedures to be applied:	The IPCC GPG can be consulted in compiling uncertainty estimates.
Any comment:	Estimated where possible, at a 95% confidence interval, consulting the guidance provided in chapter 6 of the 2000 IPCC Good Practice Guidance. If leak measurement equipment manufacturers report an uncertainty range without specifying a confidence interval, a confidence interval of 95% may be assumed.

B.7.2 Description of the monitoring plan:

Monitoring requirements
As part of monitoring, project participants should regularly monitor each leak included in the database. During these inspections, the same tools as described above should be used to detect any leaking from the repaired leaks. The following information should be collected:

- Date of monitoring;
- an assessment whether the relevant equipment has been replaced after the repair of the leak;
- the number of hours the relevant equipment was operating (not turned off) since the last monitoring inspection;
- an assessment whether the repair of the leak functions appropriately.

If the repair of the leak does not function appropriately, i.e. a leak at the same location is detected, project participants should note the date of leak repair. All information should be added to the database and be included in monitoring reports.

Monitoring plan will also cover the following key questions and will be presented upon project validation:

- Is the authority of project management clearly described?
- Is the authority for registration, monitoring, measurement and reporting clearly described?
- Are procedures identified for training of monitoring personnel?
- Are procedures identified for emergency preparedness for cases where emergencies can cause unintended emissions?
- Are procedures identified for calibration of monitoring equipment?

- Are procedures identified for maintenance of monitoring equipment and installations?
- Are procedures identified for day-to-day records handling (including what records to keep, storage area of records and how to process performance documentation)?
- Are procedures identified for dealing with possible monitoring data adjustments and uncertainties?
- Are procedures identified for review of reported results/data?

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 is undertaken by Kevin James of Climate Change Capital and Joseph Simonishvili of KazTransGaz-Tbilisi. It will be completed on May 1, 2008.

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:

June 1, 2008

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

15 years

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:

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C.2.1.2. Length of the first crediting period:

>>

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

June 1, 2008

C.2.2.2. Length:

10 years

SECTION D. Environmental impacts

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

There are no negative environmental impacts of repairing methane leaks from pipes. This project is well supported by the Georgian Government's stated Environmental Goals.

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:

NA

SECTION E. Stakeholders' comments

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

A stakeholders process will be completed before final Validation

E.2. Summary of the comments received:

To be completed before validation.

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

To be completed before validation

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public Financing was used for this project.

Annex 3

BASELINE INFORMATION

Select Excerpts from the Heath Consultants Report Prepared January 30, 2007 (the full report and the second pending report will be made available to the validators)

The Tbilisi Gas distribution system has been operating for approximately 45 years with 2027 kilometers of pipeline in the region. For the past 17 years the system has operated without cathodic protection. Approximately 1500 km of this system is underground with the remainder aboveground. The bulk of the system is steel pipe with only 10 to 12 km having plastic pipe. High pressure lines (3 to 6 bar) comprise approximately 200 km of the system, medium pressure lines (0.05 to 3 bar) comprise 400 km of the system, and low pressure lines (0.02 to 0.05) account for the majority of the system with approximately 1400 km.

Within Tbilisi, there are three gate stations which reduce transmission pressure (8 to 16 bar) down to the distribution network pressure (3 to 6 bar) and approximately 600 regulator stations owned by Tbilisi Gas, which regulate the distribution network pressures (ranging from 1.2 to 2.5 bar) down to lower pressures (0.02 to 0.03 bar) for residential service. There are also an estimated 2000 private regulator facilities in the Tbilisi region. Although these sites are private, Tbilisi Gas retains the right to maintain these facilities. During our five days of surveying from December 4 through 8, 2006, we were able to survey 41 different pressure regulating sites and 25 area shut-off valves for leak detection and measurement.

3.0 Field Program Description

During this leak survey, leak detection at the facilities was conducted using catalytic oxidation/thermal conductivity detectors (Heath Gasurveyors 6-500). The Heath Gasurveyor instruments were calibrated prior to the start of the survey using both 2.5% methane in air and 99% methane in air. All identified leaks (those that screened above 0.5% methane in air) were tagged and numbered, with the exception of some leaks below the measurement threshold of the Hi-Flow sampler (< 100 m^3/yr).
Once leaks were identified, leak rate measurements were made using the Hi-Flow Sampler.

The Hi-Flow Sampler makes leak rate measurements with the same accuracy as enclosure measurements but at a speed approaching that of leak detection screening instruments
(Howard et al., 1994; Lott et al., 1995 Howard, 1995). The Hi-Flow Sampler uses a high flow rate of air combined with a rapid enclosure to completely capture the gas leaking from the component. A catalytic oxidation/thermal conductivity sensor is used to measure the sample concentration in the air stream of the high flow system. A description of the Hi-Flow Sampler and its advantages over typical screening and enclosure measurements is provided in Appendix I.
The Hi Flow Sampler methane sensors were calibrated prior to the start of this project on December 1 also using 2.5% methane in air and 99% methane in air. This calibration was verified on December 18, 2006. The calibration of the sampler flow rate system was also confirmed before and after the project and is also shown in Appendix I. The methane sensors were also compared to the Heath Gasurveyor while in the field and found to match within 6%.

4.0 Field Measurement Results

Individual leak rates for all leaks are presented in the appendices. Leak rates sorted by leak identification number are presented in Appendix II. The leak identification number consists of a tag prefix (to identify the facility) and a tag number, both of which were written on the identification tag attached to the leaking component. Leak rates sorted by component category with emission factors are presented in Appendix III. Leaks sorted by leak rate are presented in Appendix IV. All yearly values are based on continuous leakage throughout the year. Figures 1 through 5 are illustrative pictures of the work sites during this survey.

Table 2 provides a summary of the results from the measurement program. A total of 41 sites (1 gate station, 25 regulator stations, 15 private regulator facilities) and 25 area shut-off valves were surveyed during this work. At these facilities, a total of 1557 components were surveyed. During this survey, 165 leaks were identified and measured, amounting to a total leak rate of 353,100 m^3/yr, equivalent to 5296 metric tonnes/year of CO2 equivalent. The count of leaks includes six leaks that each measured less than 100 m^3/yr. This occurrence of leaks equates to a leak frequency of 10.6%, which is larger than the high end of the leak frequency range (3 to 7%) observed in similar studies at regulator stations in the North American natural gas industry.

6.0 System Wide Leak Rate Projection

Two methods can be used to project the total leak rate from the above ground components of the entire Tbilisi Gas system. An individual emission factor for each type of facility (gate station, regulator station, regulator cabinet, and private facility) can be calculated and then multiplied by the total number of each of those types of facilities. However, this method does not account for the leak rate from the area shut-off valves. Although an emission factor can be calculated for these components, an accurate estimate for the total number of these shut-off valves is not available.

Alternatively, a more generic emission factor for all of the facilities in the area can be calculated by dividing the total leak rate measured during this project by the total facilities surveyed. This factor then also accounts for the shut-off valves in the same approximate area that was covered by the survey. Using this method, the total projected leak rate from the Tbilisi Gas above ground components would be 22,400,000 m^3/yr, equivalent to 336,000 metric tonnes CO_2 equivalent. If the area valve leakage is not included, the total projected leak rate would be approximately 17,200,000 m^3/yr, equivalent to 258,000 metric tonnes CO_2 equivalent.

Another uncertainty in the leak rate projections is the possibility that some repairs were made prior to the start of the measurement program. The project manager from Tbilisi Gas felt strongly that this was a possibility. These repairs may have been made due to a misunderstanding by repair technicians about the purpose of the project, or possibly due to concern that large leak rates might reflect badly on the maintenance crews. If such repairs were made, then the actual total leak rate from the system may be larger than the projected totals discussed above.

Annex 4

MONITORING INFORMATION

Monitoring requirements

As part of monitoring, project participants should regularly monitor each leak included in the database. During these inspections, the same tools as described above should be used to detect any leaking from the repaired leaks. The following information should be collected:

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- the number of hours the relevant equipment was operating (not turned off) since the last monitoring inspection;
- an assessment whether the repair of the leak functions appropriately.

If the repair of the leak does not function appropriately, i.e. a leak at the same location is detected, project participants should note the date of leak repair. All information should be added to the database and be included in monitoring reports

Monitoring plan will cover the following key questions and will be presented upon project validation:

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- Are procedures identified for day-to-day records handling (including what records to keep, storage area of records and how to process performance documentation)?
- Are procedures identified for dealing with possible monitoring data adjustments and uncertainties?
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