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:

Reduction of Methane Leakages in the Gas Distribution Networks operated by the company JP Serbiagas

PDD version 3
Date: November 7, 2011

A.2. Description of the project activity:

The infrastructure of a typical gas transport and distribution network includes high, medium and low pressure pipelines, gate stations, compressor stations, block stations, and pressure regulator and meter stations.

Methane emissions within gas networks result from normal operations, routine maintenance, fugitive leaks and unexpected system outages. As gas moves through a gas network, fugitive leaks can occur in all parts of the infrastructure, from connections between pipes and vessels, to valves and other specific equipment (e.g. flanges, threaded joints, meters). The leaks are caused by variations of atmospheric conditions (temperature, humidity, pressure) as well as natural deterioration and corrosion of valves and specific equipment over time.

The purpose of Reduction of Methane Leakages in the Gas Transport and Distribution Networks operated by the company JP Serbiagas (hereafter: "the project") is to reduce methane leaks in the high, medium and low pressure natural gas network operated by the state owned company JP Srbijagas[1] ("Serbiagas"), the major natural gas operator in the Republic of Serbia. The project activity entails the detection, measurement and repair of leaks in steel valves and fittings (flanges, threaded joints, stud bolts with hex nuts) located at gate stations, block stations and regulator stations, as well as other surface facilities such as the components outside of the compressor station hall and the stand-alone valves and fittings in the gas network. Collectively all valves and fittings included in the project activity shall be referred to as "components". The equipment and infrastructure within the compressor station hall (i.e. compressor) are excluded from the project activity.

Methane leaks will be detected using the Gasurveryor 3-500 and the methane leak rate will be measured using a Hi-Flow Sampler. Repairs will be carried out using a variety of best practice solutions which are superior to normal operations undertaken by Serbiagas (as described in section A.4.3). The best solution will be determined by assessment of the repair requirement for each component and will include the use of modern sealing materials made from polytetrafluoroethylene (PTFE) or, if required, extensive reconstruction of the component. Emission reductions will be calculated on the basis of the avoided

[1] JP Srbijagas, or JP Serbiagas, is Serbia's state-owned company, which engages in the transmission, distribution, storage, trade, and supply of natural gas for residential, commercial and industrial customers, and for power generation and district heating systems across the country. The company has 85% of the gas distribution market share in the Republic of Serbia. Serbiagas manages medium and low-pressure gas distribution systems with an annual gas throughput of about 2.5 billion cubic meters (bcm) with continuous increasing to reach 3.5 bcm in 2015. The distribution network covers 3650 kilometers (km) of pipes including 650 km of medium pressure (4 - 16 bar) and 3000 km of low pressure (less than 4 bar). Serbiagas transports more than 2 billion cubic meters (bcm) annually to major industrial customers and distributors via 2150 km of high pressure (16 - 50 bar) pipelines.

methane leakage. If a leak recurs, it will be measured and repaired again as per the methodology, and will be excluded from the calculation of the baseline emissions from the date of the previous inspection.

In the scenario prior to the implementation of the project activity, the volume of methane released to the atmosphere due to leaks is not monitored or measured. Components are not routinely inspected for leaks. Any detection of leaks is carried out only if a component appears to be severely damaged, or if it is heard or smelled during gas meter readings and routine activities at gate and regulator stations, in both rural and urban areas, and outside the compressor station hall. There is no inspection for leaks at stand-alone valves and fittings as there are no routine meter readings or other activities, and components are only checked if there is need for pipeline repair or maintenance. Repair activities are only carried out in the event that there is a safety concern. The repairs are carried out using klingerit (compressed asbestos jointing sheets) and/or by injecting grease.

The baseline scenario is the same as the scenario prior to the implementation of the project activity.

In addition to the reduction of methane emissions, the project activity will have important ancillary benefits toward sustainable development:

- energy conservation and sustainable use of natural resources by means of reducing natural gas distribution losses;
- improved health conditions for workers due to the elimination of asbestos in the current repair material;
- lower risk of accidents related to gas leaks;
- dissemination of modern technology related to leak detection and repair, as well as improved measurement practices.

The project will also help improve the company corporate sustainability, environmental management and operational practices.

A.3. Project participants:

Name of Party involved	Legal entities project participants (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (Yes/No)
The Republic of Serbia (host)	JP Srbijagas	No
United Kingdom of Great Britain and Northern Ireland	Natsource Europe Limited[2]	No

[2] Natsource Europe Limited is a subsidiary of Natsource LLC.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

The Project activities are focused on the gas transport and distribution network of the company JP Serbiagas

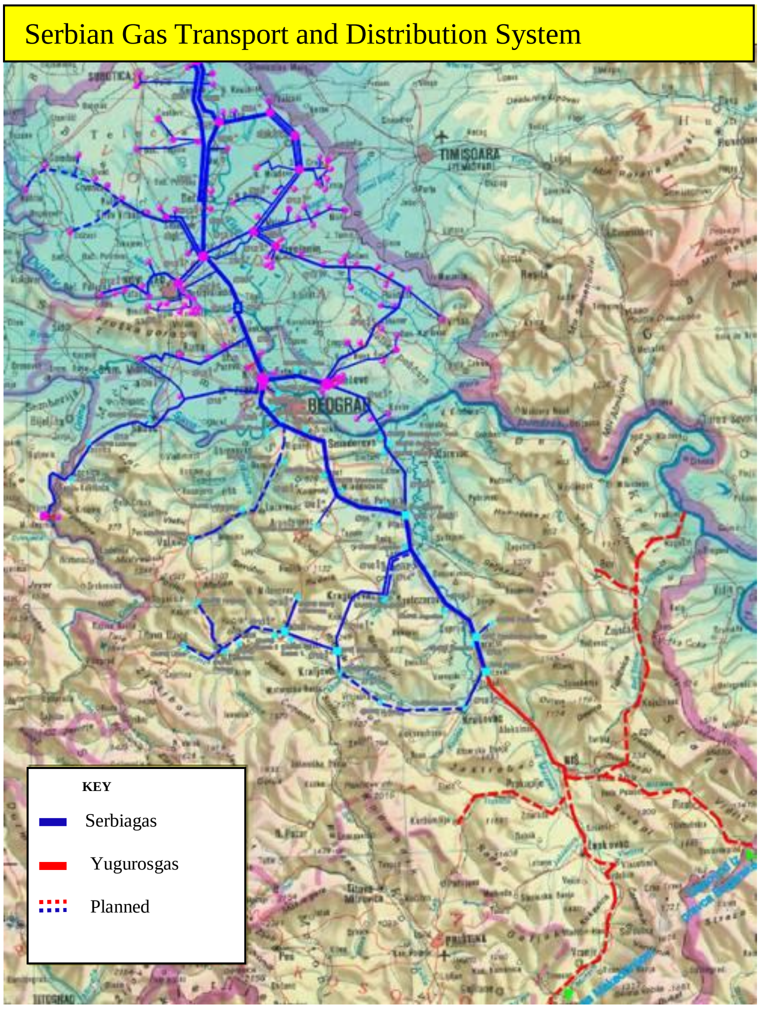

Figure 1 The gas transportation and distribution system in the Republic of Serbia

A.4.1.1. Host Party(ies):

The Republic of Serbia

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

The project activity will be implemented in the region of the city of Belgrade, the Autonomous Province of Vojvodina which includes the regions of: Central Banat, North Bačka, North Banat, South Bačka, South Banat, West Bačka, and Srem, and the following districts: Mačva, Kolubara, Braničevo, Podunavlje, Pomoravlje, Moravica, Šumadija, and Zlatibor.

Figure 2 Districts of Serbia, showing project boundary

A.4.1.3. City/Town/Community etc.:

Belgrade, Novi Sad, Subotica, Kikinda, Zrenjanin, Pančevo, Sremska Mitrovica, Sombor and Ruma.

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

The project will be implemented in the low, medium and high pressure gas distribution and transportation system, which includes 165 gate stations, 684 gas regulator stations, 1 compressor station[3], 250 block stations and 5800 km of pipelines. The geographic coordinates of the project region are:

- the most northern point is 46.172222
- the most southern point is 43.516666
- the most western point is 18.983002
- the most eastern point is 21.519444

The headquarters of Serbiagas is located at the city of Novi Sad. Its geographical coordinates are 45.251667, 19.836944.

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

Category of project activity: Sectoral scope 10 - Fugitive emissions from fuels (solid, oil and gas)

[3] Only the components outside of the compressor hall are included in the project boundary.

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

The project activity will be implemented on the steel connections between low and medium pressure pipelines, as well as the steel pipelines of the medium and high pressure transportation and distribution network operated by Serbiagas. The network is composed of 3000 km of low pressure pipeline (the project activity is only implemented at connection points with the medium pressure pipelines), 650 km of medium pressure pipeline and 2150 km of high pressure pipeline[4], as well as 165 gate stations, 684 gas regulator stations, 250 block stations and 1 compressor station.[5,6] There are roughly 16,500 valves and 66,000 fittings along the pipeline.[7] The average age of the transportation pipeline is 25 years and the average age of the distribution pipeline is 10 years.

In the scenario prior to the implementation of the project activity, there is no systematic approach to identify or repair gas leaks throughout the gas network, nor does Serbiagas have a schedule or designated budget for this. In the last two years, Serbiagas has undertaken only one leak-specific repair[8]. Routine checks for leaks are not a priority for the operation of the gas network. Inspection for leaks from components is carried out only as a secondary activity during routine meter readings, if there is indication of the presence of leaks such as major visual damage to a component, the leak is audible or the odour of natural gas is perceived. If leaks are suspected, a test is carried out using a simple soap solution. For domestic installations, leaks are detected using a Sewerin Snooper (domestic installations are not included in the project activity).

Leaks are reported to the technical support department, who carry out a repair if it is deemed there is a safety concern, such as risk of explosion. Leaks are repaired using klingerit (compressed asbestos jointing sheets) and/or by injecting grease. On the rare occasions when a valve is broken beyond repair (i.e. the valve is cracked or the thread has been stripped) then it is replaced[9].

Checks for leaks are also done in the event of pipeline repair work. If a section of the pipeline is to be serviced or repaired, the valves at either end of that section are closed to stop the gas flow. Following the closure, a check for internal leaks is done where the danger of explosion is greatest (there should be no gas in the pipe section if work involving activities such as welding is being carried out), but there is no check for external methane leaks into the atmosphere from those valves. Checks for leaks are also carried out before a new or repaired pipeline comes online.[10]

Serbiagas has two technical support departments, also referred to as Business Unit “Gas Pipeline Maintenance”, tasked with the maintenance of the network. The technical support department located in Novi Sad is responsible for the gas network in the autonomous province of Vojvodina, while the department located in Belgrade is responsible for the gas network in the city of Belgrade and the central and eastern networks.

This existing situation is the same as the baseline scenario.

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[4] http://www.srbijagas.com/?q=delatnosti/transport/transport_prirodnog_gasa and http://www.srbijagas.com/?q=delatnosti/distribucija/distribucija_prirodnog_gasa

[5] *Ibid* footnote 3.

[6] Number of stations provided by Serbiagas.

[7] Estimate of components in the network provided by Serbiagas.

[8] Work order # 02-02-1/89.

[9] Between 2009 and 2011, Serbiagas has replaced 12 defective valves and 1 flange. The work orders have been provided to the DOE as evidence.

[10] Article 113. Directive for management and maintenance of gas pipeline facilities.

Figure 3 Distribution network valve

The project activity involves transfer of technology (advanced leak detection, measurement and repair) to Serbia. The project activity entails the detection, measurement and repair of fugitive methane leaks from components in the gas network owned and operated by Serbiagas. The equipment that will be used in the project activity is manufactured by Heath Consultants, which is based in Texas, USA. Only components located at gate stations, block stations and regulator stations, as well as those at other surface facilities -- such as the exterior of or adjacent to the compressor station hall and the stand-alone valves and fittings in the gas network -- are included in the project activity. The project activity will not carry out leak detection and repair activities on any other equipment, such as compressors.

The technology and equipment used prior to and after project implementation is listed in Table A-1.

Table A-1: Comparison of baseline and project technology.

Activity	Baseline Equipment / Technology	Project Equipment / Technology
Leak detection	Soap solution Sewerin Snooper (for domestic installations)	Catalytic oxidation / Thermal conductivity detectors (Gasurveyor 3-500)
Measurement of leak volumes	None	Hi-Flow Sampler™
Leak repair	Klingerit and grease	Polytetrafluoroethylene (PTFE) sealant material or component reconstruction

During the implementation of the project activity, a unique serial number will be assigned to each component included in the project boundary. Each component will be checked for leaks using the catalytic oxidation/thermal conductivity detectors (Gasurveyor 3-500). The Gasurveyor is a highly accurate and reliable instrument in a durable, anti-static case. It operates at temperatures of -20 to 50 °C. Its sampling system is equipped with an integral pump with a flow fail sensor.

After a leak has been detected, the leak rate will be measured using a Hi-Flow Sampler. A Hi-Flow sampler is a portable, safe, battery-powered instrument designed to determine the rate of natural gas leakage around various gas distribution components. The Hi-Flow Sampler is equipped with a vacuum sampling hose that collects a large volume sample of the emissions from a leaking component. The gas leak rate can then be quantified by accurately measuring the flow rate of the sampling stream and the natural gas concentration within that stream. Technical details of the Hi-Flow Sampler are provided in Table A-2.

Table A-2: Hi-Flow Sampler specifications[11]

Detection method	Catalytic oxidation / Thermal conductivity
Range	0-5% methane, catalytic; 5-100% methane, thermal
Measured values	Gas sample flow rate Background gas concentration Sample gas concentration
Calculated values	Leak rate of component under test Leak concentration corrected for background
Measurable leak rate	0.05 to 10.50 SCFM
Accuracy of calculated leak rate	±10%
Operating temperature	0 to 50 °C

The Gasurveyor has a display showing whether there is a leak and the Hi-Flow Sampler has a display of the leak rate. Where leaks are detected, digital photographs will be taken of the displays; photographs will be time stamped, and will also include the serial number of the monitored/repaired component. The information will be written down at the time of measurement, and later inserted into a database.

Detected and measured leaks from components will be repaired using PTFE sealant material and/or by reconstruction. Replacement of valves will not be undertaken as part of the project activity. The use of PTFE sealants and the reconstruction of components will be a significant improvement compared to the current practice and technology used; it is expected to significantly reduce leaks in the transport and distribution system.

The repair process will be carried out on site. Repair procedures will include:

1. Depressurization of the gas station pipeline system using bypass sub-system.
2. Discharge of pressure in the fire safe valves.
3. Discharge of pressure in the valves of main pipeline.
4. Reconstruction of ball valves:
   4.1. Disassembly of ball valves.
   4.2. Removal and disassembly of valve stem and inspection for physical and chemical damage.
   4.3. Check and replacement of O-rings accordingly.

[11] Heath Consultants. Hi Flow sampler natural gas leak rate measurement. Instruction 55-9017 operation & maintenance. Rev.2 – May 2005.

- 4.4. Assembly of valve stem.
- 4.5. Flushing old lubricant/sealant out of the valves.
- 4.6. Injecting under high pressure fresh lubricant/sealant and final adjustment.
- 4.7. Servicing of the valve's flange connections:
  - 4.7.1. Release of stud bolts.
  - 4.7.2. Removal of worn seals.
  - 4.7.3 Replacement of seals and tightening of stud bolts.

5. Servicing of pipe's flanges:
   - 5.1. Release of stud bolts.
   - 5.2. Removal of worn seals.
   - 5.3. Replacement of seals and tightening of stud bolts.
6. Servicing of fittings:
   - 6.1. Release of fittings at threaded connections.
   - 6.2. Wrapping of PTFE sealant around fittings.
   - 6.3. Tightening and final adjustment of fittings.
7. Pressurize gas station pipeline system.

All repaired components will be checked immediately using the Gasurveyor to ensure there are no leaks remaining.

The project developer, Natsource Europe Limited ("Natsource") and its contractors will provide all of the equipment to detect and measure leaks, and the PTFE sealant material to repair the components. In addition, Natsource and its consultants will collaborate with Serbiagas staff to ensure that measuring instruments and repair materials will be used properly and that measurement and repair procedures will follow best practices.

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

A fixed crediting period (10 years) is adopted for the project. It is expected that the project activity will generate emission reductions of about 581,783 tCO2e per annum over the 10-year crediting period from 2012 through 2021.

Years	Annual estimation of emission reductions in tonnes of CO2 equivalent

2012 **2013** **2014** **2015** **2016** **2017** **2018** **2019** **2020** **2021**	**581,783** **581,783** **581,783** **581,783** **581,783** **581,783** **581,783** **581,783** **581,783** **581,783**
Total estimated emission reductions (tonnes of CO2 equivalent)	**5,817,830**
Total number of crediting years	**10**
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2e)	**581,783**

A.4.5. Public funding of the project activity:

No public funding from parties included in Annex I is provided for the project activity.

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 3
"Tool for the demonstration and assessment of additionality" – Version 05.2

This methodology and tool are available on the following website:
http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html.

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

The project activity will reduce methane leaks in the connections between low and medium pressure pipelines, as well as in the medium and high pressure pipelines of the natural gas transportation and distribution networks operated by Serbiagas. Domestic installations are not included in the project activity. The project activity satisfies all the applicability conditions in methodology AM0023, as described below.

Methodology AM0023 is applicable to project activities *"that reduce leaks in natural gas pipeline compressor stations and gate stations in natural gas long-distance transmission systems, as well as other surface facilities in gas distribution systems including pressure regulation stations by establishing advanced leak detection and repair practices".*

- The project activity meets the definition set out in AM0023; it entails the use of advanced technologies that would not have been used in the absence of the project activity (Gasurveyor 3-500, High-Flow Samplers and PTFE sealants) and will repair leaks in all valves and fittings in the project boundary as defined in section B.3, i.e. at gate, block and regulator stations, as well as other above-ground (stand-alone) valves and fittings of the pipelines in the gas transportation and distribution network.

Moreover, the project activity meets the applicability conditions of AM0023 as follows:

1. *Where natural gas pipeline operators have no current systems in place to systematically identify and repair leaks;*
   As described in Section B.4., Serbiagas does not have in place a systematic approach to detecting and repairing leaks. The company's internal gas network instruction manual, referred to as "The White Book" does not stipulate a requirement for the routine inspection of components or a requirement to repair leaks unless it is for safety concerns. As it is not required to carry out routine checks and repairs of leaks in the gas network, Serbiagas does not budget for these activities.
2. *Where leaks can be identified and accurately measured*;
   The baseline study (see Annex 3) shows that it is technically possible to identify and accurately measure leaks. As demonstrated in the barrier analysis in Section B.5. Serbiagas staff are not familiar with the equipment that will be used by the project activity. Natsource LLC has signed a contract[12] with Serbiagas to provide the financial resources for the acquisition of advanced leak detection and

[12] Emissions Reduction Purchase Agreement, executed 18 January 2011.

measurement equipment (Gasurveyors and Hi-Flow samplers), which will allow the identification and accurate measurement of methane leaks in the gas network.

3. *Where a monitoring system can be put in place to ensure leaks repaired remain repaired.*
   The project activity will enable the implementation of a monitoring system that will ensure the success of repairs. Serbiagas, in cooperation with “Energo-Sistem Limited” (Energosystems) will implement the project activities of detecting, measuring, repairing and documenting leaks during the crediting period. Serbiagas and Energosystems will form several CDM monitoring teams trained in the use of the advanced leak detection and measurement equipment. Annex 4 and Section B.7 provide detailed information on the monitoring responsibilities, teams and activities.

The methodology also applies if and only if the most likely baseline scenario is the continuation of the current leak detection and repair practices. As discussed in section B.4 of this document, the existing leak detection and repair practices for safety purposes using minimal basic technologies would have continued in absence of the project activity.

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

The physical boundary of the project activity will be the gate, block and regulator stations of the gas network, components on the exterior of and adjacent to the compressor station hall, and stand-alone valves and fittings on the gas transport and distribution pipeline. The equipment and infrastructure inside the compressor station (e.g. the compressors) and domestic installations are not included in the project boundary. Only methane emissions from unintentional leaks at components throughout the pipeline are included.

The project activity includes 165 gate stations, 684 regulator stations, 250 block stations and the components outside of the compressor station hall, and all stand-alone valves and fittings in the steel pipelines of the gas transport and distribution network. Approximately 16,500 valves and 66,000 fittings are included in the project boundary.

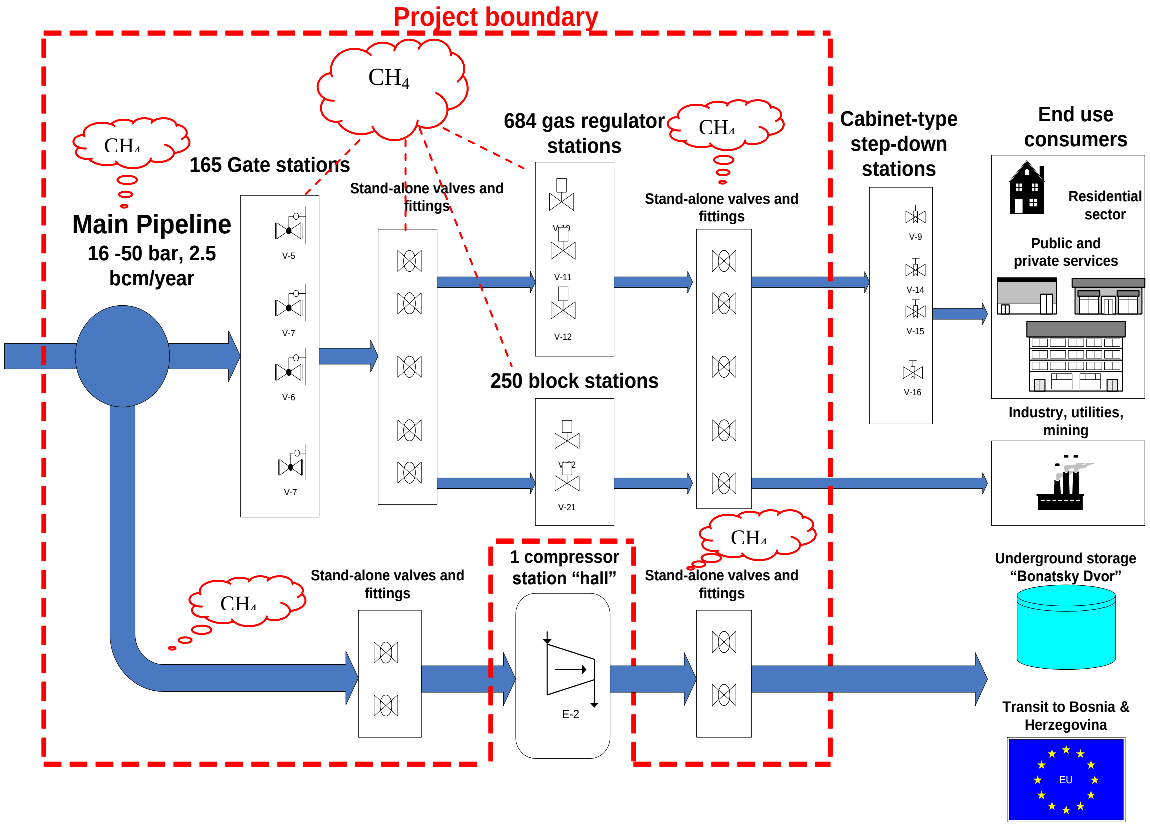

Figure 4 Project boundary diagram

Source		Gas	Included?	Justification / Explanation
Baseline	**Fugitive Emissions**	CO_2	Excluded	Not relevant to the project activity.
		N_2O	Excluded	Not relevant to the project activity.
		CH_4	Included	The main emission source. The project activity will reduce methane emissions from leaks in the gas distribution network operated by Serbiagas.
Project Activity	**Fugitive Emissions**	CO_2	Excluded	Not relevant to the project activity.
		N_2O	Excluded	Not relevant to the project activity.
		CH_4	Excluded	As per the methodology, any emissions due to recurring leaks will be excluded from the baseline emissions. Therefore, no project emissions are considered.

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

AM0023/Version 03 requires determining "*if similar efforts have been made or are expected to be made to reduce methane leaks from key components such as unit valves, blow down valves, rod packings and pressure relief valves, using similar capable leak detection and measurement technologies as described in this methodology*".

- Serbiagas has not undertaken similar efforts in any other key components of its gas network. Likewise, other gas transport and distribution companies in Serbia have not implemented advanced detection or repair technologies in their networks. Interviews with Serbiagas staff will confirm that this is accurate.

Step 1. Identification of alternatives to the project activity consistent with mandatory laws and regulations

Reasonable and credible alternatives which would produce the same or similar results as the proposed CDM activity have been considered for determining the baseline scenario. Two alternatives have been identified:

1. Continuation of the current leak detection and repair practices;
2. The proposed project not implemented as a CDM project.

Both alternatives are consistent with current laws and regulations.

Alternative 1: Continuation of the current leak detection and repair practices

Serbiagas does not carry out routine inspection and leak repair activities and does not measure the amount of gas lost due to leaks in components. The continuation of this practice is a realistic and credible alternative to the project activity as it is the least-cost option for Serbiagas.

There are no laws prohibiting leaks in a gas network. The operation of the gas network is regulated by the "Law on Pipeline Transportation of Gaseous and Liquid Hydrocarbons and Distribution of Gaseous Hydrocarbons (Official Gazette of the Republic of Serbia, No. 104/09)"[13] and the Energy Law (Official Gazette of the Republic of Serbia, No. 84/04)[14].

Law 104/09 requires the owner of the distribution network to developed internal procedures for the operation and maintenance of the network[15]. The law does not provide specific procedures that should be followed, and only requires that such internal procedures are in accordance with existing technical and regulatory requirements. To this effect, Serbiagas has developed and adopted the "Directive for management and maintenance of gas pipeline facilities", often referred to as the "White Book". The purpose of the document is to ensure the safe operation and maintenance of the gas network, in

[13] http://www.aers.org.rs/FILES/Zakoni/ZakonOCevovodnomTransportu_01regng.pdf
[14] http://www.aers.org.rs/Index.asp?l=1&a=91
[15] Article 11, Law on Pipeline Transportation of Gaseous and Liquid Hydrocarbons and Distribution of Gaseous Hydrocarbons (Official Gazette of the Republic of Serbia, No. 104/09)

compliance with local and international regulations and standards[16] (See Annex 6 for a list of laws and regulations).

The White Book defines leaks in the gas network as "uncontrollable leakage" that are "not being measured and not supervised" and occur in the gas network pipelines, joints and during the use of safety drainage valves. [17] The document further stipulates the repair of the leaks is the sole responsibility of the network owner.[18] The White Book only specifies the use of soap solution for the identification of leaks after any new pipeline installation or pipeline repair, [19] and does not specify any other equipment to be used for the repair. If a leak is found and determined to pose a safety risk, the current practice is to repair it using klingerit or by injecting grease. The activity only provides temporary repair of the leak. In addition, there is no procedure to check for the recurrence of a leak after repair. Due to the relatively poor quality of the sealing materials used, the recurrence of leaks between regular inspections is common. In rare occasions, a valve may be replaced to stop the leak.

Alternative 2: The proposed project not implemented as a CDM project

This alternative entails implementing leak identification, measurement and repair activities, without CDM. There are no laws which prevent the implementation of this project, nor are there any laws requiring a systematic approach to identifying, measuring and repairing leaks as intended in the project activity. Serbiagas does not incur any monetary loss in the form of penalties due to gas loss during distribution. Thus, this alternative is a realistic and credible alternative to the project activity.

Step 2: Elimination of alternatives using Step 3 of the Tool for the demonstration and assessment of additionality

As per the results of the barrier analysis in Section B.5, the project activity faces prohibitive barriers and would not be implemented without the CDM revenue incentive.

Assessment: Alternative 1 does not require additional efforts or investments by Serbiagas; therefore, it is most likely to continue. Hence alternative 1 is identified as the 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):

The "Tool for the demonstration and assessment of additionality" (Version 05.2), "Guidelines for objective demonstration and assessment of barriers", and guidance from AM0023 are used to determine the project additionality.

Step 1 – Identification of alternatives to the project activity consistent with mandatory laws and regulations

Sub-step 1a: Define alternatives to the project activity

[16] Article 3, Directive for management and maintenance of gas pipeline facilities.
[17] Article 30, Directive for management and maintenance of gas pipeline facilities.
[18] Article 64, Directive for management and maintenance of gas pipeline facilities.
[19] Articles 113, and Article 109. Directive for management and maintenance of gas pipeline facilities

Two plausible and credible baseline scenario alternatives were identified in section B.4:

1. Continuation of the current leak detection and repair practices; and
2. The proposed project not implemented as a CDM project.

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

As discussed in section B.4 both alternatives are consistent with existing mandatory laws and regulations.

Alternative 1: The current practices are in line with the "Law on Pipeline Transportation of Gaseous and Liquid Hydrocarbons and Distribution of Gaseous Hydrocarbons (Official Gazette of the Republic of Serbia, No. 104/09)"[20] and the Energy Law (Official Gazette of the Republic of Serbia, No. 84/04)[21]. The practices follow the "Directive for management and maintenance of gas pipeline facilities", often referred to as the "White Book".

Alternative 2: The CDM project activity also complies with the existing laws and the requirements in the White Book regarding leak inspection of gate stations, regulator stations and compressor stations, and pipelines, as well as other relevant requirements described in Section B.4.

Outcome of step 1: The identified realistic and credible alternatives are in compliance with mandatory legislation and regulations.

Step 2 – Investment Analysis

Sub-step 2a: Determine appropriate analysis method

Serbiagas does not incur any penalties for gas losses and does not have any economic incentives to reduce leaks in its gas network. The price of natural gas sold to consumer (tariff price) and the price for the transport and distribution service is regulated by the Energy Agency[22], the regulatory body overseeing the development of Serbia's energy market. The pricing must be determined based on a set of methodologies and a tariff system that sets maximum allowed revenue for gas companies. The calculation of the maximum allowed revenue for the distribution service ensures there is compensation for gas loss and is also adjusted for any increase in revenue from improved performance of the distribution system. Therefore, any reduction in gas loss and any increase in revenue from the sale of the extra gas would theoretically reduce the maximum allowed revenue. In addition, the maximum allowed revenue based on the tariff price is adjusted according to the gas procurement costs. If the project activity reduces the amount of gas to be purchased by Serbiagas from the gas producer, the reduction in cost must be accounted for, thus reducing the maximum allowed revenue through tariff price.

However, due to the uncertain correlation between the sale of the extra gas and the reduction in the maximum tariff, Option I, simple cost analysis cannot be applied. Step 3, Barrier Analysis will be used to demonstrate additionality.

[20] http://www.aers.org.rs/FILES/Zakoni/ZakonOCevovodnomTransportu_01regng.pdf
[21] http://www.aers.org.rs/Index.asp?l=1&a=91
[22] The Energy Agency was established under the "Energy Law (Official Gazette of the Republic of Serbia No. 84/04)". http://www.aers.org.rs/Index.asp?l=1&a=91&ted=&ed=&tp=

Step 3: Barrier Analysis

Sub-step 3.a: Identify barriers that would prevent the implementation of the proposed CDM project activity:

Methodology AM0023 requires the barrier analysis to include a discussion on institutional barriers, technical familiarity, and barriers to financing.

Institutional Barriers

The current practices at Serbiagas do not stop external leakages of methane to the atmosphere and at best offer only a temporary solution. A recent study by the International Gas Union (IGU)[23] conducted an evaluation of leading practices used for the management of leaks in its member countries for its 24th World Gas Conference in Argentina 2009.[24] As part of the study, one country in Eastern Europe (Russian Federation) was surveyed and was the focus of a paper that explored the possibility of implementing a systematic leak reduction program in the gas distribution network. The paper, titled "Development and Implementation of a Natural Gas Leak Reduction Program for Pressure Regulating Stations in the Mosgaz Gas Distribution System in Moscow, Russia", suggests that the practice to repair leaks that do not affect the safety of the area is not common in Eastern Europe. According to the paper "…there is less focus on the smaller leakages, which do not affect safety. It might be expected that the leakages which have been found at Mosgaz will also be found in stations elsewhere in Eastern Europe".[25]

The lack of focus described in the IGU paper also happens in the gas network owned by Serbiagas and other networks in the region[26,27], where checks for leaks are not routine and repairs are limited to circumstances that pose a safety risk. As a result, Serbiagas does not have the institutional capacity needed for longer term solutions for other leaks, and there is no dedicated team for carrying out the tasks related to any form of a leak reduction program. Currently, the identification and repair of leaks that affect the safety of the network or its surroundings is a joint effort between two departments: the gas transportation department (Business Unit "Transport") and the technical support department (Business Unit "Gas Pipeline Maintenance").

The gas transportation department staff reports any faulty equipment to the technical support department. The gas transportation department staff take note of any damaged equipment during routine meter readings to collect data on gas consumption at gate and regulator stations and other surface facilities. Staff then submit a work order to the technical support department specifying the type of equipment that requires attention[28]. The staff of the gas transportation department are not required to check for leaks and

[23] The IGU is a non-profit organisation established to "promote technical and economic progress of the gas industry". http://www.igu.org/about-igu
[24] The event takes place every three years. The next conference will take place 4-8 June 2012, in Kuala Lumpur, Malaysia.
[25] Wikkering, J.B.W. "Development and implementation of a natural gas leak reduction program for pressure regulating stations in the Mosgaz gas distribution system in Moscow, Russia". 24th World Gas Conference, Buenos Airtes, Argenitna 2009. http://www.igu.org/html/wgc2009/papers/docs/wgcFinal00668.pdf
[26] Registered projects #2404, 3430, 3339, 3910 and 4085, and validation projects in Armenia, Georgia and Uzbekistan
[27] The UNEP Risoe CDM/JI Pipeline Analysis and Database, July 1st 2011 lists 1 project in Bulgaria, 24 projects in Russia, and 3 projects in Ukraine
[28] Work orders 02-03/670, 02-04/1-307, 02-04/1-115, 02-02-1/89, 02-03/428 and 09-01/145.,

are not trained to do so. Any report of faulty equipment is limited to the condition of the equipment. Importantly, only leaks at gate and regulator stations which were audible or detected by smell would have been identified by the gas transportation department; only in one instance has it been due to a noticeable leak.[29]

The technical support department will repair leaks identified by the gas transportation department only if there is a safety concern, as defined in section B.6. Staff are trained to use klingerit and grease, or tighten the bolts to stop the leak. These options only offer a temporary solution and the recurrence of the leak is likely. For example, on February 2011 the technical support department attempted to fix a leak from a valve by tightening the screws, but the repair was not successful.[30] The technical support department will also check for leaks if there is a need to repair portions of the pipeline, in order to prevent any explosions due to welding activities. If there is a leak, it will be repaired using klingerit and/or by injecting grease, but any recurrence goes undetected unless that same portion of pipeline requires repairing again.

Notably, the detection of leaks by the gas transportation and technical support departments are limited to gate and regulator stations and other above-ground facilities where damage was visible or where leaks were heard or smelled, and within the pipeline itself if repair activities on the pipeline are needed and leakage poses a safety risk. Fittings and stand-alone valves throughout the network are not inspected, and there is no capacity within the company to implement a systematic inspection system.

The project activity will alleviate this barrier by providing Serbiagas with the support necessary to implement routine checks and repair of leaks. Upon registration, Natsource will contract "Energo-Sistem Limited" (Energosystems)[31] as the project operator. This action brings added capacity to Serbiagas to implement a systematic detection, repair and monitoring program of components in the transportation and distribution network. Energosystems will work with Serbiagas staff, implementing the project activities of detecting, measuring, repairing and documenting leaks during the crediting period. This will be done through monitoring teams (made up by staff from Serbiagas and from Energosystems) which will carry out routine inspection and repair activities. These teams will be trained to detect, measure and repair leaks and to survey the repaired components on a regular basis to ensure the success of the repairs. They will be trained in the use of the Gasurveyor, Hi-Flow Sampler and PTFE sealant by the equipment provider.

Technical Familiarity

Methodology AM0023 requires the project participant to demonstrate that the staff of the gas company are not familiar with the advanced leak detection and measurement practices that will be implemented by the project activity. The current occasional leak detection and repair activities in the Serbiagas network described in Sections A.4.1 and Section B.4 do not use advanced leak detection and measurement equipment. Interviews with company staff demonstrate that they are only familiar with the use of soap solution for leak detection (as required by the White Book), and that any leak identified does not get measured. The main reason why the advanced technology has not been available in the Serbiagas network is the lack of funds. Moreover, because there is no routine leak detection and repair activities currently carried out, it is not a priority for Serbiagas to invest in new leak detection and measurement

[29] Work order 02-02/89.
[30] i*bid* Footnote 29 .
[31] Energo Sistem Limited, or EnergoSystems, is the leading manufacturer of gas equipment in the Balkan region and and supplier of the equipment to the Serbiagas network (http://energo-sistem.rs/wp-content/themes/energo-sistem/pdf/REFERENCELIST-BALLVALVE.xls). Established in 1984, the equipment is used in installations such as gas pressure regulating stations gas pressure regulating and metering stations. www.Energo-sistem.rs

equipment (a more detailed discussion of the investment priorities follows in the barrier to financing section).

The equipment used in the project activity are confirmed to be new to Serbia.[32] This technology has only recently been introduced to the larger surrounding region due to funding through CDM or JI incentives,[33] and the technology has not yet been brought into Serbia.[34] Natsource will be introducing the advanced technology to the Serbiagas network. Following the successful registration of the project, Natsource will provide approximately 10 Hi-Flow Sampler devices and 20 Gasurveryor 500 devices, in addition to the purchase of digital cameras and laptops to be used for recording the data measured by these devices. In addition, upon registration of the project activity Natsource will hire "ET&C Consultants Limited" (ETC) to provide the methodological supervision and support to the staff implementing the project activity,[35] including training on the use of the Gasurveyor and Hi-Flow sampler to the monitoring teams (comprising of staff from Serbiagas and Energosystems).

Barrier due to financing

Serbiagas is a public company specializing in the transport, distribution, storage and trading of natural gas. Implementation costs for the project have been calculated[36] and would not be feasible within the Serbiagas annual maintenance budget.[37] Moreover, Serbiagas is not able to allocate additional funds to the maintenance budget. The financial statements for 2008 (most recent available) indicate a total income of €805 million and only €3.4 million in profit.[38]

In addition, investment priorities are aligned with Serbia's Energy Development Strategy and National Action Plan[39] and currently focus on the expansion of the gas pipeline network at a cost of over €200 million. Serbiagas is currently building a high-pressure gas pipeline with a total length of 1,222 km and is expanding the gas distribution network with a goal to provide gas to an additional 650,000 households.[40] Serbiagas has also recently signed an agreement with JSC Gazprom to prioritize the development of the trans-national South Stream gas pipeline.[41]

Due to the company's limited financial resources, funding for the project implementation and CDM registration will be provided by Natsource LLC (Natsource).

Natsource is a privately owned company with headquarters in New York. It is a leading provider of asset management, origination, and advisory and research services in global emissions and renewable energy markets. Natsource LLC is the parent company and 100% owner of both Natsource Carbon Acquisition Corporation LLC (signatory to the ERPA) and Natsource Europe Limited (project participant and project

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[32] Communication with equipment manufacturer, Heath Consultants, confirms that Gasurveyors and Hi-Flow samplers have not been sold to any company in Serbia. This confirmation has been provided to the validation DOE.
[33] As noted in footnotes 24 and 25, there are over 30 similar projects in the CDM and JI pipeline. According to Point Carbon, only 4 of these projects have been fully implemented, all of which use the same equipment that will be used by this project activity.
[34] As of August 2011, there are no gas network projects in Serbia seeking CDM registration.
[35] A copy of the quote from ET&C has been provided to the validation DOE.
[36] A copy of the project activity budget has been provided to the validation DOE.
[37] Serbiags maintenance budget for 2011.
[38] http://ec.europa.eu/enlargement/pdf/serbia/ipa/2010/24_srbijagas_ipa10.pdf
[39] http://www.srbijagas.com/?q=investicije/nacionalni_investicioni_plan
[40] http://www.srbijagas.com/?q=investicije/razvoj_gasovodnog_sistema_u_srbiji
[41] http://investing.businessweek.com/research/stocks/private/snapshot.asp?privcapId=40278885

developer). Natsource has already contributed to 80% of the validation costs. Moreover, upon registration Natsource will provide the Gasurveyors, Hi-Flow Samplers and PTFE sealants and will contract Energosystems and ETC for the implementation of the project activity.

Alleviation of the barriers by CDM

In the absence of CDM incentives, this project would not be implemented as it faces the above-described institutional, technological and financing barriers. Because of the CDM incentives, Natsource is covering all validation and registration costs for this project activity, including the costs associated with the baseline survey and PDD development. Moreover, Natsource has committed to funding 100% of the CDM, project implementation and monitoring costs, on the condition that the project achieves CDM registration. Once registered, Natsource would release funds allowing the commencement of the activities described through this document: i.e., provision of Gasurveyors, Hi-Flow Samplers, PTFE sealants; training of staff; leak detection, repair and monitoring. Natsource receives no financial benefit from the project apart from CERs. For this reason, no project implementation beyond planning will commence until successful CDM registration is achieved[42].

Step 4: Common Practice Analysis

Sub-step 4a: Analyze other activities similar to the proposed project activity

The "Tool for the demonstration and assessment of additionality" (Version 05.2) requires participants to "Provide an analysis of any other activities that are operational and that are similar to the proposed project activity. Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc."

For the purpose of this analysis, a similar activity is defined as a systematic process for leak detection, measurement and repair of components in a steel pipeline gas transport and distribution network (stand-alone components, and valves and fittings at gate, block and regulator stations as well as outside the compressor station hall) using similar technology. The region for the analysis is the Republic of Serbia, as only projects within the country would be subject to the same regulatory framework and financial climate. Only advanced technology is considered as being similar for the common practice analysis, i.e.:

- leak detection - use of an electronic gas detector;
- leak measurement - use of an electronic gas sampler which quantifies leak flow
- repair – use of PTFE-based material, or other modern sealing material.

Leak repair using traditional materials such as klingerit or natural fiber based seals or by insertion of grease is not considered to be similar, as these methods only provide temporary repair during pipeline maintenance activities such as soldering and welding. Furthermore, detection of leaks for safety purposes is not considered similar to the project activity, as it does not constitute a systematic detection.

The activities listed above have not been implemented in Serbia, either by Serbiagas or any other gas transport and distribution company. Serbiagas is the largest gas transport and distribution company in the country, and has not implemented this type of project activity or technology in any key component or section of its transport and distribution network to date. There is one other transport and distribution

[42] Letter from President of Natsource Carbon Acquisition Company LLC, 7 July 2011.

company in Serbia, Yugorosgas[43,44], which operates primarily in the southern region of Serbia. They have confirmed that they have not implemented this type of project or technology to date and do not carry out regular maintenance and repair of pipeline components[45]. There are other local companies that deliver gas to household customers and oversee the maintenance of gas distribution cabinets equipped with 1" valves and gas regulators. These local companies are not considered to have infrastructure similar to that included in the project activity as the pipes are made from polyethylene instead of steel, and therefore are not included in the common practice analysis. Because no similar activities are observed in the Republic of Serbia, the project is not considered as common practice.

Sub-step 4b: Discuss any similar Options that are occurring

No similar activities are observed in the region or country (see Sub-step 4a).

Outcome: Similar activities to the proposed CDM project are not presently observed in Serbia. The project activity is not common practice and the proposed CDM project is thus deemed additional.

CDM consideration:
In implementing the project activity, Serbiagas has considered the benefits of the CDM. Validation activities and the notification of the commencement of the project activity and of the intention to seek CDM status to both the Serbian DNA and the UNFCCC secretariat were carried out prior to the project start date. As defined in section C.1.1, the project start date is considered to be the equipment purchase date. As of the publishing of the PDD for global stakeholder consultation, the equipment had not been purchased and the project has not started. Thus, the project meets the Guidelines on the Demonstration and Assessment of Prior Consideration of the CDM. A timeline of key events is provided in Table B-2.

Table B-2 – Key events and dates in project timeline

Key Event	Date	Notes / supporting documentation
Start of baseline study	14 Mar 2011	Baseline study report
Validation contract	30 May 2011	Work assignment contract between ERM CVS and Natsource
Global stakeholder consultations	02 Jun - 01 Jul 2011	http://cdm.unfccc.int/Projects/Validation/DB/TNEDB2TADG2FMTUGZT9KFGGXZCLS00/view.html
Notification of CDM intent sent to UNFCCC	14 Jun 2011	Confirmation email from the UNFCCC Secretariat
Notification of CDM intent sent to Serbian DNA	14 Jun 2011	Delivery confirmation email
Equipment purchase	n/a	Project Start Date Equipment purchase contract

[43] http://serbia-business.webreminder.info/index.php?option=com_content&view=article&id=633:serbia-energy-natural-gas-subsector&catid=43:market-news-a-opportunities&Itemid=55
[44] http://www.yugorosgaz.rs/index.html
[45] Letter from the Executive Director of Yugorosgaz, 11 July 2011.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Emission reductions

Emission reduction estimates are calculated based on AM0023/Version 03 using *ex-ante* data. The emission reductions are estimated as follows:

> The current practice of leak detection and repair activities is assessed and described. Clear and transparent criteria are established to identify whether the detection and repair of a leak would also have occurred in the absence of the project activity.
> The time schedules for replacement of equipment in the absence of the project activity are determined.
> Data on leaks is collected during project implementation.
> The functioning of leak repair is checked during monitoring.
> Emission reductions are calculated *ex-post* based on data collection in the previous steps.

The first two steps are described below and have been undertaken as part of the preparation of the Project Design Document. Steps 3, 4 and 5 are discussed below, and will be carried out upon project implementation, through the duration of the crediting period.

Step 1: Assessment and description of the current leak detection and repair practices

AM0023/Version 03 states "Only those types of leaks that are not detected and repaired under current practices are considered in the calculation of emission reductions". Leak detection and repair practices are implemented following the White Book.

The White Book defines leaks as "uncontrollable leakage: is every gas leakage from the gas pipeline facility not being measured and not supervised by the supervisory staff. Those are the leakages of natural gas in the atmosphere during the gas pipeline perforation, leakage in the gas facilities joints and during the activation of safety drainage valve".[46] The White Book requires inspections of underground gas pipelines near road, railways and water sources once a month in urban areas and every six months in rural areas.[47] The inspection requirement does not extend to the above-ground steel pipe of the pipeline or to valves and fittings.

Nonetheless, leaks that have been detected and repaired in the above ground pipelines are classified as per the following criteria:

Safety aspect: Leaks posing risk of fire and explosion. If a portion of the pipeline is to be repaired, the valves at either end of the relevant section are closed. Staff checks for internal leaks once the valves are closed to avoid explosions during the maintenance and repair activities (e.g. welding). Leaks in the valves are repaired using klingerit and/or by injecting grease.

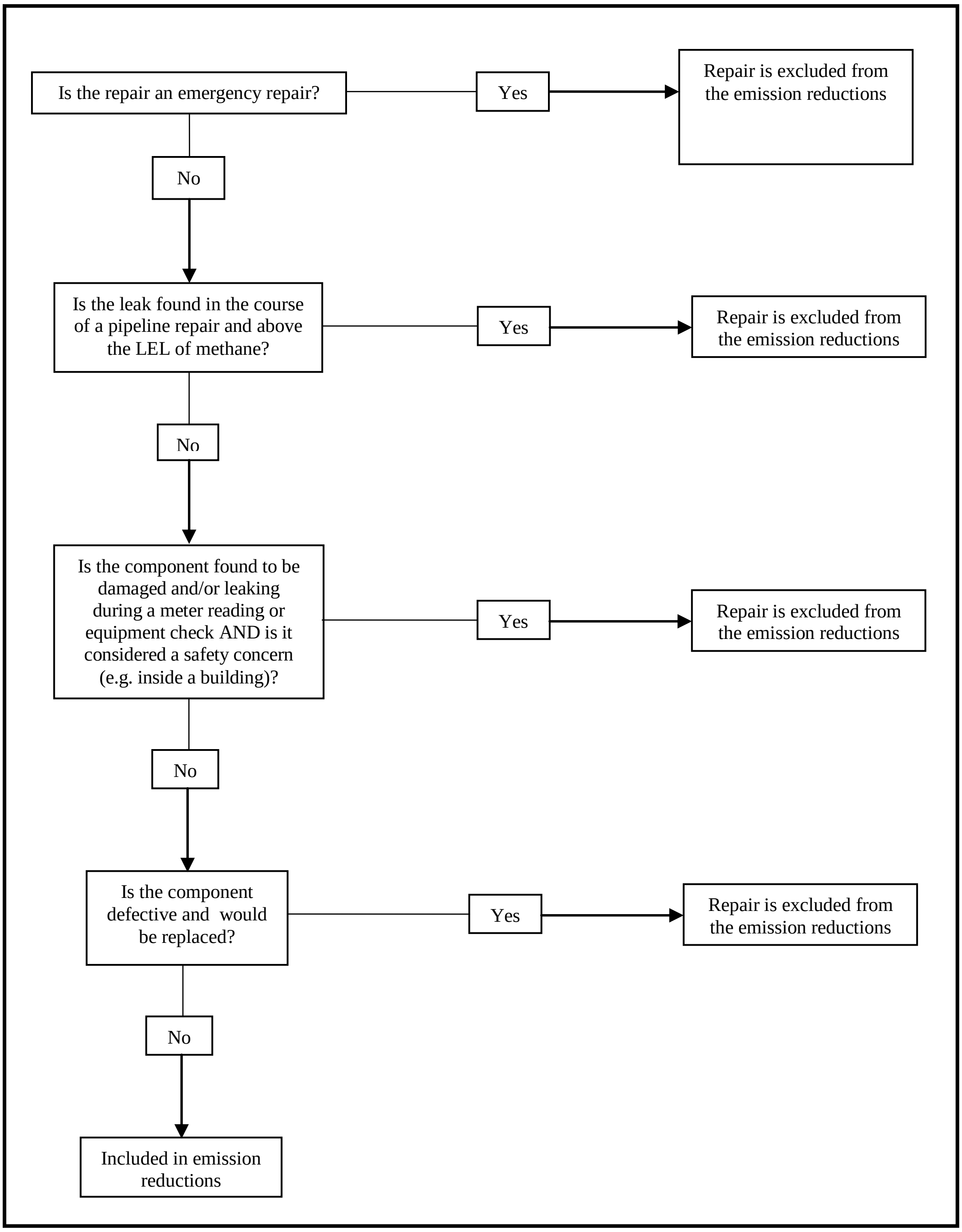
[46] Article 30, Directive for management and maintenance of gas pipeline facilities.
[47] Articles 210 and 211, Directive for management and maintenance of gas pipeline facilities.

Visibility, audibility and/or smell: If during meter reading activities staff from the gas transportation department notice extensive damage to a component or hear or smell a gas leak, then the leaking component is reported to the technical support department. If deemed to be a safety concern (i.e. are inside a building, are in a residential area) it is repair using klingerit, by injecting grease, or by tightening the bolts.

In addition to the “White Book”, evidence of current practice activities is provided in the form of:
- Interviews with management and engineering staff of Serbiagas, and
- Documentation relevant to current technologies used to measure leaks.

Leaks detected as per the above criteria are not included in the calculation of emission reductions. Specifically, component repairs which meet the following criteria will be excluded:
- The component is repaired due to an emergency event.
- The component is found to be leaking during a repair to a section of the pipeline AND the methane concentration inside the pipeline to be repaired is above the lower explosive limit of methane (5%, or 50000 ppm).
- The component is found to be leaking during a meter reading or equipment check AND is considered to be a safety concern (i.e. is inside a building).
- The component is defective and would have been replaced.

The criteria are shown in the following decision tree which will be used to determine whether the leak would have been detected and repaired in the baseline.



Step 2: Documentation of the replacement schedules for equipment

Serbiagas does not have a formal component replacement schedule. Cracked valves or valves that have had the thread stripped are to be replaced. These damaged valves are identified during meter reading and checks.

The gas distribution network and the gas transportation network infrastructure included in the project boundary have been operational for an average of 10 years and 25 years, respectively. Unless a component is found to be defective, it will not be replaced, regardless of age, and it is thus assumed that it would not be replaced during the crediting period.

Leaks detected and repaired due to the project activity will be included in the *ex-post* calculation of the emission reductions.

Equipment is replaced if found to be defective due to:
- The component showing signs of extensive damage; or
- The component has ceased to function.

Leaks that are stopped due to the replacement of components that have entirely ceased to function will not be included in the CDM project. If a component has to be replaced because it becomes defective having been previously repaired as part of the project activity it will be removed from the CDM project for the remainder of the crediting period. Only components that are reconstructed due to the project activity, which will not have been replaced under normal practices, will be included in the *ex-post* calculation of emission reductions. The number of components replaced because they become defective equates to roughly 24 valves and 1 fitting annually.[48]

Should any gate or regulator station be part of a replacement programme in the future any leaks from the components from these stations will be removed from the CDM project.

Leaks repaired as part of the project activity and leaks repaired under the normal practices discussed above will be recorded in the project activity's database. These records will ensure that there is clarity on which leaks have been repaired as part of the baseline, and which are part of the CDM project.

Step 3: Data collection during project implementation

The project implementation includes initial survey and regular subsequent surveys of components at each gate and regulator station, as well as components on other surface facilities such as the outdoor components at the compressor station and stand-alone valves and fittings.
Leaks that will be repaired are:
- Leaks in stand-alone valves and fittings in the pipeline
- Leaks from components in the gate and regulator stations and from components outside of the compressor station hall

Equipment and infrastructure inside of the compressor stations will not be surveyed for leaks and are not included in the project activity.

For each leak that will be detected and repaired as part of the project activity, the following information will be collected and entered into the database:
- Whether the leak would also have been detected and repaired in the absence of the project activity (using the criteria and decision tree established in Step 1 above);
- Date of leak detection;
- Date of leak repair;
- Exact location of the leak and unique identification number;

[48] Estimate based on all work orders for component replacement between January 2009 and February 2011 for an area representing 25% of the network. Copies of the work orders have been provided to the validation DOE.

- Measured leak flow rate (liters per minute converted to m^3 per hour);
- Measurement method, to determine the uncertainty range of the measurement.

As per the project description in section A.2 of this document, all inspected leaking components will be repaired. A record of all repairs will be included in monitoring reports.

Leak detection will be carried out using the Gasurveyor 3-500. Once the leak has been detected, the Hi-Flow Sampler will be used to measure the leak flow rate. Once the leak rate has been measured and recorded, the component will be repaired. After the repair, a new leak detection and measurement will be carried out to ensure that the repair has been successful.

Step 4: Monitoring requirements

Step 4 is the monitoring of emissions during the project to check for re-emerging leaks. The monitoring plan will cover only the components that have been subject to repair. For components where no re-emerging leaks are found, emissions are taken to be zero for the entire period since the last monitoring period. Recurring leaks will be measured again using the Hi-Flow Samplers. This leak rate is conservatively assumed to have remained at the same level since the day after the last project repair of the component, or after the last inspection, whichever is most recent. This is consistent with the principles set in AM0023/Version 03. These leaks will be repaired again, and monitored as before.

The following information will be collected for each component:

- Date of monitoring;
- The number of hours the component was in operation since the last monitoring;
- An assessment as to whether the repair of the leak was successful. If a leak recurs, the date of its subsequent repair will also be noted.

Data will be recorded in a database, which will be the basis for the monitoring reports.

Step 5: Calculation of emission reductions

Calculation of emission reductions is based on the underlying assumption that a leak which has been detected and repaired due to the project activity would have continued to emit methane with the flow rate measured prior to repair, until the equipment concerned would have been repaired. In most cases it is conservative to assume that the leak flow rate prior to repair of the leak would have remained constant, since leaks may grow larger over time. Emission reductions will be calculated as follows:

$$ER_y = ConvFactor * \Sigma [F_{CH4,\, i} * T_{i,\, y} * (1-UR_i)] * GWP_{CH4} \qquad (1)$$

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 tonnes CH_4 (this factor amounts to 0.0007168 tCH_4/m^3 CH_4 at standard pressure and temperature);

i=1,…,I – The index of *i*- th leaking valve, including only those which meet the criteria in step 1;

I – All leaks eligible towards accounting of emission reductions;

$F_{CH4,\,i}$ – The leak flow rate of methane for leak *i* from the leaking component (m^3 CH_4/h), based on the Hi-Flow sampler reading (l/min);

UR_i – The uncertainty range for measurement method applied to leak *i.* The uncertainty range UR_i is calculated based on technical documentation for Hi-Flow Sampler together with chapter 6 of the 2000 IPCC Good Practice Guidance. Additional detail on the calculation is provided in Annex 3;

$T_{i,\,y}$ – The time (in hours) the component for leak *i* has been operating during the monitoring period *y*. Since the gas distribution system is in continuous operation, time $T_{i,\,y}$ is considered to be 8760 hours (1 year);

GWP_{CH4} – The globing warming potential for methane (tCO_2eq/tCH_4). The global warming potential GWP_{CH4} of methane is set at 21 (t CO_2eq/t CH_4), but will be monitored throughout the crediting period.

Conversion of Hi-Flow sampler reading to $F_{CH4,\,i}$:

$F_{CH4,\,i}$ = 0.001 m^3/L x 60 min/h

The Hi-Flow sampler reading of the leak flow rate is normalized to standard temperature 0°C and is based on a standard pressure 101.3 kPa (barometric pressure 29.92 inHg). The application of the uncertainty range will compensate for actual barometric pressure at the time of reading.

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

Data / Parameter:	ConvFactor
Data unit:	t CH_4 / m^3 CH_4
Description:	The factor to convert m^3 CH_4 into t CH_4. At standard temperature and pressure (0 °C and 101.3 kPa) this factor is 0.0007168 tCH_4/m^3 CH_4
Source of data used:	AM0023 v.3
Value applied:	0.0007168
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:

The project boundary includes 16,500 valves and 66,000 fittings. *Ex-ante* emission reductions are calculated based on a survey of 539 valves and 70 fittings on the Serbiagas distribution system. The survey was carried out 14-25 March 2011.[49] The following Table provides information on the leak survey:

Component	Number of Components				Average flow rate of methane		
	Total	Surveyed	with Leaks		Avg per leaking component (l/min)	Avg per inspected component (l/min * % with leaks)	$m^3 CH_4/h$
				A	B	A*B = C	C*0.001 m^3/L * 60 min/h
Valves	16,500	539	172	31.9%	9.23	2.94	0.177
Fittings	66,000	70	15	21.4%	1.82	0.39	0.0234

Therefore:

Baseline emissions from valves:

ER_y = ConvFactor * I * [$F_{CH4, i}$ * $T_{i, y}$ * (1-UR_i)] * GWP_{CH4}

= 0.0007168 t CH_4 / m^3 CH_4 * 16,500 valves * [0.177 m^3 CH_4 / h * 8760 h * (1- 0.011)] * 21 tCO_2eq

= 380,295 t CO_2eq

Baseline emissions from fittings:

ER_y = ConvFactor * I*[$F_{CH4, i}$ * $T_{i, y}$ * (1-UR_i)] * GWP_{CH4}

= 0.0007168 t CH_4 / m^3CH_4 * 66,000 fittings * [0.0234 m^3 CH_4 / h * 8760 h * (1- 0.011)] * 21 tCO_2eq

= 201,488 t CO_2eq

The total *ex-ante* baseline emissions are: 380,295 + 201,488 = 581,783 tonnes of CO_2 equivalent.

The *ex-ante* emission reductions estimate is based on average leak rates determined in the initial baseline study, extrapolated to the entire distribution system. Though this is a reasonable approach for the *ex-ante* estimates, actual emission reductions on which CERs will be claimed will be calculated as per methodology AM0023 and may differ from this estimate. Some reasons for potential differences include:

[49] The components were selected at random for the survey with the only criteria given being to select a range of different geographical locations and varying ages of the stations surveyed. The characteristics of the regions chosen for the baseline study are representative of the network as a whole and therefore the average leak rates should be similar across the network.

- As discussed in previous sections, any component replaced due to safety concerns or valves that would have been replaced because of a malfunction will be excluded from the baseline.
- Because leak rates tend to increase over time, a leak rate measured during the feasibility study could differ from the rate measured for the same component during the initial inspection for repair.
- The estimate assumes 100% effectiveness of repairs.
- Older parts of the network may have a higher leak rate than those tested during the baseline study. Younger parts may have lower leak rates.

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

Year	**Estimated project activity emissions (tonnes of CO_2 eq)**	**Estimated baseline emissions (tonnes of CO_2 eq)**	**Estimated leakages (tonnes of CO_2 eq)**	**Estimated emission reductions (tonnes of CO_2 eq)**
2012	0	581,783	0	581,783
2013	0	581,783	0	581,783
2014	0	581,783	0	581,783
2015	0	581,783	0	581,783
2016	0	581,783	0	581,783
2017	0	581,783	0	581,783
2018	0	581,783	0	581,783
2019	0	581,783	0	581,783
2020	0	581,783	0	581,783
2021	0	581,783	0	581,783
Total (tonnes of CO_2 equivalent)	0	5,817,830	0	**5,817,830**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	i (Number)
Data unit:	--
Description:	Total number of leak identified, repaired and then re-surveyed
Source of data to be used:	Repair and monitoring log

Value of data applied for the purpose of calculating expected emission reductions in section B.5	82,500 (16,500 valves and 66,000 fittings)
Description of measurement methods and procedures to be applied:	Each leak will be tagged with a number and monitored after repair for any additional leaks. A digital photograph will be taken of the leaking component, the tag, the Gasurveyor display and the Hi-Flow Sampler display. The information will be recorded electronically in the repair and monitoring log.
QA/QC procedures to be applied:	Each component for which a leak is detected will be designated a unique serial number (painted at or next to the valve). After repair, the components will be monitored for any additional leaks. All data will be stored in the database and a back-up will be made. Thus, the uncertainty level of data is low.
Any comment:	Serbiagas does not have a complete inventory of all the components in the distribution network. The technical support department of Serbiagas have provided us with their estimate of the numbers of components based on internal surveys of known gate stations and estimates for the numbers in block stations.

Data / Parameter:	Time T_i
Data unit:	# of hours per reporting year
Description:	Hours of equipment operation for each leak
Source of data to be used:	Monitoring database
Value of data applied for the purpose of calculating expected emission reductions in section B.5	8,760
Description of measurement methods and procedures to be applied:	The number of hours will be calculated as: 8760 h – outage. Any outage will be recorded electronically by the database management team as per the monitoring procedures in the monitoring plan in Section B.7.2 and the detailed monitoring plan in Annex 4.
QA/QC procedures to be applied:	Any outages resulting from damaged component replacement or reconstruction or due to the repair of leaks by the project activity will be documented and logged into the project database.
Any comment:	The assumption of 8760 hours of operation takes into account that there is no replacement schedule and assumes no outages.

Data / Parameter:	Date
Data unit:	Date and time
Description:	Date and Time leak was repaired
Source of data to be used:	Repair and monitoring log

Value of data applied for the purpose of calculating expected emission reductions in section B.5	For simplicity of *ex-ante* calculations, it is assumed that all components have the same date of repair, i.e. 31 December 2011.
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:	GWP_{CH4}
Data unit:	t CO_2eq
Description:	The global warming potential of methane
Source of data to be used:	IPCC
Value of data applied for the purpose of calculating expected emission reductions in section B.5	21
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	The project developer will monitor whether a new GWP is adopted by IPCC and agreed upon by COP
Any comment:	

Data / Parameter:	$F_{CH4,\ i}$
Data unit:	m^3 CH_4/h
Description:	The leak flow rate of methane for leak *i* from the leaking component
Source of data to be used:	Hi-Flow Sampler reading
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Valves: 0.177 Fittings: 0.0234

Description of measurement methods and procedures to be applied:	The Hi-flow Sampler measures a component's leak rate at a high flow rate, measuring the flow rate of the sample stream and the natural gas concentration in the steam. The device then calculates the leak rate adjusting automatically for methane content in the stream and in the background
QA/QC procedures to be applied:	To ensure accuracy, the Hi-Flow Sampler takes two measurements at different flow rates. The first measurement is taken at the highest possible flow rate, followed by a second flow rate at approximately 70-80% of the first measurement. If the two calculated leak rates are within 10% of each other, then the leak rate ($F_{CH4,i}$) displayed by the Hi-Flow sampler is considered accurate.
Any comment:	The Hi-Flow Sampler provides a reading in l/min. The reading is normalized to a standard temperature of 0 °C and assumes a barometric pressure of 29.92 in Hg. To convert from l/min to m^3/h: m^3/h = 0.001 m^3/L x 60 min/h. The average leak rate per valve and fitting identified in the baseline survey was extrapolated to the entire gas distribution system for the ex-ante emission reduction estimates. The actual leak rate per component will be used for calculation the ex-post emission reductions. Digital photography of the display reading of the Hi-Flow Sampler of the leak rate measured will be taken as evidence.

Data / Parameter:	UR_i
Data unit:	unitless
Description:	The uncertainty factor for measurement equipment applied to leak i. This parameter reflects the fact that the leak measurement equipment is not 100% accurate
Source of data to be used:	Manufacturer Instruction manual of the Hi-Flow Sampler
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.011
Description of measurement methods and procedures to be applied:	This fraction is calculated as the standard deviation of the square root of the sum of the squares of each measured leak rate times the accuracy range of ±10% at a 95% confidence interval. It is calculated on the basis of Hi-Flow Sampler documentation, and the IPCC "Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories", Chapter 6, p. 12. Please see Annex 3. This approached will also be used for the *ex-post* estimates.
QA/QC procedures to be applied:	The IPCC Good Practice Guidance will be consulted in compiling uncertainty estimates.

Any comment:	The instruction manual does not specify a confidence interval; a confidence interval of 95% may be assumed as per the methodology.

Data / Parameter:	Pressure
Data unit:	Bar
Description:	Barometric pressure at time of leak rate reading
Source of data to be used:	Hi-Flow Sampler
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	The Hi-Flow Sampler calculates the flow rate assuming a pressure of 101.3 kPa.[50]
QA/QC procedures to be applied:	Data recording equipment will be calibrated and double checked on a regular basis. Procedures for checks and calibration of the Hi-Flow Sampler follow the procedures defined by the technology provider.
Any comment:	Any difference between the assumed barometric pressure of the Hi-Flow Sampler and actual barometric pressure results in such a small adjustment that the reading easily falls within the corrected range of the Hi-Flow Sampler. This has been confirmed by the manufacturer and validated by the DOE.

Data / Parameter:	Temperature
Data unit:	Degrees Celsius
Description:	Temperature of the gas when it is leaked
Source of data to be used:	Hi-Flow Sampler (automatically taken into account by the sampler)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	The Hi-Flow sampler has a built-in temperature sensor. The flow rate reading is normalized at a standard temperature of 0ºC.[51]

[50] Hi-Flow sampler calibration letter from Heath Consultants.
[51] Hi-Flow sampler calibration letter from Heath Consultants.

QA/QC procedures to be applied:	Data recording equipment will be calibrated and double checked on a regular basis. Procedures for checks and calibration of the Hi-Flow Sampler follow the procedures defined by the technology provider.
Any comment:	

B.7.2. Description of the monitoring plan:

The monitoring methodology applied to the project is based on the monitoring methodology AM0023/Version03. The monitoring plan reflects good monitoring practice appropriate to the type of project activity.

All data necessary to estimate anthropogenic GHG emissions by sources within the boundary of this project, as well as procedures to collect and archive this data, are included in the monitoring plan summarized below. Further detail regarding monitoring procedures is provided in Annex 4.

Serbiagas technical and engineering staff, in cooperation with the project operator “Energo Sistem Ltd” (Energosystems), will implement the project operations and monitoring activities by performing detection, measurement, repair and documentation of identified leaks during the crediting period. Natsource and the consultant “ET&C Consultants Limited” (ETC) will provide methodological supervision and support to the Serbiagas team.

Operational structure:

Various teams will be set-up for the implementation of the monitoring plan:

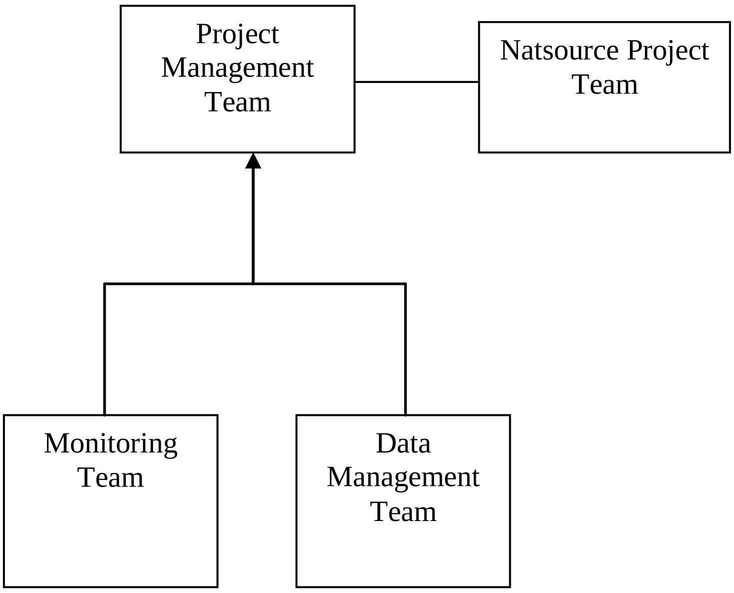
Monitoring teams: Serbiagas and Energosystems will form several CDM monitoring teams, which will be trained by ETC. Monitoring team management will report to the project management team.

Database Management team: The project operator, Energosystems, in cooperation with ETC will be responsible for documenting the leak measurement data obtained from the monitoring teams datasheets, and ensuring that it is correctly entered into the database. The database management team will also record any system outages across the network and ensure that CERs are not included for any component leakages where outages are recorded.
Database management team reports to the project management team.

Project Management team: The Project Management team (referred to as the Monitoring Managers) will be responsible for coordinating the CDM project in general, and will focus on planning, organizing, and managing all resources involved in the full cycle of project implementation and monitoring. Natsource will provide training on the specific monitoring requirements of CDM.

Natsource’s Project team: Natsource will coordinate with Serbiagas’ Legal and Accounting departments to make sure the project is fully compliant with relevant Serbian regulations and will also be responsible for ensuring the credibility of the project, by involving independent third parties on an ongoing basis. The Natsource team lead will communicate any issues to the project management team.

The operational structure is represented as follows:



For more detailed responsibilities refer to Annex 4

Training Program: ETC will provide training for Serbiagas and Energosystems local staff on how to use the detection and measurement equipment, how to conduct effective repairs using PTFE sealant, and how to properly document the detected leaks. They will also provide Serbiagas and Energosystems with a set of instructions and manuals on how to conduct leak detection and measurements. It is expected that initially about 30 people will participate in this training program. The staff selection will be based on experience working with gas systems, and technical knowledge in working with computers and hi-tech tools..

Calibration of Equipment: Calibration kits and spare part kits are delivered with the Hi-Flow Sampler package. Procedures for checks and calibration of the Hi-Flow Sampler follow the procedures defined by the technology provider. The manufacturer of the leak detector (Heath Gas Surveyor series) requires the device to be calibrated at least once every year under normal operating conditions. Serbiagas/Energosystems will confirm the calibration validity of the detectors at least once every week. When needed, calibration of the detector will be done following the procedures contained in the instruction manual. Serbiagas/Energosystems will keep all records of calibration in special paper and electronic form.

Leak Measurement: Serbiagas and Energosystems will survey for leaks in all components included in the project boundary using Gasurveyor 3-500 instruments. Once identified, leaks will be tagged and given a unique number in addition to the component number.[52] The flow rate for each leak will then be measured using Hi-Flow Samplers. A digital photograph will be taken of the leaking component, the tag, the Gasurveyor display and the Hi-Flow Sampler display. These photographs will be archived by the database team. In addition, the type of repair expected given the nature of the leak and its location will be categorized in general terms such as valve reconstruction, PTFE sealant, etc.

[52] All components will have a unique number.

Leak Repair: After leaks have been detected and measured, they will be repaired by the Serbiagas and Energosystems team. The time period between the initial measurements and the repairs will vary based on a number of factors including proximity to other leaks on the repair teams schedule, size of leak, type of leak and time required for repairs, availability of the repair materials, etc. In case there is any discrepancy between the final measurement and the original measurement, a third measurement will be taken to confirm the change. The final, leak rate displayed by the Hi-Flow Sampler will be used to determine baseline leakage as per the methodology AM0023.

Monitoring Repaired Leaks: All leaks that have been subject to repair will be monitored – using the same leak detection technologies on each leak identified in the baseline – to ensure they are maintained on an annual basis. Where a leak repair fails, it is conservatively assumed that the leak resumed the day after the last inspection, or in case of the first inspection, the day after the repair has taken place. Emission reductions are counted from the date of subsequent repair of that same leak, and are measured using the same type of equipment, the Hi-Flow Sampler, as in the initial survey. Such leaks will be repaired again followed by new leak measurements. Monitoring teams will have separate datasheets which they will pass to the database management team for uploading.

Data archiving: During each component inspection, existence of a leak, leak rate, and type of repair will be recorded. It will be noted whether the repair was undertaken due to the project activity, or due to emergency situations or malfunctions, as noted in section B.6.1. All collected data will be stored in the database at the end of each day of inspection. Back-up electronic copies of the database and digital photographs of the Gasurveyor and Hi-Flow Sampler displays will be made (weekly or monthly) and will be kept for at least two years after the end of the crediting period or the last issuance of CERs, whichever is later.

QA/QC:

ETC will be responsible for monitoring the work of the monitoring teams on a continuing basis. ETC will provide an independent valuation of the monitoring team's capacities. Any issues or problems detected by ETC will be reported back to Serbiagas/Energosystems and Natsource who will then conduct corrective actions.

Natsource's team will provide support for CDM registration and verification activities. At the end of each monitoring period, ETC will submit a draft monitoring report for review and approval to Serbiagas/Energosystems' Monitoring Manager and Natsource, to check for irregularities. In the event that such irregularities are observed:

- Serbiagas/Energosystems will carry out an analysis of the irregularities and their causes immediately with any needed assistance from ETC and Natsource.
- The management of Serbiagas /Energosystems will make a decision, in consultation with Natsource, on appropriate corrective actions to eliminate the non-conformity and its causes.

Corrective actions will be executed under the supervision of the Monitoring Manager, and any necessary amendments will be made.

See Annex 4 for further QA/QC details on the Monitoring Plan.

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):

Natsource carried out an initial baseline study in cooperation with the measurement specialists ANEM

Management Ltd. It was completed on 25/03/2011.

Contact details:
Ilya Kramarenko
ANEM Management, Ltd.
57 Spyrow Kypriano, office 501
Larnaka, Cyprus

ANEM is not a project participant.

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:

1 January 2012 (expected) – date of equipment purchase

The starting date of the project activity is defined as the earliest date on which the implementation or construction or real action began, and is considered to be the date when the project participant has committed to expenditures related to the implementation. As shown in the project timeline in section B.5, equipment and materials (i.e. Hi-Flow Samplers, Gasurveyors, PTFE sealant) will be provided after the project secures CDM registration, and this will be the first action taken in project implementation.

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

10 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:

n/a

C.2.1.2. Length of the first crediting period:

n/a

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/01/2012, or the date of registration, whichever is earlier

C.2.2.2. Length:

10 years

SECTION D. Environmental impacts

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

The project activity does not have significant impact on the environment (air, water, soil, as well as plant and animal life) and is not subject to environmental assessment[53].

Materials and equipment used in this project are environmentally friendly, do not emit harmful substances into the atmosphere, and are not a source of noise, vibration, or any other harmful physical impact. All activities related to implementation of the project are performed within the right-of-way (assigned location near the pipeline), thus any impact on surrounding vegetation or pollution of water protection zones, water reservoirs, and drains is negligible.

Transport during delivery of materials to the site will be carried out using existing transport lines. Where automotive transport is utilized, its refueling will take place at the closest refueling stations.

The project activity has no trans-boundary environmental impacts.

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

Not applicable. The project activity is not considered to result in any significant environmental impacts.

[53] The Ministry of Environment, Mining and Physical Planning provided written confirmation that the project activity is not subject to an environmental impact assessment.

SECTION E. Stakeholders' comments

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

Stakeholder consultations were carried out 09 March 2011. The list of participants was developed under guidance provided by Serbia's Designated National Authority, the Ministry of Environment and Spatial Planning. Invitations were sent by Serbiagas. Please refer to Annex 5 for a list of invitees and a copy of the invitation.

The following participants attended the stakeholder meeting:

Natsource

Mr. John Paul Miller
Mr. Sergey Soldatenko

JP Srbijagas

Mr. Jovica Budimir
Mr. Miroslav Lekic
Mr. Borisav Milosevic
Mr. Borko Mandic
Mr. Miodrag Bakic
Ms. Jasminka Amidzic
Ms. Dragana Skoric
Ms. Adrijana Strikovic
Ms. Maja Opacic
Mr. Ilija Selakovic
Ms. Milica Prijic

Other participants:

Institute for public health of Vojvodina, Mr. Emil Zivadinovic
Economic Chamber of Serbia, Ms. Vera Raznatovic
JP "Transnafta", Mr. Sava Djuric
Provincial Secretariat for energy and mineral raw materials, Ms. Branislava Djuric
Municipality administration for environment protection Novi Sad: Mrs Ljubica Mijatovic Topalov, Ms. Aleksandra Laketa, Mrs. Janja Zulum Luka
JP "Vojvodina forests", Mr. Milenko Ilic

E.2. Summary of the comments received:

The following questions were asked by the participants:

How long will the project last?
Are there any negative expectations in relation to the level of technological development after processing the results of measurements?
Have you installed, used this equipment somewhere else, and what are your previous experiences?
Who finances the project and what is the cost of it? Will there be investments into measuring based on the results of measuring?

As far as air quality is concerned, is carbon dioxide the only parameter for determination or there are some other ways?
During this 10 year period, how often will the reports be made, on annual level or differently?
What are the obligations of Srbijagas in this project? Are they supposed to improve the network, change elements or something special?

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

No negative comments were received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Natsource Europe Limited
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FAX:	+44 20 8439 9514
E-Mail:	cdm_representative@natsource.com
URL:	www.natsource.com
Represented by:	John Paul Miller
Title:	Project Manager
Salutation:	Mr.
Last name:	Miller
Middle name:	
First name:	John Paul
Department:	
Mobile:	
Direct FAX:	+44 20 8439 9514
Direct tel:	+44 20 8439 9515
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Postcode/ZIP:	21000
Country:	Republic of Serbia
Telephone:	+ 381 21 481 2703
FAX:	+ 381 21 481 2703
E-Mail:	kabinet@srbijagas.com

URL:	http://www.srbijagas.com
Represented by:	Jovica Budimir
Title:	Executive Director of Investments
Salutation:	Mr.
Last name:	Budimir
First name:	Jovica
Department:	
Mobile:	
Direct FAX:	+ 381 21 481 2600
Direct tel:	+ 381 21 481 4166
Personal e-mail:	jovica.budimir@srbijagas.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public financing was or will be used for this project

Annex 3

BASELINE INFORMATION

The Serbiagas pipeline system

Natural gas is normally transported to customers through a pressurized pipeline. The high, medium and low-pressure gas transport and distribution network, operated by the company Serbiagas, annually transports more than 2.5 billion cubic meters (bcm) of natural gas. This number is increasing and is expected to reach 3.5 bcm by 2015. The gas system covers 5,800 km of pipes, including 650 km of medium pressure (4 - 16 bars), 2150 km of high pressure (16-50 bars) and 3000 km of low pressure (less than 4 bars) pipe. There is 1 compressor station, 165 gate stations and 684 regulator stations, 250 block stations, which together with stand alone components in the connecting pipeline, have a total of approximately 16,500 valves and 66,000 fittings.

There are two main sources of leaks in the Serbiagas network – cracks/breaks in the pipeline; and leaks from components at gate, regulator and the compressor station, most notably from valves and fittings (i.e. flanges, threaded joints, stud bolts with hex nuts), and at stand-alone valves and fittings. Because cracks and breaks occur randomly, most leak repair activities are carried out for safety concerns and focus on leaks from components at gate, regulator and the compressor station, which are in known locations and number.

Serbiagas does not have a routine leak check and repair maintenance practice. Leaks within the city limits are more likely to be detected because of the odour, sound and/or knowledge of some activity that would likely cause leakage (e.g. construction beside a pipeline component, accident, etc.). The White Book contains no provisions requiring the implementation of a systematic leak detection and repair program. It only requires checking for leaks from underground pipelines that are under roads, railroad tracks and water sources once a month if located within the city and once every six months if located outside the city. Fittings are not surveyed at all.

Under existing practice, an identified leak is repaired by tightening bolts, injecting grease or by replacing the sealant with klingerit.

Description of the sample measurement program baseline study

The baseline study was carried out 14 - 25 March 2011, by ANEM Management, Ltd. The components were selected at random for the survey with the only criteria given being to select a range of different geographical locations and varying ages of the stations surveyed. It consists of a survey of 539 valves and 70 fittings in the gas distribution network in 30 gas distribution points at the following locations:

- Novi Sad
- Temerin
- Bachka Polanka
- Gospodintsi
- Popovicha
- Stara Pozova
- Panchevo
- Sr. Metrovicha
- Ruma

Leak detection was done using catalytic oxidation/thermal conductivity detectors (Gasurveyors 3-500). Once detected, the leaks were tagged and numbered and the leak rate was measured using Hi-Flow Samplers. All the equipment used was calibrated prior to beginning measurement as per manufacturer specifications. The leak rates for each leaking component were entered into a database.

During the baseline study, 31.9% and 21.4% of the surveyed valves and fittings, respectively, were found to be leaking. The average leak rate of the components has been extrapolated to components included in the project boundary to estimate the *ex-ante* emission reductions:

Component	Number of Components				Average flow rate of methane		
	Total	Surveyed	with Leaks		Avg per leaking component (l/min)	Avg per inspected component (l/min * % with leaks)	$m^3 CH_4/h$
				A	B	A*B = C	C*0.001 m^3/L * 60 min/h
Valves	16,500	539	172	31.9%	9.23	(9.23*31.9%) = 2.94	0.177
Fittings	66,000	70	15	21.4%	1.82	0.39	0.0234

Therefore:

Baseline emissions from valves:

$ER_y = ConvFactor * I * [F_{CH4,\ i} * T_{i,\ y} * (1-UR_i)] * GWP_{CH4}$

$= 0.0007168\ t\ CH_4 / m^3\ CH_4 * 16{,}500\ valves * [0.177\ m^3\ CH_4 / h * 8760\ h * (1- 0.011)] * 21\ tCO_2eq$

$= 380{,}295\ t\ CO_2eq$

Baseline emissions from fittings:

$ER_y = ConvFactor * I*[F_{CH4,\ i} * T_{i,\ y} * (1-UR_i)] * GWP_{CH4}$

$= 0.0007168\ t\ CH_4 / m^3 CH_4 * 66{,}000\ fittings * [0.0234\ m^3\ CH_4 / h * 8760\ h * (1- 0.011)] * 21\ tCO_2eq$

$= 201{,}488\ t\ CO_2eq$

The total *ex-ante* baseline emissions are: 380,295 + 201,488 = 581,783 tonnes of CO_2 equivalent.

- For *ex-post* calculations, the actual leak rate measured for each component will be used to determine the emission reductions achieved.

Estimation of uncertainty factor

Equation 6 of AM0023 v.3 (which is equation 1 in this PDD) requires calculating an uncertainty range (*URi*) for the method that will be used for measuring each leak. In the case of the project activity, the measurement method applied is the Hi-Flow Sampler.

The Uncertainty Factor (*URi*) for Hi-Flow sampler is calculated as the standard deviation of the square root of the sum of the uncertainty range for each leak. The calculations use an accuracy range of ±10%, as per the Hi-Flow Sampler Instruction 55-9017 operation & maintenance. Rev.2 (May 2005) and assume a 95% confidence interval (consulting the guidance provided in chapter 6, p.12 of the IPCC "Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories"). The Rule A of this document is applied to estimate the uncertainty factor:

"Where uncertain quantities are to be combined by addition, the standard deviation of the sum will be the square root of the sum of the squares of the standard deviations of the quantities that are added with the standard deviations all expressed in absolute terms (this rule is exact for uncorrelated variables). Using this interpretation, a simple equation can be derived for the uncertainty of the sum, that when expressed in percentage becomes:

$$U_{total} = \frac{\sqrt{(U_1 \bullet x_1)^2 + (U_2 \bullet x_2)^2 + ... + (U_n \bullet x_n)^2}}{x_1 + x_2 + ... + x_n}$$

Where:

U_{total} = the uncertainty factor (URi in equation 6 of the methodology) is calculated as the standard deviation of the square root of the sum of the squares of each measured leak rate times the accuracy range of ±10% at a 95% confidence interval
U_i = 10% accuracy of the calculated leak rate as per the Hi-Flow Sampler instruction manual
x_i = leak rate (lpm) measured for each leaking component, which is $F_{CH4,i}$ of equation 6 of the methodology.

The value of *URi* for the Hi-Flow Sampler was calculated as 1.1% and will remain the same for each measured leak (in the *ex-ante* calculation) as required by the methodology. This same approach will be used for the *ex-post* estimates.

The square of the uncertainty range for each leak is calculated as: $(U_i*x_i)^2$
The sum of $(U_i * x_i)^2$ is equal to 290.106
The square root of the sum of $(U_i * x_i)^2$ is equal to 17.03249835
The sum of the leak volumes x_i is equal to 1605.8

Therefore:

U_{total} = 17.03249835/1605.8 = 1.1%

The detailed calculation breakdown is provided in the table below. Due to the size of the database, only the information relevant to the calculation of *URi* is copied over. The complete data set can be found in the "Parameters" tab of the "ER Calculation Spreadsheet" (columns J-U) provided to the validation DOE.

Type of equipment	Assigned number	Hi-Flow Sampler ID	Leak rate lpm	Measurement photo	Uncertainty calculation (URi) Accuracy Range (U_i)	$(U_i * x_i)^2$ Note: $x_i = F_{CH4,i}$
manometer	S1-0031-01-163	163	0.7	IMG_0013	0.1	0.0049
stop valve	S1-0002-01-1	1	6.4	SAM_0068	0.1	0.4096
stop valve	S1-0002-03				0.1	0
stop valve	S1-0002-04				0.1	0
stop valve	S1-0002-05				0.1	0
stop valve	S1-0002-06				0.1	0
stop valve	S1-0002-07				0.1	0
stop valve	S1-0002-08				0.1	0
stop valve	S1-0002-09				0.1	0
stop valve	S1-0002-10				0.1	0
stop valve	S1-0002-18				0.1	0
stop valve	S1-0002-19				0.1	0
stop valve	S1-0002-20				0.1	0
stop valve	S1-0002-21				0.1	0
stop valve	S1-0002-22				0.1	0
stop valve	S1-0003-09-15	15	6.0	SAM_0081	0.1	0.36
stop valve	S1-0003-21				0.1	0
stop valve	S1-0003-22-18	18	7	SAM_0084	0.1	0.49
stop valve	S1-0003-23				0.1	0
stop valve	S1-0003-24				0.1	0
stop valve	S1-0004-18-25	25	2.80	SAM_0094	0.1	0.0784
stop valve	S1-0004-19-29	29	1.60	SAM_0098	0.1	0.0256
stop valve	S1-0004-20				0.1	0
stop valve	S1-0004-21-24	24	6.00	SAM_0093	0.1	0.36
stop valve	S1-0004-22				0.1	0

Type of equipment	Assigned number	Hi-Flow Sampler ID	Leak rate lpm	Measurement photo	Uncertainty calculation (URi) Accuracy Range (U_i)	$(U_i * x_i)^2$ Note: $x_i = F_{CH4,i}$
stop valve	S1-0004-23-33	33	1.90	SAM_0101	0.1	0.0361
stop valve	S1-0004-24				0.1	0
stop valve	S1-0004-25				0.1	0
stop valve	S1-0004-36-39	39	5.10	SAM_0107	0.1	0.2601
stop valve	S1-0004-37				0.1	0
stop valve	S1-0004-38-41	41	1.70	SAM_0109	0.1	0.0289
stop valve	S1-0004-39				0.1	0
stop valve	S1-0005-04-45	45	0.3	SAM_0115	0.1	0.0009
stop valve	S1-0005-05				0.1	0
stop valve	S1-0005-07				0.1	0
stop valve	S1-0005-08				0.1	0
stop valve	S1-0005-09				0.1	0
stop valve	S1-0005-10				0.1	0
stop valve	S1-0005-11				0.1	0
stop valve	S1-0005-12-46	46	3.60	SAM_0132	0.1	0.1296
stop valve	S1-0005-13				0.1	0
stop valve	S1-0006-07				0.1	0
stop valve	S1-0006-08				0.1	0
stop valve	S1-0006-09				0.1	0
stop valve	S1-0007-10				0.1	0
stop valve	S1-0007-11				0.1	0
stop valve	S1-0007-12				0.1	0
stop valve	S1-0007-15				0.1	0
stop valve	S1-0009-01-62	62	6.8	SAM_0178	0.1	0.4624
stop valve	S1-0010-01				0.1	0
stop valve	S1-0010-02				0.1	0
stop valve	S1-0010-03				0.1	0
stop valve	S1-0010-04-63	63	3.0	SAM_0189	0.1	0.09
stop valve	S1-0010-05				0.1	0
stop valve	S1-0010-06				0.1	0
stop valve	S1-0010-07-64	64	2.7	SAM_0190	0.1	0.0729
stop valve	S1-0010-08				0.1	0
stop valve	S1-0010-09				0.1	0
stop valve	S1-0010-10				0.1	0

Type of equipment	Assigned number	Hi-Flow Sampler ID	Leak rate lpm	Measurement photo	Uncertainty calculation (URi) Accuracy Range (U_i)	Uncertainty calculation (URi) $(U_i * x_i)^2$ Note: $x_i = F_{CH4,i}$
stop valve	S1-0010-12				0.1	0
stop valve	S1-0010-14				0.1	0
stop valve	S1-0011-06-69	69	3.7	SAM_0214	0.1	0.1369
stop valve	S1-0011-07				0.1	0
stop valve	S1-0011-09				0.1	0
stop valve	S1-0011-10				0.1	0
stop valve	S1-0011-11				0.1	0
stop valve	S1-0011-12				0.1	0
stop valve	S1-0011-15				0.1	0
stop valve	S1-0012-01				0.1	0
stop valve	S1-0012-02				0.1	0
stop valve	S1-0012-03				0.1	0
stop valve	S1-0012-04				0.1	0
stop valve	S1-0012-05				0.1	0
stop valve	S1-0012-06				0.1	0
stop valve	S1-0012-09				0.1	0
stop valve	S1-0012-10-73	73	1.0	SAM_0238	0.1	0.01
stop valve	S1-0013-01-82	82	22.3	SAM_0261	0.1	4.9729
stop valve	S1-0013-02-77	77	10.2	SAM_0257	0.1	1.0404
stop valve	S1-0013-03				0.1	0
stop valve	S1-0013-04				0.1	0
stop valve	S1-0013-05-81	81	3.8	SAM_0259	0.1	0.1444
stop valve	S1-0013-06-79	79	3.0	SAM_0258	0.1	0.09
stop valve	S1-0013-07-83	83	2.3	SAM_0262	0.1	0.0529
stop valve	S1-0013-08-85	85	3.7	SAM_0264	0.1	0.1369
stop valve	S1-0013-09				0.1	0
stop valve	S1-0013-10				0.1	0
stop valve	S1-0013-11-84	84	0.9	SAM_0263	0.1	0.0081
stop valve	S1-0013-12				0.1	0
stop valve	S1-0013-13				0.1	0
stop valve	S1-0014-01-86	86	8.9	SAM_0281	0.1	0.7921
stop valve	S1-0014-02-87	87	16.9	SAM_0283	0.1	2.8561

Type of equipment	Assigned number	Hi-Flow Sampler ID	Leak rate lpm	Measurement photo	Uncertainty calculation (URi) Accuracy Range (U_i)	$(U_i * x_i)^2$ Note: $x_i = F_{CH4,i}$
stop valve	S1-0014-03				0.1	0
stop valve	S1-0014-04				0.1	0
stop valve	S1-0014-05-88	88	1.2	SAM_0284	0.1	0.0144
stop valve	S1-0014-06				0.1	0
stop valve	S1-0015-01-89	89	6.8	SAM_0294	0.1	0.4624
stop valve	S1-0015-02-90	90	3.6	SAM_0295	0.1	0.1296
stop valve	S1-0015-03				0.1	0
stop valve	S1-0015-04				0.1	0
stop valve	S1-0015-05				0.1	0
stop valve	S1-0015-06				0.1	0
stop valve	S1-0016-01-91	91	6.9	SAM_0305	0.1	0.4761
stop valve	S1-0016-02-92	92	5.2	SAM_0307	0.1	0.2704
stop valve	S1-0016-03				0.1	0
stop valve	S1-0016-04				0.1	0
stop valve	S1-0016-05-93	93	0.7	SAM_0308	0.1	0.0049
stop valve	S1-0016-06				0.1	0
stop valve	S1-0017-01-94	94	7.1	SAM_0317	0.1	0.5041
stop valve	S1-0017-02-95	95	20.7	SAM_0319	0.1	4.2849
stop valve	S1-0017-03-96	96	0.7	SAM_0320	0.1	0.0049
stop valve	S1-0017-04				0.1	0
stop valve	S1-0017-05				0.1	0
stop valve	S1-0019-01-99	99	6.7	SAM_349	0.1	0.4489
stop valve	S1-0019-02				0.1	0
stop valve	S1-0019-04				0.1	0
stop valve	S1-0019-05-100	100	9.8	SAM_350	0.1	0.9604
stop valve	S1-0019-06				0.1	0
stop valve	S1-0019-11				0.1	0
stop valve	S1-0019-12				0.1	0
stop valve	S1-0019-14				0.1	0
stop valve	S1-0019-15				0.1	0
stop valve	S1-0019-16				0.1	0
stop valve	S1-0019-20				0.1	0

Type of equipment	Assigned number	Hi-Flow Sampler ID	Leak rate lpm	Measurement photo	Uncertainty calculation (URi) Accuracy Range (U_i)	$(U_i * x_i)^2$ Note: $x_i = F_{CH4,i}$
stop valve	S1-0019-22				0.1	0
stop valve	S1-0019-23-112	112	0.9	SAM_363	0.1	0.0081
stop valve	S1-0019-24				0.1	0
stop valve	S1-0019-25				0.1	0
stop valve	S1-0019-26-102	102	2.0	SAM_353	0.1	0.04
stop valve	S1-0019-27				0.1	0
stop valve	S1-0019-28-103	103	0.4	SAM_354	0.1	0.0016
stop valve	S1-0019-01-99	99	6.7	SAM_349	0.1	0.4489
stop valve	S1-0019-02				0.1	0
stop valve	S1-0019-04				0.1	0
stop valve	S1-0019-05-100	100	9.8	SAM_350	0.1	0.9604
stop valve	S1-0019-06				0.1	0
stop valve	S1-0019-11				0.1	0
stop valve	S1-0019-12				0.1	0
stop valve	S1-0019-14				0.1	0
stop valve	S1-0019-15				0.1	0
stop valve	S1-0019-16				0.1	0
stop valve	S1-0019-20				0.1	0
stop valve	S1-0019-22				0.1	0
stop valve	S1-0019-23-112	112	0.9	SAM_363	0.1	0.0081
stop valve	S1-0019-24				0.1	0
stop valve	S1-0019-25				0.1	0
stop valve	S1-0019-26-102	102	2.0	SAM_353	0.1	0.04
stop valve	S1-0019-27				0.1	0
stop valve	S1-0019-28-103	103	0.4	SAM_354	0.1	0.0016
stop valve	S1-0020-01				0.1	0
stop valve	S1-0020-02				0.1	0
stop valve	S1-0020-03				0.1	0
stop valve	S1-0020-04				0.1	0
stop valve	S1-0020-05				0.1	0
stop valve	S1-0020-06				0.1	0
stop valve	S1-0020-07-116	116	5.9	SAM_0452	0.1	0.3481
stop valve	S1-0020-08				0.1	0

Type of equipment	Assigned number	Hi-Flow Sampler ID	Leak rate lpm	Measurement photo	Uncertainty calculation (URi) Accuracy Range (U_i)	$(U_i * x_i)^2$ Note: $x_i = F_{CH4,i}$
stop valve	S1-0020-09				0.1	0
stop valve	S1-0020-10				0.1	0
stop valve	S1-0020-11				0.1	0
stop valve	S1-0020-12				0.1	0
stop valve	S1-0020-13-117	117	7.8	SAM_0453	0.1	0.6084
stop valve	S1-0020-14				0.1	0
stop valve	S1-0020-15				0.1	0
stop valve	S1-0020-16				0.1	0
stop valve	S1-0020-17				0.1	0
stop valve	S1-0020-18-114	114	4.6	SAM_0449	0.1	0.2116
stop valve	S1-0020-19				0.1	0
stop valve	S1-0020-21				0.1	0
stop valve	S1-0020-22				0.1	0
stop valve	S1-0020-23				0.1	0
stop valve	S1-0020-24				0.1	0
stop valve	S1-0020-26				0.1	0
stop valve	S1-0020-27				0.1	0
stop valve	S1-0020-28				0.1	0
stop valve	S1-0020-30				0.1	0
stop valve	S1-0020-31				0.1	0
stop valve	S1-0020-32				0.1	0
stop valve	S1-0020-33				0.1	0
stop valve	S1-0020-36-120	120	4.6	SAM_0459	0.1	0.2116
stop valve	S1-0020-37				0.1	0
stop valve	S1-0020-38				0.1	0
stop valve	S1-0020-39				0.1	0
stop valve	S1-0020-40				0.1	0
stop valve	S1-0020-42-122	122	6.6	SAM_0461	0.1	0.4356
stop valve	S1-0020-44				0.1	0
stop valve	S1-0020-45				0.1	0
stop valve	S1-0020-48				0.1	0
stop valve	S1-0020-49				0.1	0
stop valve	S1-0020-50				0.1	0
stop valve	S1-0020-52				0.1	0
stop valve	S1-0021-01				0.1	0
stop valve	S1-0021-02-124	124	7.3	SAM_0472	0.1	0.5329
stop valve	S1-0021-03-	125	2.5	SAM_0473	0.1	0.0625

Type of equipment	Assigned number	Hi-Flow Sampler ID	Leak rate lpm	Measurement photo	Uncertainty calculation (URi) Accuracy Range (U_i)	$(U_i * x_i)^2$ Note: $x_i = F_{CH4,i}$
	125					
stop valve	S1-0021-04				0.1	0
stop valve	S1-0021-05-126	126	8.6	SAM_0475	0.1	0.7396
stop valve	S1-0021-06				0.1	0
stop valve	S1-0021-07-127	127	1.8	SAM_0476	0.1	0.0324
stop valve	S1-0021-08				0.1	0
stop valve	S1-0022-01-128	128	10.9	SAM_0496	0.1	1.1881
stop valve	S1-0022-02				0.1	0
stop valve	S1-0022-03				0.1	0
stop valve	S1-0022-04				0.1	0
stop valve	S1-0022-05-129	129	25.1	SAM_0501	0.1	6.3001
stop valve	S1-0022-06				0.1	0
stop valve	S1-0022-07-130	130	4.1	SAM_0503	0.1	0.1681
stop valve	S1-0022-08				0.1	0
stop valve	S1-0022-09-132	132	2.9	SAM_0505	0.1	0.0841
stop valve	S1-0022-10				0.1	0
stop valve	S1-0022-11-131	131	3.4	SAM_0504	0.1	0.1156
stop valve	S1-0023-01-133	133	4.5	DSC02238	0.1	0.2025
stop valve	S1-0023-02				0.1	0
stop valve	S1-0023-03				0.1	0
stop valve	S1-0023-04				0.1	0
stop valve	S1-0023-05				0.1	0
stop valve	S1-0023-06				0.1	0
stop valve	S1-0024-01				0.1	0
stop valve	S1-0024-02-136	136	2.1	DSC02252	0.1	0.0441
stop valve	S1-0024-03				0.1	0
stop valve	S1-0024-04				0.1	0
stop valve	S1-0024-05				0.1	0
stop valve	S1-0024-06				0.1	0
stop valve	S1-0025-01				0.1	0
stop valve	S1-0025-02				0.1	0
stop valve	S1-0025-03				0.1	0
stop valve	S1-0025-04				0.1	0

Type of equipment	Assigned number	Hi-Flow Sampler ID	Leak rate lpm	Measurement photo	Uncertainty calculation (URi) Accuracy Range (U_i)	$(U_i * x_i)^2$ Note: $x_i = F_{CH4,i}$
stop valve	S1-0025-05				0.1	0
stop valve	S1-0025-06				0.1	0
stop valve	S1-0025-07				0.1	0
stop valve	S1-0025-08				0.1	0
stop valve	S1-0025-09				0.1	0
stop valve	S1-0025-10				0.1	0
stop valve	S1-0025-11				0.1	0
stop valve	S1-0025-12				0.1	0
stop valve	S1-0025-13				0.1	0
stop valve	S1-0025-14				0.1	0
stop valve	S1-0025-15				0.1	0
stop valve	S1-0025-16				0.1	0
stop valve	S1-0025-17				0.1	0
stop valve	S1-0026-07				0.1	0
stop valve	S1-0026-08				0.1	0
stop valve	S1-0026-09-153	153	31.1	SAM_0588	0.1	9.6721
stop valve	S1-0026-10-146	146	9.5	SAM_0579	0.1	0.9025
stop valve	S1-0026-13-154	154	40.3	SAM_0589	0.1	16.2409
stop valve	S1-0026-14				0.1	0
stop valve	S1-0026-15				0.1	0
stop valve	S1-0026-16				0.1	0
stop valve	S1-0026-17-148	148	9.9	SAM_0581	0.1	0.9801
stop valve	S1-0026-18				0.1	0
stop valve	S1-0026-19				0.1	0
stop valve	S1-0026-20-147	147	14.5	SAM_0580	0.1	2.1025
stop valve	S1-0026-21				0.1	0
stop valve	S1-0026-23				0.1	0
stop valve	S1-0026-24				0.1	0
stop valve	S1-0026-29				0.1	0
stop valve	S1-0026-32-150	150	9.6	SAM_0584	0.1	0.9216
stop valve	S1-0026-34-151	151	23.4	SAM_0585	0.1	5.4756
stop valve	S1-0026-44-152	152	8	SAM_0589	0.1	0.64
stop valve	S1-0026-45				0.1	0
stop valve	S1-0026-46				0.1	0

Type of equipment	Assigned number	Hi-Flow Sampler ID	Leak rate lpm	Measurement photo	Uncertainty calculation (URi) Accuracy Range (U_i)	$(U_i * x_i)^2$ Note: $x_i = F_{CH4,i}$
stop valve	S1-0026-47				0.1	0
stop valve	S1-0026-48				0.1	0
stop valve	S1-0026-49				0.1	0
stop valve	S1-0027-12				0.1	0
stop valve	S1-0027-13				0.1	0
stop valve	S1-0027-14-158	158	0.7	SAM_0594	0.1	0.0049
stop valve	S1-0030-01-162	162	38.9	IMG_0009	0.1	15.1321
stop valve	S1-0032-01				0.1	0
stop valve	S1-0032-02				0.1	0
stop valve	S1-0032-03				0.1	0
stop valve	S1-0032-04				0.1	0
stop valve	S1-0032-09				0.1	0
stop valve	S1-0032-10				0.1	0
stop valve	S1-0032-11				0.1	0
stop valve	S1-0032-12				0.1	0
stop valve	S1-0032-13				0.1	0
stop valve	S1-0032-14				0.1	0
stop valve	S1-0033-13				0.1	0
stop valve	S1-0033-14				0.1	0
stop valve	S1-0033-18				0.1	0
stop valve	S1-0033-20				0.1	0
stop valve	S1-0033-21				0.1	0
stop valve	S1-0033-23				0.1	0
stop valve	S1-0033-25				0.1	0
stop valve	S1-0033-26				0.1	0
stop valve	S1-0033-34				0.1	0
stop valve	S1-0033-35				0.1	0
stop valve	S1-0033-36				0.1	0
stop valve	S1-0033-37				0.1	0
stop valve	S1-0033-38				0.1	0
stop valve	S1-0033-39				0.1	0
stop valve	S1-0033-40				0.1	0
stop valve	S1-0033-41				0.1	0
stop valve	S1-0033-42				0.1	0
stop valve	S1-0033-43				0.1	0
stop valve	S1-0033-44				0.1	0
stop valve	S1-0033-45-174	174	1.3	SAM_0761	0.1	0.0169
stop valve	S1-0033-46				0.1	0
stop valve	S1-0033-47-	168	4.1	SAM_0757	0.1	0.1681

Type of equipment	Assigned number	Hi-Flow Sampler ID	Leak rate lpm	Measurement photo	Uncertainty calculation (URi) Accuracy Range (U_i)	Uncertainty calculation (URi) $(U_i * x_i)^2$ Note: $x_i = F_{CH4,i}$
	168					
stop valve	S1-0033-48				0.1	0
stop valve	S1-0033-49				0.1	0
stop valve	S1-0033-50-166	166	6.2	SAM_0756	0.1	0.3844
threaded connection	S1-0023-07-134	134	0.2	DSC02239	0.1	0.0004
threaded connection	S1-0023-08-135	135	0.2	DSC02241	0.1	0.0004
threaded connection	S1-0025-18-137	137	0.2	DSC02261	0.1	0.0004
threaded connection	S1-0025-19-138	138	0.5	DSC02262	0.1	0.0025
threaded connection	S1-0026-01-139	139	0.5		0.1	0.0025
threaded connection	S1-0026-02-141	141	2.5		0.1	0.0625
threaded connection	S1-0026-03-142	142	1.4	SAM_0570	0.1	0.0196
threaded connection	S1-0026-04-143	143	1.2	SAM_0573	0.1	0.0144
threaded connection	S1-0026-05-144	144	1.2	SAM_0574	0.1	0.0144
threaded connection	S1-0026-06-145	145	1.2	SAM_0576	0.1	0.0144
threaded connection	S1-0028-01-159	159	0.5	SAM_0611	0.1	0.0025
threaded connection	S1-0028-02-160	160	0.3	SAM_0612	0.1	0.0009
threaded connection	S1-0033-51-177	177	3	SAM_0764	0.1	0.09
threaded connection	S1-0033-52-176	176	8.1	SAM_0763	0.1	0.6561
threaded connection	S1-0033-55-179	179	6.3	SAM_0765	0.1	0.3969
valve	S1-0001-01-1	1	0.5	SAM_0057	0.1	0.0025
valve	S1-0001-02-2	2	0.6	SAM_0058	0.1	0.0036
valve	S1-0001-03-3	3	2.9	SAM_0059	0.1	0.0841
valve	S1-0001-04-4	4	7.0	SAM_0060	0.1	0.49

Type of equipment	Assigned number	Hi-Flow Sampler ID	Leak rate lpm	Measurement photo	Uncertainty calculation (URi) Accuracy Range (U_i)	$(U_i * x_i)^2$ Note: $x_i = F_{CH4,i}$
valve	S1-0001-05				0.1	0
valve	S1-0001-06-5	5	8.2	SAM_0061	0.1	0.6724
valve	S1-0001-07-6	6	8.3	SAM_0062	0.1	0.6889
valve	S1-0001-08				0.1	0
valve	S1-0001-09-7	7	8.4	SAM_0063	0.1	0.7056
valve	S1-0001-10				0.1	0
valve	S1-0001-11				0.1	0
valve	S1-0001-12				0.1	0
valve	S1-0001-13				0.1	0
valve	S1-0001-14				0.1	0
valve	S1-0001-15				0.1	0
valve	S1-0001-16				0.1	0
valve	S1-0001-17-9	9	8.4	SAM_0064	0.1	0.7056
valve	S1-0001-18-10	10	8.7	SAM_0065	0.1	0.7569
valve	S1-0002-02-2	2	15.1	SAM_0069	0.1	2.2801
valve	S1-0002-11-5	5	7	SAM_0072	0.1	0.49
valve	S1-0002-12-6	6	10.7	SAM_0073	0.1	1.1449
valve	S1-0002-13				0.1	0
valve	S1-0002-14-7	7	25.6	SAM_0074	0.1	6.5536
valve	S1-0002-15-4	4	30.1	SAM_0071	0.1	9.0601
valve	S1-0002-16				0.1	0
valve	S1-0002-17-3	3	23.4	SAM_0070	0.1	5.4756
valve	S1-0002-23-8	8	30.5	SAM_0075	0.1	9.3025
valve	S1-0002-24				0.1	0
valve	S1-0003-01				0.1	0
valve	S1-0003-02-11	11	4.4	SAM_0077	0.1	0.1936
valve	S1-0003-03				0.1	0
valve	S1-0003-04				0.1	0
valve	S1-0003-05				0.1	0
valve	S1-0003-06-	13	3.1	SAM_0079	0.1	0.0961

Type of equipment	Assigned number	Hi-Flow Sampler ID	Leak rate lpm	Measurement photo	Uncertainty calculation (URi) Accuracy Range (U_i)	$(U_i * x_i)^2$ Note: $x_i = F_{CH4,i}$
	13					
valve	S1-0003-07				0.1	0
valve	S1-0003-08				0.1	0
valve	S1-0003-10-10	10	14.2	SAM_0076	0.1	2.0164
valve	S1-0003-11				0.1	0
valve	S1-0003-12-12	12	23.9	SAM_0078	0.1	5.7121
valve	S1-0003-13				0.1	0
valve	S1-0003-14				0.1	0
valve	S1-0003-15				0.1	0
valve	S1-0003-16-14	14	20.0	SAM_0080	0.1	4
valve	S1-0003-17				0.1	0
valve	S1-0003-18				0.1	0
valve	S1-0003-19-17	17	6.8	SAM_0083	0.1	0.4624
valve	S1-0003-20-16	16	30.3	SAM_0082	0.1	9.1809
valve	S1-0003-25				0.1	0
valve	S1-0003-26				0.1	0
valve	S1-0003-27-19	19	9.9	SAM_0085	0.1	0.9801
valve	S1-0003-28				0.1	0
valve	S1-0003-29-20	20	9.9	SAM_0086	0.1	0.9801
valve	S1-0003-30				0.1	0
valve	S1-0003-31				0.1	0
valve	S1-0003-32				0.1	0
valve	S1-0003-33				0.1	0
valve	S1-0003-34-21	21	26.8	SAM_0087	0.1	7.1824
valve	S1-0004-01-22	22	31.9	SAM_0092	0.1	10.1761
valve	S1-0004-02				0.1	0
valve	S1-0004-03				0.1	0
valve	S1-0004-04-27	27	6.1	SAM_0096	0.1	0.3721
valve	S1-0004-05				0.1	0
valve	S1-0004-06-28	28	8.2	SAM_0097	0.1	0.6724
valve	S1-0004-07				0.1	0
valve	S1-0004-08				0.1	0

					Uncertainty calculation (URi)	
Type of equipment	**Assigned number**	**Hi-Flow Sampler ID**	**Leak rate lpm**	**Measurement photo**	**Accuracy Range (U_i)**	**$(U_i * x_i)^2$ Note: x_i = $F_{CH4,i}$**
valve	S1-0004-09				0.1	0
valve	S1-0004-10-30	30	9.10	SAM_0099	0.1	0.8281
valve	S1-0004-11				0.1	0
valve	S1-0004-12				0.1	0
valve	S1-0004-13-32	32	6.70	SAM_0100	0.1	0.4489
valve	S1-0004-14				0.1	0
valve	S1-0004-15				0.1	0
valve	S1-0004-16-26	26	19.80	SAM_0095	0.1	3.9204
valve	S1-0004-17-34	34	29.20	SAM_0102	0.1	8.5264
valve	S1-0004-26				0.1	0
valve	S1-0004-27-35	35	4.10	SAM_0103	0.1	0.1681
valve	S1-0004-28				0.1	0
valve	S1-0004-29				0.1	0
valve	S1-0004-30-36	36	6.90	SAM_0104	0.1	0.4761
valve	S1-0004-31				0.1	0
valve	S1-0004-32-38	38	7.10	SAM_0106	0.1	0.5041
valve	S1-0004-33				0.1	0
valve	S1-0004-34-40	40	4.10	SAM_0108	0.1	0.1681
valve	S1-0004-35				0.1	0
valve	S1-0004-40-37	37	1.50	SAM_0105	0.1	0.0225
valve	S1-0004-41				0.1	0
valve	S1-0005-01-42	42	5.2	SAM_0112	0.1	0.2704
valve	S1-0005-02-43	43	9.8	SAM_0113	0.1	0.9604
valve	S1-0005-03				0.1	0
valve	S1-0005-06-44	44	8	SAM_0114	0.1	0.64
valve	S1-0006-01				0.1	0
valve	S1-0006-02-47	47	8.9	SAM_0119	0.1	0.7921
valve	S1-0006-03				0.1	0
valve	S1-0006-04-48	48	4.2	SAM_0120	0.1	0.1764

Type of equipment	Assigned number	Hi-Flow Sampler ID	Leak rate lpm	Measurement photo	Uncertainty calculation (URi) Accuracy Range (U_i)	Uncertainty calculation (URi) $(U_i * x_i)^2$ Note: $x_i = F_{CH4,i}$
valve	S1-0006-05				0.1	0
valve	S1-0006-06-49	49	15.2	SAM_0121	0.1	2.3104
valve	S1-0006-10				0.1	0
valve	S1-0007-01-50	50	4.8	SAM_0134	0.1	0.2304
valve	S1-0007-02-51	51	11.1	SAM_0135	0.1	1.2321
valve	S1-0007-03				0.1	0
valve	S1-0007-04				0.1	0
valve	S1-0007-05-52	52	3.2	SAM_0136	0.1	0.1024
valve	S1-0007-06				0.1	0
valve	S1-0007-07				0.1	0
valve	S1-0007-08-53	53	8.8	SAM_0137	0.1	0.7744
valve	S1-0007-09				0.1	0
valve	S1-0007-13-54	54	1.9	SAM_0138	0.1	0.0361
valve	S1-0007-14-55	55	1.4	SAM_0139	0.1	0.0196
valve	S1-0008-01-56	56	5.8	SAM_0159	0.1	0.3364
valve	S1-0008-02				0.1	0
valve	S1-0008-03				0.1	0
valve	S1-0008-04-57	57	15.5	SAM_0160	0.1	2.4025
valve	S1-0008-05				0.1	0
valve	S1-0008-06-58	58	0.9	SAM_0162	0.1	0.0081
valve	S1-0008-07-59	59	2.3	SAM_0163	0.1	0.0529
valve	S1-0009-02-60	60	4.4	SAM_0174	0.1	0.1936
valve	S1-0009-03				0.1	0
valve	S1-0009-04				0.1	0
valve	S1-0009-05				0.1	0
valve	S1-0009-06				0.1	0
valve	S1-0009-07-61	61	1.9	SAM_0175	0.1	0.0361
valve	S1-0010-11-65	65	1.4	SAM_0191	0.1	0.0196
valve	S1-0010-13-	66	2.4	SAM_0192	0.1	0.0576

					Uncertainty calculation (URi)	
Type of equipment	**Assigned number**	**Hi-Flow Sampler ID**	**Leak rate lpm**	**Measurement photo**	**Accuracy Range (U_i)**	**$(U_i * x_i)^2$ Note: $x_i = F_{CH4,i}$**
	66					
valve	S1-0011-01				0.1	0
valve	S1-0011-02				0.1	0
valve	S1-0011-03-67	67	21.5	SAM_0211	0.1	4.6225
valve	S1-0011-04-68	68	4.7	SAM_0213	0.1	0.2209
valve	S1-0011-05				0.1	0
valve	S1-0011-08-70	70	4.8	SAM_0216	0.1	0.2304
valve	S1-0011-13-71	71	1.8	SAM_0217	0.1	0.0324
valve	S1-0011-14-72	72	1.9	SAM_0218	0.1	0.0361
valve	S1-0012-07-74	74	0.9	SAM_0239	0.1	0.0081
valve	S1-0012-08-75	75	1.0	SAM_0240	0.1	0.01
valve	S1-0012-11-76	76	0.9	SAM_0241	0.1	0.0081
valve	S1-0012-12				0.1	0
valve	S1-0018-01				0.1	0
valve	S1-0018-02				0.1	0
valve	S1-0018-03-97	97	19.8	SAM_331	0.1	3.9204
valve	S1-0018-04				0.1	0
valve	S1-0018-05				0.1	0
valve	S1-0018-06				0.1	0
valve	S1-0018-07				0.1	0
valve	S1-0018-08				0.1	0
valve	S1-0018-09				0.1	0
valve	S1-0018-10				0.1	0
valve	S1-0018-11				0.1	0
valve	S1-0018-12				0.1	0
valve	S1-0019-03-98	98	19.2	SAM_348	0.1	3.6864
valve	S1-0019-07-104	104	13.0	SAM_356	0.1	1.69
valve	S1-0019-08-105	105	6.8	SAM_357	0.1	0.4624
valve	S1-0019-09-110	110	9.7	SAM_361	0.1	0.9409
valve	S1-0019-10-	106	8.9	SAM_358	0.1	0.7921

					Uncertainty calculation (URi)	
Type of equipment	**Assigned number**	**Hi-Flow Sampler ID**	**Leak rate lpm**	**Measurement photo**	**Accuracy Range (U_i)**	**$(U_i * x_i)^2$ Note: $x_i = F_{CH4,i}$**
	106					
valve	S1-0019-13-109	109	11.2	SAM_359	0.1	1.2544
valve	S1-0019-17				0.1	0
valve	S1-0019-18				0.1	0
valve	S1-0019-19-101	101	3.1	SAM_352	0.1	0.0961
valve	S1-0019-21-111	111	7.1	SAM_362	0.1	0.5041
valve	S1-0019-03-98	98	19.2	SAM_348	0.1	3.6864
valve	S1-0019-07-104	104	13.0	SAM_356	0.1	1.69
valve	S1-0019-08-105	105	6.8	SAM_357	0.1	0.4624
valve	S1-0019-09-110	110	9.7	SAM_361	0.1	0.9409
valve	S1-0019-10-106	106	8.9	SAM_358	0.1	0.7921
valve	S1-0019-13-109	109	11.2	SAM_359	0.1	1.2544
valve	S1-0019-17				0.1	0
valve	S1-0019-18				0.1	0
valve	S1-0019-19-101	101	3.1	SAM_352	0.1	0.0961
valve	S1-0019-21-111	111	7.1	SAM_362	0.1	0.5041
valve	S1-0020-20-113	113	39.8	SAM_0448	0.1	15.8404
valve	S1-0020-25-115	115	29.6	SAM_0451	0.1	8.7616
valve	S1-0020-29-119	119	44.2	SAM_0458	0.1	19.5364
valve	S1-0020-34-121	121	9.5	SAM_0460	0.1	0.9025
valve	S1-0020-35				0.1	0
valve	S1-0020-41				0.1	0
valve	S1-0020-43				0.1	0
valve	S1-0020-46-118	118	14.4	SAM_0457	0.1	2.0736
valve	S1-0020-47				0.1	0
valve	S1-0020-51				0.1	0
valve	S1-0020-53-	123	8.6	SAM_0462	0.1	0.7396

Type of equipment	Assigned number	Hi-Flow Sampler ID	Leak rate lpm	Measurement photo	Uncertainty calculation (URi) Accuracy Range (U_i)	$(U_i * x_i)^2$ Note: $x_i = F_{CH4,i}$
	123					
valve	S1-0020-54				0.1	0
valve	S1-0026-11-149	149	5.5	SAM_0583	0.1	0.3025
valve	S1-0026-12				0.1	0
valve	S1-0026-22				0.1	0
valve	S1-0026-25				0.1	0
valve	S1-0026-26				0.1	0
valve	S1-0026-27				0.1	0
valve	S1-0026-28-156	156	4	SAM_0590	0.1	0.16
valve	S1-0026-30				0.1	0
valve	S1-0026-31				0.1	0
valve	S1-0026-33				0.1	0
valve	S1-0026-35				0.1	0
valve	S1-0026-36				0.1	0
valve	S1-0026-37				0.1	0
valve	S1-0026-38				0.1	0
valve	S1-0026-39				0.1	0
valve	S1-0026-40				0.1	0
valve	S1-0026-41				0.1	0
valve	S1-0026-42-157	157	4.8	SAM_0591	0.1	0.2304
valve	S1-0026-43				0.1	0
valve	S1-0027-01				0.1	0
valve	S1-0027-02				0.1	0
valve	S1-0027-03				0.1	0
valve	S1-0027-04				0.1	0
valve	S1-0027-05				0.1	0
valve	S1-0027-06				0.1	0
valve	S1-0027-07				0.1	0
valve	S1-0027-08				0.1	0
valve	S1-0027-09				0.1	0
valve	S1-0027-10				0.1	0
valve	S1-0027-11				0.1	0
valve	S1-0029-01-161	161	9.3	IMG_0006	0.1	0.8649
valve	S1-0032-05				0.1	0
valve	S1-0032-06				0.1	0
valve	S1-0032-07				0.1	0
valve	S1-0032-08				0.1	0
valve	S1-0033-01-	165	22.3	SAM_0755	0.1	4.9729

Type of equipment	Assigned number	Hi-Flow Sampler ID	Leak rate lpm	Measurement photo	Uncertainty calculation (URi) Accuracy Range (U_i)	$(U_i * x_i)^2$ Note: x_i = $F_{CH4,i}$
	165					
valve	S1-0033-02				0.1	0
valve	S1-0033-03				0.1	0
valve	S1-0033-04-164	164	6.0	SAM_0753	0.1	0.36
valve	S1-0033-05				0.1	0
valve	S1-0033-06				0.1	0
valve	S1-0033-07				0.1	0
valve	S1-0033-08				0.1	0
valve	S1-0033-09-173	173	21.2	SAM_0760	0.1	4.4944
valve	S1-0033-10				0.1	0
valve	S1-0033-11				0.1	0
valve	S1-0033-12-169	169	9.7	SAM_0758	0.1	0.9409
valve	S1-0033-15-175	175	28.9	SAM_0762	0.1	8.3521
valve	S1-0033-16				0.1	0
valve	S1-0033-17				0.1	0
valve	S1-0033-19				0.1	0
valve	S1-0033-22-170	170	3.9	SAM_0759	0.1	0.1521
valve	S1-0033-24				0.1	0
valve	S1-0033-27				0.1	0
valve	S1-0033-28				0.1	0
valve	S1-0033-29				0.1	0
valve	S1-0033-30				0.1	0
valve	S1-0033-31				0.1	0
valve	S1-0033-32				0.1	0
valve	S1-0033-33				0.1	0

Annex 4

MONITORING INFORMATION

1. Management of the project monitoring

Teams

To achieve all of the monitoring goals and objectives, a monitoring plan will be developed in order to monitor the quality of the work and to plan and coordinate activities of all entities involved in the monitoring.

Serbiagas, in cooperation with the project operator, "Energo Sistem Limited" (Energosystems) will implement the project activities of detecting, measuring, repairing and documenting leaks during the crediting period. Natsource and the consultants, "ET&C Consultants Limited" (ETC), will provide CDM methodological supervision and support to local staff.

Monitoring teams. Serbiagas and Energosystems will form several CDM monitoring teams, which will be trained by ETC. Each monitoring team will consist of two technical specialists. One specialist will be in charge of leak detection and measurement activities, and will coordinate with the database team to make sure the detected leaks are being accurately entered into the database. Monitoring teams will have separate datasheets which they will pass to the database management team for uploading. These teams will be also responsible for the repair of all re-emerging leaks and any new leaks.

The teams will be equipped with:

- Gasurveyor 3-500;
- High Flow Sampler;
- Digital Camera;
- PTFE Sealant;
- Equipment to conduct repairs;
- Tags; and
- Ladder.

The monitoring team management reports to the project management team.

Database Management team. The project operator, Energosystems, in cooperation with ETC will be responsible for documenting the leak measurement data, and ensuring that it is correctly entered into the database. The data will be entered on an electronic database on a daily basis during the leak detection and measurement phase of the project, as well as during the repair phase. During annual monitoring, any new detection, measurements and repairs will be added to the database. The database management team will be tasked with checking data and managing the collection, processing, storage, archiving and backup of all data and records. This team will also be responsible for estimating the CERs achieved based on the information from the database, discounting for any repairs that would have been done in the baseline scenario as per the decision tree described in Step 1 of Section B.6.1. The database manager is also responsible for recording all outages across the network and ensuring that CERs are not included for the sections of the project where outages have occurred. Outages which are not the result of the project activity will be recorded by the Serbiagas Technical Support Department and forwarded to the Database Management team before the end of each monitoring period.

Database management team reports to the project management team.

<u>*Project Management Team*</u>. The Project Management team will be responsible for coordinating the CDM project, and will focus on planning, organizing, and managing all resources involved in full cycle of project implementation and monitoring. This team will supervise the database management team and monitoring teams. Natsource will provide training on the specific monitoring requirements of CDM. The project management will also coordinate all other project related activities, such as cooperation with Natsource to allocate resources required for project implementation and monitoring; coordination with relevant government bodies in the Republic of Serbia; issues and conflicts resolution; etc. The project management team leaders (referred to as the Monitoring Managers) are responsible for the overall project monitoring.

<u>*Natsource's Project Team*</u>. Natsource will provide funds for project implementation, monitoring, and for leak detection and measurement equipment, repair materials, digital cameras, computers and software. Natsource will coordinate with Serbiagas' Legal and Accounting departments to make sure the project is fully compliant with relevant Serbian regulations.

Natsource will also be responsible for ensuring the quality assurance of the project, by involving independent third parties on an ongoing basis. Natsource will pay for ongoing project related works and quality control services, to be provided by ETC.

Natsource will provide project management support and CDM methodological supervision, to ensure that the project is implemented in line with CDM requirements.

Training of local staff

ETC will provide training to Serbiagas and Energosystems local staff on to the use of the detection and measurement equipment, on how to conduct effective repairs, and how to properly document the detected leaks, measurement and repairs. They will also provide Serbiagas and Energosystems with a set of instructions and manuals on leak detection and measurements. It is expected that initially about 30 people will participate in this training program. The staff selection will be based on experience working with gas systems, and technical knowledge in working with computers and hi-tech tools.

The theoretical part of training will focus on essential features of the gas detectors and Hi-Flow Sampler, calibration requirements, undertaking minor equipment maintenance and upkeep, and ensuring critical equipment operation (downloading data, taking proper measurements, etc.). The field part of training will focus on practical skills of actual leak detection and measurement, data processing, and valve and fitting leak repair.

2. Field monitoring procedures

As described in the PDD, all leaks will be repaired during the first year of project implementation. Subsequently, the monitoring plan will be implemented to ensure that the effectiveness of the leak repair is checked at least annually.

Monitoring for re-emerging leaks

Each component repaired under this CDM project will be inspected in the monitoring stage of the project activity. The monitoring teams will use the Gasurveyor 3-500 to check for re-emerging leaks in repaired components.

At each component, the monitoring teams will manually record the tag information of the repaired component (date and time, information on leaks) on special forms and hand over the forms to the Monitoring Manager for recording into the database.

Any micro leak (a leak that is lower than the lowest sensitivity threshold of Hi-Flow Sampler and certainly cannot be measured by Hi-Flow Sampler) will be noted in a special form which will be handed over to the Monitoring Manager who will record it in the database. These leaks will be conservatively assumed to be 1.42 l/min (the lowest sensitivity threshold of the Hi-Flow Sampler) and any emission reductions will be calculated using this flow rate..

Any re-emerging leak will be measured and repaired as per the procedures described below.

Repair of re-emerging leaks

Where a previously detected and repaired leak re-emerges, the monitoring team will measure the leak rate using the Hi-Flow Sampler. Two measurements will be taken. If the two measurements deviate by more than 10% it normally indicates a human error and the measurements are stopped. The monitoring team will start the test over again. If the two measurements deviate by less than 10%, the reading shown on the High Flow Sampler will be used.

A digital photo will be taken of the component, serial number, and Hi-Flow Sampler reading.

The monitoring team will then repair the leak.

Once the leak has been repaired, the component will be inspected again using the Gasurveyor 3-500 to ensure that the repair has been effective. A digital photo will be taken of the component, serial number, and the detector read out.

All information on these events will be recorded in a special written form that is handed over to the Monitoring Manager who compiles it in the database.

Summarizing monitoring results and reporting to Project Developer

The Monitoring Manager is responsible for day-to-day monitoring. The Monitoring Manager will summarize all paper reports from regular inspections and reports from monitoring teams into the database. Monitoring report summaries will be provided to project developer and to DOE for verification.

Calibration

Calibration kits and spare part kits are delivered with the Hi-Flow Sampler package. The Hi-Flow Sampler calibration is verified using the calibration gas cylinder, as required in the equipment instruction manual. The Hi-Flow sampler will verify the calibration using 2.5% CH_4 which is applied to the background inlet port. The equipment is calibrated when the concentration on the display matches the concentration stamped on the calibration gas cylinder.

Every month the Hi-Flow Sampler will be recalibrated with the calibration kit and performed by certified staff from Serbiagas/Energosystems.

The calibration of the Gasurveyor is valid for 12 months. The calibration will be confirmed by Serbiagas/Energosystems once every week. When needed, calibration will be done following the field calibration procedures contained in the instruction manual.

Quality assurance and corrective action

For the purposes of quality assurance, the independent technical expert, ETC, will be monitoring the work of the monitoring teams. The on-going responsibilities of ETC are as follows:

- Conduct leak sample measurement study on the Serbiagas distribution network to determine whether leak rates identified by Serbiagas/Energosystems monitoring teams were in line with their own independent assessment;
- Provide formal training to Serbiagas/Energosystems staff;
- Provide an independent evaluation of the Serbiagas/Energosystems' technical team's capabilities and techniques;
- Provide an independent assessment on what types of materials and equipment Serbiagas/Energosystems technical teams should use to most effectively repair leaks;
- Visit Serbia to provide further training as and when requested by Natsource.

ETC will be responsible for quality control of the project implementation and monitoring on a continuing basis. ETC will visit Serbia initially every two weeks for the first 2 months of the project implementation and then slowly reduce its presence while retaining its supervisory role for the duration of the project. ETC, or a successor with relevant expertise in leak reduction projects, will visit the project at least twice a year. Their role and responsibilities will be the following:

- Make sure that maintenance and monitoring of leaks are being conducted in accordance with the Monitoring Plan;
- Examine the Serbiagas/Energosystems' database to ensure that data is being recorded and handled as per the requirements of this Monitoring Plan;
- Audit data to ensure that adequate records are being kept, and that leaks found and repaired have been accurately documented in the database;
- Examine Serbiagas/Energosystems' technical teams to ensure that they are properly operating equipment and conducting leak detection, monitoring and repair activities, and advise on any training needs required;
- Make sure that project implementation and monitoring is on schedule and highlight any risks of delay;
- Check repair/replacement schedule of any equipment that are due to be replaced or repaired for the coming year;
- Submit a draft monitoring report to Natsource and Serbiagas/Energosystems for review after each visit.

Any issues or problems detected by ETC will be reported back to Serbiagas/Energosystems and Natsource who will then conduct corrective actions.

Corrective Actions. At the end of each monitoring period, ETC will submit a draft monitoring report for review and approval to Serbiagas/Energosystems' Monitoring Manager and Natsource, to check for irregularities. In the event that such irregularities are observed:

- Serbiagas/Energosystems will carry out an analysis of the irregularities and their causes immediately with any needed assistance from ETC and Natsource.
- The management of Serbiagas /Energosystems will make a decision, in consultation with Natsource, on appropriate corrective actions to eliminate the non-conformity and its causes.
- Corrective actions will be executed under the supervision of the Monitoring Manager, and any necessary amendments will be made

3. Data storage

The monitoring teams are required to fill out special paper forms at the sites and hand them over to the Monitoring Manager, who will in turn record the information in the database. The Monitoring Manager will:

- Check the completeness of the data;
- Compile the data in an electronic database;
- Arrange for physical storage of the paper forms and;
- Communicate the information (paper forms and electronic files) further to Natsource on a regular basis.

ETC will carry out additional quality assurance of the data, arrange the storage of data in physical and electronic databases and on a regular basis forward the data to Natsource.

4. *Ex-ante* calculation of emission reductions

Please see section B.6.3 above for detail on how the database managers will calculate emission reductions.

5. Data and parameter monitored

Please see section B.7.1 above for detail on the data and parameters that will be tracked, and information on how they will be monitored.