Climate project methodology No. 0009

“Leak detection and repair in gas production, processing, transmission, storage and distribution systems and in refinery facilities”

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1. Terms and definitions

1. For the purpose of this methodology, the following definitions apply:

(i) Refinery gas. Also known as still gas, can be defined as: “Any form or mixture of gases produced in refineries by distillation, cracking, reforming and other processes. The principal constituents are methane, ethane, ethylene, normal butane, butylene, propane, propylene, etc. Refinery gas is used as a refinery fuel and a petrochemical feedstock” and is generally produced from light ends distillation units of refinery facilities, where it has a pressure that allows its immediate use;

(ii) Component. Sealed surfaces of above-ground process equipment, including valves, flanges, and other connectors, pump seals, compressor seals, pressure relief valves, open-ended lines, and sampling connections. These components represent mechanical joints, seals, and rotating surfaces, which in time tend to wear and develop unintentional leaks.

(iii) Physical leak. The unintentional and continuous loss of natural gas or refinery gas from a component. The leaking may occur past a seal, mechanical connection or minor flaw on the component at a rate that is in excess of normal tolerances allowed by the manufacturer. Leaks may occur due to normal wear and tear, improper or incomplete assembly of components, inadequate material specification, manufacturing defects, damage during installation or use, corrosion, fouling and demanding service conditions (e.g. vibrations and thermal cycling);

(iv) Leak detection and repair (LDAR) program. A structured program to detect and repair physical leaks from components. If a component is determined to have a physical leak, then the component is tagged and the physical leak repaired within a specified time. In the context of this methodology the following types of LDAR programs are defined:

(a) Conventional LDAR program. This comprises (where applicable) physical leaks detected by worker audio, visual and olfactory responses, area and building monitoring for flammable or toxic gases, worker personal monitors and leak checks performed as part of normal inspection and maintenance activities. The conventional LDAR program shall also comprise any additional leak detection and repair measures required and enforced by local regulations. The physical leaks that are detected and repaired within the framework of conventional LDAR cannot be included in the project activity;

(b) Advanced LDAR program. A program that is in addition to the conventional LDAR program.

(v) Repair of physical leaks. A repair of a physical leak occurs when the natural gas or refinery gas losses from a physical leak at a component are reduced to within normal manufacturer’s tolerances for periods during which the component is in pressurized natural gas or refinery gas service. The repair may be achieved by tightening or adjusting the component, applying sealants, replacing packing materials or seals, repairing or replacing the component. Conversion to better performing components, packing materials, and seals, conversion to sealless technologies can help to reduce the project emissions;

(vi) Process venting. Engineered or intentional releases of natural gas or refinery gas to the atmosphere, such as the venting of natural gas or refinery gas by pneumatic devices, equipment and pipeline depressurization events, disposal of processing waste or by-product streams (e.g. dehydrator and storage tank vents), and discharges from emergency pressure relief events;

(vii) Maintenance. It is a set of activities that are performed on components in accordance to international standards in order to correct or to prevent any degradation in their operating conditions. The maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning and the effects limited.

(viii) Greenhouse Gas (GHG). A greenhouse gas listed in Annex A to the Kyoto Protocol, unless otherwise specified in a particular methodology;

(ix) Crediting period. The period in which verified and certified GHG emission reductions or increases in net anthropogenic GHG removals by sinks attributable to a climate project activity, as applicable, can result in the issuance of carbon units. The time period that applies to a crediting period for a climate project activity, and whether the crediting period is renewable or fixed, is determined in accordance with Section 4 *Project crediting period* of this methodology.

2. Scope and applicability

2.1. Scope

2. This methodology is applicable to project activities that reduce physical leaks in components through the introduction of an advanced LDAR program.

2.2. Applicability

3. The methodology is applicable under the following conditions:

(i) During the last three years prior to the implementation of the project activity, no advanced LDAR program was in place to address physical leakage from components that are included in the project boundary;

(ii) New physical leaks that are detected at components during the crediting period (e.g. not at the time the project starts) are accountable only if the components were included in the project boundary at the validation of the project activity;

(iii) Physical leaks that need to be repaired due to current regulations and legislation are accountable only if it can be demonstrated that relevant regulations and legislation are not enforced in the country.

4. Note that this methodology is not applicable to:

(i) Physical leaks that are detected and repaired under a conventional LDAR program;

(ii) Physical leaks that can be repaired by tightening/re-greasing or by similar measures;

(iii) Physical leaks that are identified on components where the latest scheduled maintenance or replacement was not done before the starting date of a project activity as documented through maintenance logs, maintenance schedules, maintenance guidelines, worker logbooks, or other similar sources;

(iv) Reductions in process venting;

(v) Reductions in natural gas or refinery gas combustion by process heaters or boilers, engines and thermal oxidizers.

5. In addition, the applicability conditions of the tools referred to above apply.

6. The methodology is only applicable if the most likely baseline scenario is the continuation of the current practice.

7. In case of changes in the GHG regulatory legal framework of the Russian Federation, this methodology is subject to revision in order to take into account the relevant changes.

8. The methodology is neutral towards GHG programs[1]. If a GHG program is applied, the requirements of that program will complement the requirements of the methodology[2]. This methodology is based on the existing methodology developed under the Clean Development Mechanism (AM0023) [28] and includes its adaptation to current Russian regulations and standards.

2.3. Project boundary

9. The spatial extent of the project boundary includes the components where the project activity is being implemented. The spatial extent of the project boundary should be clearly illustrated in the project design document.

10. Moreover, only methane (CH_4) emissions from physical leaks that were detected through the introduction of the advanced LDAR program should be included in the project boundary. The project boundary should be defined by clear definition of all components that are, or could be, sources of physical leakage.

11. For the purpose of defining the project boundary a database should be used, which is further described in Step 2 of the *Baseline emissions* section of this methodology.

12. The emission sources included in or excluded from the project boundary are shown in Table 1.

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[1] Greenhouse gas program, GHG program means a voluntary or mandatory international, national or sub-national system or scheme that regiters, accounts for or manages GHG emissions, removals, emission reductions or removal enhancements outside the organization or GHG project (ISO 14064-2:2019 | Greenhouse gases, Part 2);

[2] Examples of GHG programmes in Russia - GOST R ISO 14064-1-2021 (accounting and management of GHG emissions at the level of organisations), GOST R ISO 14064-2-2021 (accounting and management of GHG emissions at the level of projects), GOST R ISO 14067-2021 (carbon footprint of products); at the international level – European Union Emission Trading System (EU ETS), Clean Development Mechanism (CDM), GHG Protocol for companies/projects/products and for Scope 3 accounting, Verified Carbon Standard (VCS), Gold Standard, etc.

Table 1. Emissions sources included in or excluded from the project boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	Physical leaks from the components included in the project boundary	CO_2	No	The CO_2 content in natural gas/refinery gas is very low. Exclusion is conservative
		CH_4	Yes	Main source of emissions
		N_2O	No	The N_2O content in natural gas/refinery gas is negligible
Project Activity	Physical leaks from the components included in the project boundary	CO_2	No	The CO_2 content in natural gas/refinery gas is very low. Exclusion is conservative
		CH_4	Yes	Main source of emissions
		N_2O	No	The N_2O content in natural gas/refinery gas is negligible

3. Baseline methodology

13. The baseline[3] is set conservatively[4] for a business-as-usual activity, taking into account all existing policies and measures, but not considering additional project activities (Business-as-usual model).

14. The project developer may use one of the following approaches to determine the baseline with justification for the appropriateness of the choices[5]:

(i) an ambitious benchmark approach where the baseline is set at least at the average emission level of the 20% best performing comparable activities providing similar outputs and services in a defined scope in similar social, economic, environmental and technological circumstances;

(ii) an approach based on existing actual or historical emissions, adjusted downwards by at least 5%, unless otherwise specified in the project methodology.

15. The approaches above provide a framework for general understanding of the ways in which baselines can be defined. A detailed approach to determining the baseline for this type of project is provided in section **Ошибка! Источник ссылки не найден.** “**Ошибка! Источник ссылки не найден.**”.

3.1. Procedure for the selection of the most plausible baseline scenario

16. The most plausible baseline scenario is identified in three steps:

[3] Greenhouse gas baseline, GHG baseline - quantitative reference(s) of GHG emissions and/or GHG removals that would have occurred in the absence of a GHG project and provides the baseline scenario for comparison with project GHG emissions and/or GHG removals (ISO 14064-2:2019 Greenhouse gases - Part 2)

[4] Calculation of the baseline is considered conservative if the final estimate of emission reductions resulting from project activities will not be overestimated. If there is any doubt, the project developer should better understate the baseline projection.

[5] Approaches to determining baselines are given in Action taken by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement at its third session (FCCC/PA/CMA/2021/10/Add.1, Article 6, paragraph 4, p. 34, para. 36). URL: https://unfccc.int/sites/default/files/resource/cma2021_10a01E.pdf.

(i) Step 1: Identify all realistic and credible alternative scenarios to the proposed project activity and eliminate alternatives that do not comply with legal or regulatory requirements.

(ii) Step 2: Assess the alternative scenarios to the proposed project activity and eliminate alternative scenarios that face prohibitive barriers.

(iii) Step 3: Determine the most likely alternative (baseline scenario).

3.2. Baseline emissions

17. Baseline emissions are determined based on the quantity of CH_4 emitted through physical leaks that are detected and repaired as part of the project activity (i.e., by the advanced LDAR program).

18. Baseline emissions are calculated in these four steps:

(i) Step 1: Establishment of criteria to identify which types of physical leaks are eligible for crediting.

(ii) Step 2: Establishment of a database to manage all information related to the project activity.

(iii) Step 3: Documentation of schedules for maintenance and replacement of components.

(iv) Step 4: Calculation of baseline emissions.

3.2.1. Step 1: Establishment of criteria to identify which types of physical leaks are eligible for crediting

19. For this purpose, project participants should first describe and assess in the project design document the current leak detection and repair practices applied by the operating company as well as the relevant local industry and regulatory standards. Based on this information, the project participants should classify different types of physical leaks. The following criteria may, inter alia, be taken into account in the classification of physical leaks:

(i) Safety aspects. Some physical leaks need to be repaired for safety reasons. An assessment of the safety regulations, local industry safety standards and their implementation may help in identifying what types of physical leaks are detected and repaired under the current safety regulations or other legislation of the country and local industry safety practices. In some cases, there may be a separate emergency repair apparatus specially dedicated to repairing leaks that are considered a safety risk.

(ii) Accessibility. Some physical leaks may not get detected by a conventional LDAR program because they are inaccessible (e.g. they occur in crowded areas, are unsafe to access due to hot surfaces, or they are elevated and require ladders with fall-protection or lifts to access).

(iii) Visibility, audibility and/or smell. Some companies may detect and repair physical leaks only if staff see, smell or hear the physical leak.

(iv) Practicability of repairs. Some physical leaks may only get repaired where they are deemed economical to fix or if spare parts or industry standard repair materials are available.

(v) Leak detection technologies. The types of physical leaks that are identified may depend on the technology used to detect physical leaks. The introduction of new advanced technologies as part of the project activity may help to identify physical leaks that would otherwise not be detected. It has to be defined which types of physical leaks are usually detected using the current technological means and measurement instruments.

20. In undertaking the assessment, the following types of information shall be used:

(i) Written protocols and all physical leak repair records available from the previous years;

(ii) Equipment component specifications and design standards;

(iii) Written internal procedures which instruct staff how to identify and repair physical leaks;

(iv) Interviews with key staff of the company, in particular managers responsible for physical leak detection and repair, e.g. on practices undertaken that are not part of documented protocols;

(v) Documentation on the technologies and measurement instruments used to detect physical leaks and repair materials available to undertake repairs.

21. Using this type of information, clear criteria should be established to identify whether the detection and repair of a physical leak during project implementation would also have occurred under conventional LDAR. These criteria should be documented in the project design document and be validated by the validation and verification body.

22. To facilitate the decision-making process when classifying detected physical leaks as part of either a conventional or advanced LDAR program during the project, a flowchart could be used like the example shown in Figure 1 below.

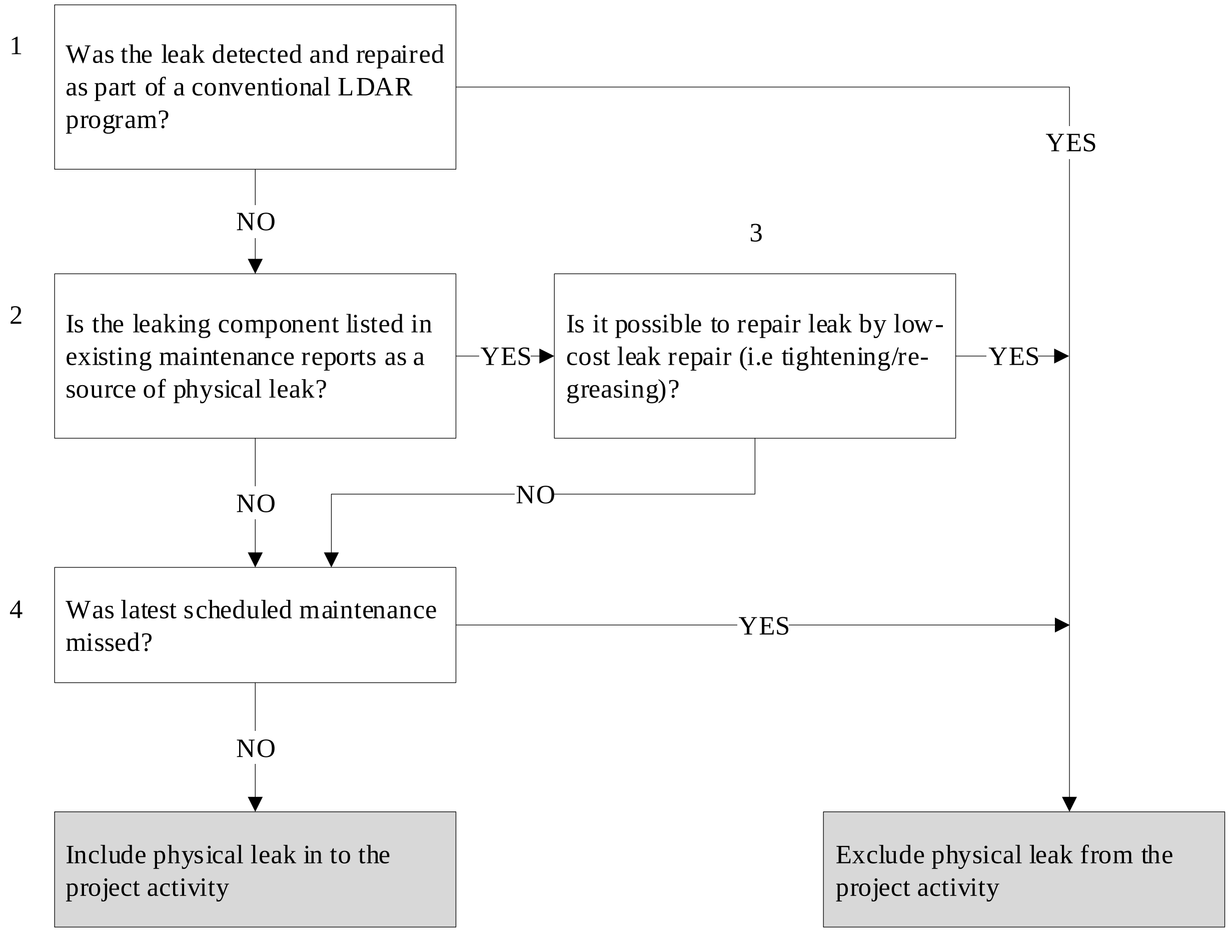

Figure 1: Criteria for inclusion/exclusion leak in/from project activities

3.2.2. Step 2: Establishment of a database to manage all information related to the project activity

23. As part of an advanced LDAR program, a database shall be established to manage all relevant information related to the detection and repair of physical leaks. All data collected during project implementation should be entered into this database. The database should, inter alia, include the following information on each physical leak:

(i) Data to clearly identify the component: ID number, type of component, size of component, service, process unit or area, location of the component, type of the facility, digital photo number, etc.;

(ii) Relevant information on the detection of the physical leak: date of detection, detection method applied, who detected the leak, detection reading if applicable e.g. screening value or leak image, etc.;

(iii) In case measurements of the flow from the physical leak are undertaken, relevant information on the measurement: date of measurement, the measurement method applied, the measured leak rate FCH_4, and the uncertainty of the measurement;

(iv) Hours during which the component is in pressurized natural gas or refinery gas service since the last leak survey or facility turnaround;

(v) Information regarding the eligibility of the physical leak to be included in the project activity (information that is required to distinguish between leaks detected by the conventional LDAR program and the advanced LDAR program);

(vi) Information regarding the time in which the physical leak is eligible for crediting year *y*;

(vii) Relevant information on the repair of the detected physical leak: date of physical leak repair attempts and final successful physical leak repair.

24. In addition to the information that is required to be entered in the database, all of the following three ways of tagging leak locations and tracking leak measurements must be applied to clearly identify a leak location:

(i) A digital photo of the leak itself is taken and this photograph is then documented together with the actual leakage rate and measurement date;

(ii) The leak itself is physically tagged on-site and the leak rate and measurement date are written on the tag; and

(iii) The location of the leak is documented on a drawing of the facility itself, when the leak measurement and date are entered into the database.

25. The database should be continuously updated during the crediting period with information on the physical leaks repaired during the crediting period. The data in the database should also be included in each monitoring report.

3.2.3. Step 3: Documentation of schedules for maintenance and replacement of components

26. In the absence of an advanced LDAR, the physical leak would often cease to leak when the equipment would be replaced.

27. In calculating baseline emissions, it is assumed that a physical leak would have continued to emit gas until the component concerned would have been either maintained or replaced. In all cases the maximum period for which baseline emissions from a leak are accountable is:

(i) Five years in the case that a *renewable* crediting period is chosen;

(ii) The end of the crediting period in the case that a *non-renewable* crediting period is chosen.

28. The expected time schedules for the replacement of components that may be subject to leaks shall be identified in cases where such time schedules exist. For this purpose, it should be identified when a single component or the entire facility would be subject to replacement in the baseline scenario.

29. In order to identify the schedules of replacements that would take place in the baseline scenario, project participants should use written documentation of the company and interviews with managers on performed and planned replacements. The expected schedule of replacements should be documented in the project design document and validated by the validation and verification body.

3.2.4. Step 4: Calculation of baseline emissions

30. There are two options for the calculation of baseline emissions. The choice taken by project participants should be documented in the project design document and cannot be changed during the crediting period. In addition, baseline emissions are capped to the baseline emission level of the first crediting year.

31. Option 1. Use any tool listed in the *Monitoring equipment* section to detect (but not to quantify) the physical leaks and apply default emission factors developed by NIPIGAS. Emissions should be calculated by multiplying the CH_4 fraction in the natural gas or refinery gas with the appropriate emission factors and then summing up all components that are accountable for the baseline emissions in a crediting year *y*, as follows:

$$BE_y = \min\left[BE_1; \frac{1}{1000} \times GWP_{CH_4} \times \sum_i \sum_r \left(EF_i \times T_{i,r}\right)\right] \tag{1}$$

With

$$BE_1 = \frac{1}{1000} \times GWP_{CH_4} \times \sum_i \sum_r EF_i \times T_{i,r} \tag{2}$$

Where:

BE_1	=	Baseline emissions for the first crediting year of the crediting period (t CO_2e);
BE_y	=	Baseline emissions for crediting year *y* (t CO_2e);
GWP_{CH_4}	=	Global warming potential of methane valid for the commitment period (t CO_2e / t CH_4);
EF_i	=	Emission factor for the component type *i* is determined according to Equation 3 (kg/hour/component type);
$T_{i,r}$	=	The time the component *r* of component type *i* would leak in the baseline scenario and would be eligible for crediting during the crediting year *y* (hours);
i	=	Component types as classified by the NIPIGAS (RD 39.142-00 “Procedure for calculation of emission of hazardous substances to environment by uncontrolled sources of oil and gas equipment” 2001, Appendix 1);
r	=	Components of component type *i* for which physical leaks were detected during initial survey and repaired and which would leak in the baseline scenario during the crediting year *y*.

32. The emission factor for the component type *i* shall be calculated as follows:

$$EF_i = 0{,}0036 \times g_i \times n_i \times x_i \times w_{CH_4,y} \tag{3}$$

Where:

EF_i	=	Emission factor for the component type *i* (kg/hour/component type);

g_i = Emission rate from component type *i* in the stream (mg/s);

n_i = Number of components of the type *i* in the stream;

x_i = The proportion of type *i* components in the stream that have lost their tightness (unit fraction);

$w_{CH_4,y}$ = Average mass fraction of methane in the natural gas/refinery gas for crediting year *y* (kg CH_4 / kg gas);

i = Component types as classified by the NIPIGAS (RD 39.142-00 "Procedure for calculation of emission of hazardous substances to environment by uncontrolled sources of oil and gas equipment" 2001, Appendix 1).

Table 2. Oil and natural gas production average emission factors

Component – Service	**Emission rate (g_i), mg/s**	**The proportion of components in the stream that have lost their tightness (x_i), unit fraction (total number of components of a given type is taken as 1)**
Valves – gas	5.83	0.293
Pressure safety valves – gas	37.78	0.460
Flanges – gas	0.20	0.030
Radial-flow compressor – gas	33.34	0.765
Piston compressor – gas	31.95	0.700
Pump seals – gas	38.89	-
Pump end seals – gas	22.22	-

Source: RD 39.142-00 "Procedure for calculation of emission of hazardous substances to environment by uncontrolled sources of oil and gas equipment", NIPIgazpererabotka OJSC, 25.04.2001, Appendix 1.

33. Option 2. Measure the flow rates of the physical leaks through the use of a Hi-Flow Samplers™, calibrated bag or other suitable flow measurements technology as described in the *Monitoring equipment* section below.

34. Baseline emissions are calculated as follows:

$$BE_y = \min\left\{BE_1, ConvFactor \times \sum_j \left[F_{CH4,j} \times T_{j,y} \times (1 - UR_j)\right] \times GWP_{CH4}\right\} \quad (4)$$

With

$$BE_1 = ConvFactor \times \sum_j \left[F_{CH4,j} \times T_{j,y=1} \times (1 - UR_j)\right] \times GWP_{CH4} \quad (5)$$

Where:

BE_1 = Baseline emissions for the first crediting year of the crediting period (t CO_2e);

BE_y = Baseline emissions for crediting year *y* (t CO_2e);

$ConvFactor$	=	Conversion factor to convert Nm^3 CH_4 into t CH_4;
j	=	All physical leaks that are included in the project activity for which physical leaks were detected and repaired and which would leak in the baseline scenario during the crediting year *y*;
$F_{CH4,j}$	=	Measured flow rate of methane for the physical leak *j* from the leaking component (m^3 CH_4 / h);
UR_j	=	Uncertainty range for the flow rate measurement method applied to physical leak *j*;
$T_{j,y}$	=	The time the relevant component, in which physical leak *j* occurred, would leak in the baseline scenario and would be eligible for crediting during the crediting year *y* (hours);
GWP_{CH_4}	=	Same as defined in Equitation 1 above (t CO_2e / t CH_4).

35. The uncertainty of the measurement is taken into account conservatively by using the flow rate at the lower end of the uncertainty range of the measurement at a 95% confidence interval for baseline emissions from leaks. For example, if the measured flow rate is 1 m^3/h and the uncertainty range of the measurement method is ±10%, emissions reductions shall be calculated based on a flow rate of 0.9 m^3/h. Given the large quantity of measurements potentially involved in the baseline study, calculation methods provided in the 2006 IPCC Guidelines to calculate UR using the combined uncertainties of all measurements can be used.

36. The following assumption should be made in the calculation of baseline emissions:

(i) For components where no physical leaks were detected at the initial survey and where physical leak(s) were detected during a subsequent survey, baseline emissions shall be accounted from the moment when the leak was detected;

(ii) Baseline emissions from a specific leak j or a specific component r are included in the calculations until whichever of the following occurs first:

(iii) The equipment concerned is replaced for a non-leak related reason (i.e. it breaks down); or

(iv) The end of the last crediting period of the overall project activity; or

(v) The maximum period for which a specific leak can be accounted towards emission reductions is over. This maximum period is five years (if a renewable crediting period is chosen) or the end of the crediting period (if a non-renewable crediting period is chosen).

4. Project crediting period

37. The crediting period is a maximum of 5 years with a maximum of two renewable periods of 5 years each, or a maximum of 10 years without the possibility of renewal.

38. For project validation until 31 December 2025, projects may be submitted to the Validation and Verification Body for validation if they were started no earlier than 5 years prior to

submission of the validation documents. From 1 January 2026 - no earlier than 2 years prior to submission of validation documents.

39. The crediting period starts no earlier than 5 years before submission of the validation documents for projects validated before 31 December 2025 and no earlier than 2 years before submission of the validation documents for projects validated after 1 January 2026.

40. Additionality and baseline must be assessed at the start of the crediting period and confirmed or revised at the start of the next 5-year phase if the project is implemented in 3 5-year phases.

5. Additionality

41. Additionality shall be demonstrated using Guidelines #1 Demonstration of the additionality of the project activity.

6. Monitoring plan requirements

6.1. Monitoring procedures

6.1.1. Establishment of a database

42. Please refer to Step 2 of the *Baseline emissions* section.

6.1.2. Data collection during project implementation

43. The implementation of the project involves an initial survey and regular subsequent surveys of each component within the project boundary. Increasing the frequency at which physical leak surveys are conducted will tend to increase the level of physical leak control achieved.

6.2. Monitoring equipment

44. Project participants may use the following tools to detect, but not to quantify, physical leaks in components:

(i) **Electronic gas detectors** using small hand-held gas detectors or "sniffing" devices to detect accessible physical leaks. Electronic gas detectors are equipped with catalytic oxidation and thermal conductivity sensors designed to detect the presence of specific gases. Electronic gas detectors can be used on larger openings that cannot be screened by soaping;

(ii) **Organic Vapor Analyzers (OVAs)** and **Toxic Vapor Analyzers (TVAs)** are portable hydrocarbon detectors that can also be used to identify physical leaks. An OVA is a flame ionization detector (FID), which measures the concentration of organic vapors over a range of 0.5 to 50,000 parts per million (ppm). TVAs and OVAs measure the concentration of methane in the area around a physical leak;

(iii) **Acoustic leak detection** using portable acoustic screening devices designed to detect the acoustic signal that results when pressurized gas escapes through an orifice. As gas moves from a high-pressure to a low-pressure environment across a physical leak opening, the turbulent flow produces an acoustic signal, which is detected by a hand-held sensor or probe, and read as intensity increments on a meter. Although acoustic detectors do not measure physical leak rates, they provide a relative indication of leak size – a high intensity or "loud" signal corresponds to a greater leak rate.

(iv) **Optical Gas Imaging Instruments.** There are two general classes of such instruments, active and passive instruments. The active type uses a laser beam that is reflected by the background. The attenuation of the beam passing through a hydrocarbon cloud provides the optical image. The passive type uses ambient illumination to detect the difference in heat radiance of the hydrocarbon cloud. Optical gas imaging instruments do not measure leak rates, but allows faster screening of components than FID detectors.

45. One of the following technologies shall be used to measure leak flow rates:

(i) **Bagging techniques** are commonly used to measure flow rates of physical leaks. The leaking component or leak opening is enclosed in a "bag" or tent. An inert carrier gas such as nitrogen is conveyed through the bag at a known flow rate. Once the carrier gas attains equilibrium, a gas sample is collected from the bag and the methane concentration of the sample is measured. The flow rate of the physical leak from the component is calculated from the purge flow rate through the enclosure and the concentration of methane in the outlet stream as follows:

$$F_{CH_4,i} = F_{purge,i} \times w_{CH_4,i} \tag{6}$$

Where:

$F_{CH_4,i}$	=	The leak flow rate of methane for leak *i* from the leaking component ($m^3 CH_4/h$);
$F_{purge,i}$	=	The purge flow rate of the clean air or nitrogen at leak i (m^3/h);
$w_{CH_4,i}$	=	The measured mass fraction of methane in the natural or refinery gas during the crediting year *y* (kg CH_4 / kg gas).

(ii) **High volume or Hi-Flow Samplers™** capture all emissions from a leaking component to quantify leak flow rates. Leak emissions, plus a large volume sample of the air around the leaking component, are pulled into the instrument through a vacuum sampling hose. High volume samplers are equipped with dual hydrocarbon detectors that measure the concentration of hydrocarbon gas in the captured sample, as well as the ambient hydrocarbon gas concentration. Sample measurements are corrected for the ambient hydrocarbon concentration, and the leak rate is calculated by multiplying the flow rate of the measured sample by the difference between the ambient gas concentration and the gas concentration in the measured sample. Methane emissions are obtained by calibrating the hydrocarbon detectors to a range of concentrations of methane-in-air. High volume samplers are equipped with special attachments designed to promote complete emissions capture and to prevent interference from other nearby emissions sources.[6] The hydrocarbon sensors are used to measure the exit concentration in the air stream of the system. The sampler essentially makes rapid vacuum enclosure measurements;

[6] The background concentration must be subtracted from the main sample concentration because it may be elevated due to other leaks in the vicinity of the leak being measured. Variables such as wind speed and wind direction may cause the background concentration to fluctuate, so the background is measured simultaneously with the sample concentration.

(iii) **Calibrated bag** measurements use anti-static bags of known volume (e.g. 0.085 m^3 or 0.227 m^3) with a neck shaped for easy sealing around the vent. Measurement is made by timing the bag expansion to full capacity while also employing a technique to completely capture the leak while the inflation is being timed. The measurement is repeated on the same leak source numerous times (at least 7, typically 7 to 10 times) to ensure a representative average for the fill times (outliers or problem times should be omitted and the tests rerun until a representative average rate is established). The temperature of the gas is measured to allow correction of volume to standard conditions. Additionally, the gas composition is measured to verify the proportion of methane in the vented gas, since in some cases air may also be vented, resulting in a mixture of natural gas and air. Calibrated bags allow for reliable measurement of leak flow rates of more than 250m^3/h. The leak flow rate of methane is calculated as follows:

$$F_{CH_4,i} = V_{bag} \times w_{sampleCH_4,i} \times \frac{3600}{t_{aver,i}} \tag{7}$$

Where:

$F_{CH_4,i}$	=	The leak flow rate of methane for leak *i* from the leaking component ($m^3 CH_4$/h);
V_{bag}	=	Volume of calibrated bag used for measurement (m^3);
$w_{sampleCH_4,i}$	=	The concentration of methane in the sample flow from leak *i* (volume percent);
$t_{aver,i}$	=	Average bag fill time for leak *i* (seconds).

6.3. Monitoring requirements

46. For each component where a physical leak has occurred, the following information should be collected during regular monitoring checks:

(i) Date of monitoring;

(ii) An assessment whether the relevant component has been replaced after the repair of the leak;

(iii) The number of hours during which the component is in pressurized natural gas or refinery gas service;

(iv) An assessment whether the repair of the leak functions appropriately.

47. All information should be added to the database and be included in monitoring reports.

Data and parameters monitored

48. In some cases, particular measuring tools may also automatically account for certain parameters that do not need to be separately measured.

Data / Parameter:	$T_{i,x}$
Data unit:	Hours

Description	The time the component *x* of component type *i* was leaking during the crediting year *y* (hours)
Source of data used:	Plant records
Measurement procedures (if any)	Any outages will be recorded
Recording frequency	Constant
Proportion of data to be monitored	100%
QA/QC procedures to be applied	Any outages resulting from system repairs will be documented and logged in the project database in the form of a reduction in the time of operation. To be clear, if an unrelated activity requires the shut-down of an already repaired piece of equipment, the hours of operation for every piece of affected equipment with be reduced in the database for the entire duration of the shut-down. Any other unscheduled shutdown will also be timed and accounted for through a reduction of operating hours
Any comment:	-

Data / Parameter:	T_z
Data unit:	Hours
Description	The time (in hours) the relevant component has been leaking during the crediting year *y*
Source of data used:	Plant records
Measurement procedures (if any)	Any outages will be recorded
Recording frequency	Constant
Proportion of data to be monitored	100%
QA/QC procedures to be applied	Any outages resulting from system repairs will be documented and logged in the project database in the form of a reduction in the time of operation. To be clear, if an unrelated activity requires the shut-down of an already repaired piece of equipment, the hours of operation for every piece of affected equipment with be reduced in the database for the entire duration of the shut-down. Any other unscheduled shutdown will also be timed and accounted for through a reduction of operating hours
Any comment:	-

Data / Parameter:	Temperature and pressure of natural gas
Data Unit	ºC and bar
Source of data used:	Conditions observed at the point and time of the leak rate measurement
Measurement procedures (if any)	-
Recording frequency	At the time of each leak measurement
Proportion of data to be monitored	100%
QA/QC procedures to be applied	Data measurement equipment will be calibrated and double checked on a regular basis. The manufacturer's recommended calibration procedures shall be applied
Any comment:	Applicable only in the case that option 2 for the calculation of baseline and project emissions is selected

Data / Parameter:	$T_{i,r}$
Data unit:	Hours
Description	The time the component *r* of component type *i* would leak in the baseline scenario and would be eligible for crediting during the crediting year *y* (hours)
Source of data used:	Plant records

Measurement procedures (if any)	Any outages will be recorded
Recording frequency	Constant
Proportion of data to be monitored	100%
QA/QC procedures to be applied	Any outages resulting from system repairs will be documented and logged in the project database in the form of a reduction in the time of operation. To be clear, if an unrelated activity requires the shut-down of an already repaired piece of equipment, the hours of operation for every piece of affected equipment with be reduced in the database for the entire duration of the shut-down. Any other unscheduled shutdown will also be timed and accounted for through a reduction of operating hours
Any comment:	-

Data / Parameter:	$T_{j,y}$
Data unit:	Hours
Description	The time the relevant component, in which physical leak *j*, occurred, would leak in the baseline scenario and would be eligible for crediting during the crediting year *y* (hours)
Source of data used:	Plant records
Measurement procedures (if any)	Any outages will be recorded
Recording frequency	Constant
Proportion of data to be monitored	100%
QA/QC procedures to be applied	Any outages resulting from system repairs will be documented and logged in the project database in the form of a reduction in the time of operation. To be clear, if an unrelated activity requires the shut-down of an already repaired piece of equipment, the hours of operation for every piece of affected equipment with be reduced in the database for the entire duration of the shut-down. Any other unscheduled shutdown will also be timed and accounted for through a reduction of operating hours
Any comment:	-

Data / Parameter:	UR_j
Data Unit	Fraction
Description:	The uncertainty range for the measurement method applied to leak *j*
Source of data used:	Manufacturer data and/or IPCC GPG
Measurement procedures (if any)	Estimated, where possible, at a 95% confidence interval, consulting the guidance provided in Chapter 6 of the 2000 IPCC Good Practice Guidance. If leak measurement equipment manufacturers report an uncertainty range without specifying a confidence interval, a confidence interval of 95% may be assumed
Recording frequency	Periodically
Proportion of data to be monitored	100%
QA/QC procedures to be applied	-
Any comment:	Applicable only in the case that option 2 for the calculation of baseline and project emissions is selected

Data / Parameter:	UR_z
Data Unit	Fraction
Description:	The uncertainty range for the measurement method applied to leak *z*
Source of data used:	Manufacturer data and/or IPCC GPG

Measurement procedures (if any)	Estimated, where possible, at a 95% confidence interval, consulting the guidance provided in Chapter 6 of the 2000 IPCC Good Practice Guidance. If leak measurement equipment manufacturers report an uncertainty range without specifying a confidence interval, a confidence interval of 95% may be assumed
Recording frequency	Periodically
Proportion of data to be monitored	100%

QA/QC procedures to be applied	-
Any comment:	Applicable only in the case that option 2 for the calculation of baseline and project emissions is selected

Data / Parameter:	$w_{CH_4,y}$, $w_{CH4,i,}$
Data Unit	kg CH_4/kg gas
Description:	Average mass fraction of methane in the natural gas/refinery gas for crediting year *y*
Source of data used:	Direct measurement
Measurement procedures (if any)	
Recording frequency	Periodically
Proportion of data to be monitored	100%
QA/QC procedures to be applied	For the purpose of determining average mass fraction of methane, a natural gas or refinery gas sample should be collected and chemical analysis should be made in the laboratory
Any comment:	-

Data / Parameter:	$w_{sampleCH4,i}$
Data Unit	volume percent
Description:	The concentration of methane in the sample flow from leak *i*
Source of data used:	Direct measurement
Measurement procedures (if any)	
Recording frequency	Periodically
Proportion of data to be monitored	100%
QA/QC procedures to be applied	-
Any comment:	Applicable only in the case that option 2 for the calculation of baseline and project emissions is selected

Data / Parameter:	$F_{CH4,\ i}$/$F_{CH4,\ z}$/
Data unit:	m^3CH_4/h
Description	The leak flow rate of methane for leak (*i, z)* from the leaking component
Source of data used:	On-site measurements
Measurement procedures (if any)	Procedures requires by manufactures of the equipment used to measure leak flow rates should be followed
Recording frequency	Annual
Proportion of data to be monitored	100%
QA/QC procedures to be applied	-
Any comment:	Applicable only in the case that option 2 for the calculation of baseline and project emissions is selected. The leak flow rate ($F_{CH4,j}$) and conversion

	factor (*ConvFactor*) should be corrected to the same reference temperature and pressure conditions. For example if value of 0.00067 (IPCC 2006 Vol.2, p. 4.12) is used to convert from m³ CH_4 into t CH_4, then the flow rate should corrected to reference conditions of 20 degree Celsius and 101.3 kPa

Data / Parameter:	$F_{purge,i}$
Data unit:	m³/h
Description	The purge flow rate of the clean air or nitrogen at leak *i*
Source of data used:	On-site measurements
Measurement procedures (if any)	Procedures requires by manufactures of the equipment used to measure leak flow rates should be followed
Recording frequency	Annual
Proportion of data to be monitored	100%
QA/QC procedures to be applied	-
Any comment:	Applicable only in the case that option 2 for the calculation of baseline and project emissions is selected. The purge flow rate and leak flow rate should be corrected to the same reference temperature and pressure conditions

Data / Parameter:	$t_{aver,i}$
Data unit:	sec
Description	Average bag fill time for leak *i*
Source of data used:	On-site measurements
Measurement procedures (if any)	Procedures requires by manufactures of the equipment used to measure leak flow rates should be followed
Recording frequency	Annual
Proportion of data to be monitored	100%
QA/QC procedures to be applied	-
Any comment:	Applicable only in the case that option 2 for the calculation of baseline and project emissions is selected

Data / Parameter:	BE_{CAP}
Data unit:	t CO_2e
Description:	Capped quantity of the baseline emissions, defined as the baseline emissions for the first year of the crediting period
Source of data:	Monitored baselines emissions during the first year of the first crediting period
Value to be applied:	-
Any comment:	-

7. Project Scenario

7.1. Project emission calculation

49. Project emissions include emissions from physical leaks that take place on components included in the project boundaries in the following cases:

(i) If a repair of a physical leak ceases to function, for as long as it is not repaired again; or

(ii) If a new physical leak is detected in a component which was part of the initial survey and for which no physical leak was detected during that survey, as long as that physical leak is not repaired.

50. Project emissions are calculated as follows:

51. In case of Option 1:

$$PE_y = \frac{1}{1000} \times GWP_{CH_4,y} \times \sum_i \sum_x [EF_i \times T_{i,x}] \quad (8)$$

Where:

PE_y	=	Project emissions for crediting year *y* (t CO_2e);
$GWP_{CH_4,y}$	=	Global warming potential of methane valid for the commitment period (t CO_2e / t CH_4);
EF_i	=	Emission factor for the component type *i* is determined according to Equation 3 (kg/hour/component type);
$T_{i,x}$	=	The time the component *x* of component type *i* was leaking during the crediting year *y* (hours);
i	=	Component types as classified by the NIPIGAS (RD 39.142-00 “Procedure for calculation of emission of hazardous substances to environment by uncontrolled sources of oil and gas equipment” 2001, Appendix 1);
x	=	All components of component type *i* that are accounted for as project emissions during the crediting year *y*.

52. In case of Option 2:

$$PE_y = ConvFactor \times \sum_z [F_{CH4,z} \times T_z \times (1 + UR_z)] \times GWP_{CH_4} \quad \text{Equation (9)}$$

Where:

$PE_{CO_2,T,y}$	=	Project emissions in crediting year *y* (tCO_2e);
$ConvFactor$	=	Conversion factor to convert Nm^3 CH_4 into t CH_4;
z	=	All leaks that are accounted for as project emissions during the crediting year *y*;
$F_{CH4,z}$	=	The leak flow rate of methane for the physical leak *z* from the leaking component (Nm^3CH_4/h);
UR_z	=	The uncertainty range for the measurement method applied to leak *z*;
T_z	=	The time the relevant component has been leaking during the crediting year *y* (hours);

GWP_{CH_4} = Global warming potential of methane valid for the commitment period ($t\ CO_2e\ /\ t\ CH_4$).

53. The uncertainty of the measurement is taken into account conservatively by using the flow rate at the upper end of the uncertainty range of the measurement at a 95% confidence interval for project emissions from leaks. For example, if the measured flow rate is 1 m^3/h and the uncertainty range of a measurement is ±10% , emissions reductions will be calculated at an effective flow rate of 1.1 m^3/h. Given the large quantity of measurements potentially involved, calculation methods provided in the 2006 IPCC Guidelines to calculate UR using the combined uncertainties of all measurements can be used.

54. The following assumptions should be made in the calculation of project emissions:

(i) If a repair of a physical leak ceases to function, it is conservatively assumed that the leak resumed either:

(a) At the same flow rate that was measured prior to its repair when using only leak detection equipment;

(b) At the newly measured leak rate if the leak is re-measured using leak measurement equipment at the time of monitoring (in case of Option 2);

(c) At the flow rate specified by the NIPIGAS methodology (in case of Option 1).

(ii) It is further assumed that the leak resumed at the day when the leak was last checked and confirmed not to leak and that it continued to leak for the entire time since that date. Thus, leaks where the repair failed should be included in the project emissions;

(iii) For components where no physical leak was detected at the initial survey and where physical leak(s) were detected during subsequent survey, project emissions from these components shall be accounted since the moment when the leak was detected;

(iv) Project emissions from a specific physical leak are included in the calculations until whichever of the following are earlier:

(a) The date of any repair of the physical leak, as long as the repair does not cease to function; or

(b) The equipment concerned is replaced (i.e. it breaks down).

7.2. Emission reduction

55. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \text{Equation (10)}$$

Where:

ER_y = Emission reductions for crediting year *y* (tCO_2e);

BE_y = Baseline emissions for crediting year *y* ($t\ CO_2e$);

PE_y = Project emissions for crediting year y (t CO_2e).

7.3. Risk management

56. As part of the project implementation, it is recommended to develop a risk assessment system with a description of the most likely risks that may arise at all stages of the climate project. For such an assessment, the project developer should develop a detailed matrix with the following information, as a minimum:

(i) The main stages of the implementation of the climate project;

(ii) Description of the risks that may arise at each stage of the climate project;

(iii) Description of the probability of occurrence of risks. For this, the rating options "low, medium, high" or any other understandable numerical scales can be used;

(iv) Description of the impact of each risk on the results of the entire project. This can also be done using "low, medium, high" or any other understandable numerical scale;

(v) Description of the period of influence of each risk on the entire climate project;

(vi) Development of measures to minimize or avoid each type of risks;

(vii) The time for the implementation of each measure that reduces or prevents the occurrence of risks is indicated.

Stage of climate project implementation	**Description of risks**	**Probability of occurrence**	**Impact on the project**	**Impact period**	**Risk minimization methods**	**Implementation period**
		low medium high	low medium high	Preparation period 1-2 years after the implementation The entire period of the climate project	Detailed description of mitigation measures for each risk	Description of the time frame for the implementation of these activities
		Scale from 1 to 5 or others	Scale from 1 to 5 or others			

8. Leakage assessment

57. According to the Order of the Ministry of Economic Development of Russia No. 248[7] dated 11 May 2022, project activities should not lead to an aggregate increase in greenhouse gas emissions or reduce their absorption levels outside the scope of such activities.

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[7] Appendix No. 1 to the Order of the Ministry of Economic Development of Russia No. 248 dated 11 May 2022, paragraph "в";

58. At the same time, it is necessary to be aware of and fully account for the fact that if project leaks[8] exist they must be assessed.

9. Non-permanence risk analysis

59. Not applicable.

10. Methods to prevent double counting, negative impacts on the environment and society

60. In order to prevent double counting[9] the developer of the climate project should set out a system of approaches in the project design documentation and develop technical solutions that will ensure the absence of double counting in accordance with GOST R ISO 14080-2021. National Standard of the Russian Federation. Greenhouse Gas Management and Related Activities. System of Approaches and Methodological Support for the Implementation of Climate Projects. In particular, it is necessary to:

(i) avoid boundary overlap while setting the boundaries;

(ii) ensure that consistent methodologies are used for each type of GHG emission source;

(iii) establish a principle of disclosure of information on climate projects;

(iv) analyze any areas of potential overlap and communicate the potential for conflict.

61. The climate project should demonstrate that it complies with all legal requirements in the jurisdiction where it is located. Project proponents should consider whether there is a risk that their project will have a negative impact on local communities, biodiversity and the environment. Such projects should not lead to increased air, soil, surface and groundwater pollution, community conflict, land tenure issues, forced evictions, human rights violations, or reduced health and well-being due to restricted access to a forest or natural area.

62. Human Rights

(i) The project respects internationally proclaimed human rights including dignity, cultural property and uniqueness of indigenous people. The project is not complicit in Human Rights abuses.

(ii) The project does not involve and is not complicit in involuntary resettlement.

(iii) The project does not involve and is not complicit in the alteration, damage or removal of any critical cultural heritage.

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[8] Leakage (for a project activity) means the net change of anthropogenic emissions by sources of GHGs which occurs outside the project boundary, and which is measurable and attributable to the climate project activity, as applicable (CDM-EB07-A04-GLOS Glossary CDM terms. Version 08.0).

[9] Double counting: accounting for GHG emissions or removals more than once. Double counting can occur between organizations, i.e. two or more reporting organizations take ownership of the same GHG emissions or removals. Double counting can also occur inside an organization when GHG emissions or removals are taken into account in different categories (this type of double counting should not occur). (ISO/TR 14069:2013 Greenhouse gases - Quantification and reporting of greenhouse gas emissions for organizations - Guidance for the application of ISO 14064-1).

63. Labor Standards

(i) The project respects the employee's freedom of association and their right to collective bargaining and is not complicit in restrictions of these freedoms and rights.

(ii) The project does not involve and is not complicit in any form of forced or compulsory labor.

(iii) The project does not employ and is not complicit in any form of child labor.

(iv) The project does not involve and is not complicit in any form of discrimination.

(v) The project provides workers with a safe and healthy work environment and is not complicit in exposing workers to unsafe or unhealthy work environments.

64. Environmental Protection

(i) The project does not involve and is not complicit in significant conversion or degradation of critical natural habitats, including those that are (a) legally protected, (b) officially proposed for protection, (c) identified by authoritative sources for their high conservation value or (d) recognized as protected by traditional local communities.

65. Anti-corruption

(i) The project does not involve and is not complicit in corruption.

11. Recommendations for updating or keeping the baseline unchanged at the renewal of the crediting period and project activity

12. At the renewal of crediting period the project is subject to verification with elements of validation and a technical assessment by a validation and verification body to determine necessary updates to the baseline, the additionality and the quantification of emission reductions.

13. In order to update the baseline, the approach to its definition, the main parameters and assumptions used in the analysis are revised and updated. The baseline shall be representative of the conditions for the beginning of a new crediting period and be valid for that period.

14. The additionality at the renewal of the crediting period is checked for compliance to the criteria under Tool #1 at the date of the beginning of the new crediting period.

15. Normative References

1. Order of the Ministry of Economic Development of Russia dated 11.05.2022 No. 248 "On approval of the criteria and procedure for attributing projects implemented by legal entities, individual entrepreneurs or individuals to climate projects, the form and procedure for reporting on the implementation of a climate project" (registered with the Ministry of Justice of Russia on 30.05.2022, No. 68642)

16. **GOST R ISO 14064-1-2021. National Standard of Russian Federation. Greenhouse Gases. Part 1. Requirements and Guidance for Quantification and Reporting of Greenhouse Gas Emissions and Absorption at Organization Level (approved and enacted by Rosstandart Order No. 1029-st dated 30.09.2021);**

17. **GOST R ISO 14064-2-2021. National Standard of the Russian Federation. Greenhouse Gases. Part 2. Requirements and Guidance on Quantification, Monitoring and Reporting Documentation for Projects to Reduce Greenhouse Gas Emissions or to Increase Their Absorption at the Project Level (approved and enacted by Rosstandart Order No. 1030-st dated 30.09.2021);**

18. **GOST R ISO 14064-3-2021. National Standard of the Russian Federation. Greenhouse Gases. Part 3. Requirements and Guidance for Validation and Verification of Declarations on Greenhouse Gases (approved and enacted by Rosstandart Order No. 1031-st dated 30.09.2021);**

19. **GOST R ISO 14065-2014 National Standard of the Russian Federation. Greenhouse Gases. Requirements for Greenhouse Gas Validation and Verification Bodies for Their Application in Accreditation or Other Forms of Recognition (approved and enacted by Rosstandart Order No. 1869-st dated 26.11.2014);**

20. **GOST R ISO 14080-2021. National Standard of the Russian Federation. Management of Greenhouse Gases and Related Activities. System of Approaches and Methodological Support for the Implementation of Climate Projects (approved and enacted by Rosstandart Order No. 1033-st dated 30.09.2021);**

21. **GOST R ISO 14066-2013. National Standard of the Russian Federation. Greenhouse Gases. Requirements for Competence of Greenhouse Gas Validation and Verification Groups (approved and enacted by Rosstandart Order No. 2274-st dated 17.12.2013);**

22. **Order No. 371 of the Ministry of Natural Resources of Russia dated 27.05.2022 "On approval of methods for quantitative determination of greenhouse gas emissions and greenhouse gas removals" (with effect from 01.03.2023, except for certain provisions effective from 01.03.2024);**

23. **Order No. 300 of the Ministry of Natural Resources of the Russian Federation dated 30.06.2015 "On approval of methodological guidelines and guidelines for quantitative determination of greenhouse gas emissions by organizations carrying out economic and other activities in the Russian Federation" (until 01.03.2023);**

24. **IPCC 2006. Guidelines for National Greenhouse Gas Inventories of the Intergovernmental Panel on Climate Change, 2006. Iggleston, L. Buendia, K. Miwa, T. Ngara and K. Tanabe. // T.1-5. - IGES// Hayyam. 2006.**

25. **ISO 6707-1:2020 Buildings and civil engineering works - Vocabulary - Part 1: General terms. IDT. Publication date: 2020-08;**

26. **GOST R ISO 6707-1-2020. National Standard of the Russian Federation. Buildings and Structures. General Terms (approved and enacted by Rosstandart Order No. 1388-st dated 24.12.2020);**

27. **RD 39.142-00 "Procedure for calculation of emission of hazardous substances to environment by uncontrolled sources of oil and gas equipment", NIPIgazpererabotka OJSC, 25.04.2001**

28. **AM0023 "Leak detection and repair in gas production, processing, transmission, storage and distribution systems and in refinery facilities"--- Version 4.0.0 Large-scale Methodology. https://cdm.unfccc.int/UserManagement/FileStorage/LV8NU1GYWTK06COJPDIXQ35FR2MA47**