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ROLE OF INTERNATIONAL COOPERATION AND TRANSFER OF BEST AVAILABLE TECHNOLOGIES IN FULFILLMENT OF PARIS AGREEMENT

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The article presents methods of detecting and measuring the leak of associated and natural gas during the extraction and processing of hydrocarbons. Preventing leaks of natural and associated gas is one of the most effective mitigation measures aimed at reducing the effects of climate change. The return of investment in environmental projects using new carbon emissions trading mechanisms under Article 6 of the Paris Agreement is also being discussed.

The article discusses the application of innovative technologies: such as infrared cameras for detecting methane leaks, methane detectors - Hi-Flow Sampler - selected samplers that allow to accurately measure the volume and intensity of gas leaks from numerous valves, flanges and compressor components at pipelines, storage facilities, and compressor stations.

The purpose of the article is to assess the potential of the oil and gas industry to reduce greenhouse gas (GHG) emissions, as well as to draw up a package of the most cost effective and environmentally friendly solutions to ensure the fulfillment of the GHG reduction commitments undertaken by Azerbaijan under the Paris Agreement.

Keywords: *Paris Agreement, mitigations measures, engineered emissions sources, leak detection, carbon trading, environmental-friendly technologies*

In accordance with the recently ratified Paris Agreement1, Azerbaijan voluntarily has taken obligation to achieve 35% reduction in greenhouse gas emissions by 2030 compared to the base year 1990 as its contribution to the global climate change mitigation efforts. It should be noted that this goal framed under Azerbaijan Intended Nationally Determined Contribution (INDC)2 was submitted to UNFCCC well in advance on 29 September of 2015.

Leading role to achieve this ambitious goal was assigned to energy sector in particular to oil and natural gas industry and formulated as follows:

- Application of new and modern environmental-friendly technologies in the oil and gas processing, production of fuel in line with EURO-5 standards in a new refinery complex by 2019 and strengthening the capacity of the staff;
- Modernization of gas pipelines, gas distribution system and other measures to decrease losses up to 1% by 2020 and ensure the volume of reduction in compliance with international standards by 2050;
- Based on adopted strategy, accumulation of gases emitted to the atmosphere during oil-gas production, prevention of gas leakages during oil-gas processing and at distribution networks.

For SOCAR these ambitions require substantial efforts and funding to improve existing Measurement, Reporting and Verification (MRV) system. This includes building capacity of experts to compile a solid GHG inventory, develop software to ensure timely reporting, including archiving activity data, methods and emission factors used and GHG emission estimates.

SOCAR's GHG inventory began in 2008 based on Order 68 of the Company president. Main goal was to comply with country reporting requirements to UNFCCC and to assess capacity for mitigation projects implementation under Clean Development Mechanism. Few project were prepared and submitted by SOCAR, one of them "Capture and processing low pressure associated gas from the Neft Dashlari and Palchiq Pilpilassi oil fields of SOCAR" received positive validation report (REPORT NO.TURKEY-VAL/TURKEYVAL/CER.630.10.C45/2011 REVISION NO.05) from Bureau Veritas Certification. Nevertheless, none of them was registered by UNFCCC.

Under the Paris Agreement new carbon trading mechanisms were introduced as reflected in Articles 6 of the Agreement. Countries that submitted to UNFCCC their emissions-reduction targets in the form of "Nationally determined contributions" (NDCs) can cooperate in achieving ambitious emission targets through transactions in emission reductions. Possible measures could include the use of natural gas instead of coal for electric and heat production, transitioning to renewable energy, reduction of fugitive emissions from oil and natural gas industry and etc. Azerbaijan put emphasis on arranging for cooperation under Article 6 in a which does not lead to double counting of emission reductions globally.

Article 6 of the Paris Agreement makes international cooperation through carbon markets more flexible and can bring additional public and private finance and catalyze emissions reductions in a country hosting the mitigation activity. This should lead to higher ambition, given that mitigation can be made more cost-effective.

To ensure cost effectiveness of mitigation actions and to learn from best practice in area of fugitive emissions reduction in oil and natural gas industry in 2017 Memorandum of Understanding was signed between SOCAR Ecology Department and Carbon Limits (CL) company – a leading Scandinavian consultancy company in area of identification and development of emission reduction opportunities in traditional energy sectors, but also in capacity building and policy advice.

CL performed first Leak Detection and Repair campaign (LDAR) followed by an assignment focused on emission reduction analysis starting January 2017. Initially LDAR covers leaks detection at Gas Processing Plant, Compressor station at underground gas reservoirs; compressor stations, oil storage tanks and pipelines at onshore sites; oil and sludge storage tanks and leaks at oil refinery. In summary, the main findings were as follows:

- Total losses from all quantified emission points are around 3.4 million m3 per year, of which the around 1.5 million m3 per year are methane emissions and 1.9 million m^3 per year are NMVOCs.
- Although most of the identified emission points are leaks (i.e. unintended emissions), around 70% of total volume estimated losses are from vents, i.e. engineered emissions sources.
- Emissions from storage tanks, as well as fugitive emissions from numerous valves, flanges and compressor components at all the sites) are found to be the largest sources of emission.

Carbon Limits recommended to analyze the technical options and costs to address these large potential for emission reductions and assess opportunity of joint project implementation.

It was decided to implement joint pilot project at oil & natural gas production sites of Azneft PU, register project under EU Fuel Quality Directive and participate in EU emission trading scheme.

EU have to meet strict quality requirements3 to protect human health and the environment and make sure that vehicles can safely travel from one country to another.

Common fuel quality rules help

- reduce greenhouse gas and air pollutant emissions
- establish a single fuel market and ensure that vehicles can operate everywhere in the EU on the basis of compatible fuels.

The Fuel Quality Directive applies to

- petrol, diesel and biofuels used in road transport
- gasoil used in non-road-mobile machinery.

The Fuel Quality Directive requires a reduction of the greenhouse gas intensity of transport fuels by a minimum of 6% by 2020. Emissions reporting covers full lifecycle, including reduction of upstream emissions (such as flaring and venting) at the extraction stage of fossil feedstocks. The greenhouse gas intensity of fuels is calculated on a life-cycle basis, covering emissions from extraction, processing and distribution.

Due to COVID-19 pandemic the period of emissions purchasing was prolonged till the end of 2021. Nevertheless, due to huge amount of project proposed prices for so called Upstream of Emission Reductions (UERs) varies from 50 to 20 Euro per 1 ton of CO2 equivalent of emissions reduced.

Council Directive (EU) 2015/625 defines the method to calculate, and the details to report, the greenhouse gas intensity of regulated fuels. Member States shall apply these rules as of 21 April 2017.

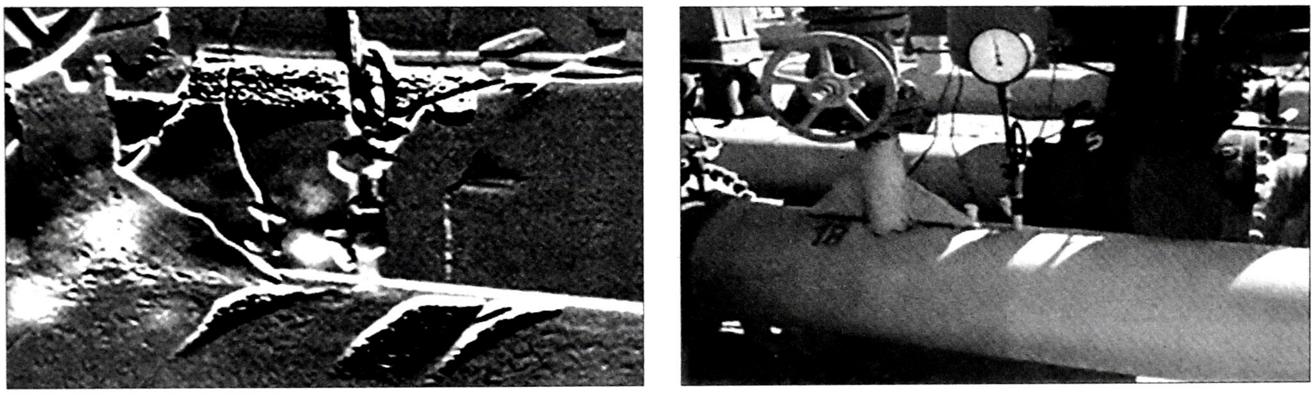
Project activity "Advanced LDAR at SOCAR upstream Oil & Associated Gas production facilities" jointly implemented by CL and ED aims to mitigate methane leaks that occur as a result of oil production activities It targets mitigation of leaks from selected components related to ongoing oil production operations at five oil production units (PUs) - Absheron, Amirov, Bibiheybat, Taghiyev and Narimanov owned by SOCAR, and operated by its subsidiary Azneft.

According to contract signed CL performed instrumental measurements using advanced leak detection technologies as FLIR GFX 320 Optical Gas Imaging and Hi-Flow™ Sampler with Calibrated volume bag, as per the approved CDM methodology AM00234.

Unintentional methane leakages from oil and gas operations are attributed to unintentional equipment or pipeline leaks. The fugitives occur as oil and associated gas circulates at high pressure through different parts of the infrastructure of oil and associated gas systems and escapes into the atmosphere through tattered connections in the pipelines, worn pump and compressor seals, valves or flanges. They are typically caused by normal component wear, thermal and vibrational stresses and seasonal expansion/contraction cycling from ambient air temperature changes. Fugitive emissions therefore arise from various oil field operations and a multitude of devices, including well cellars and well heads, separators (knock outs, etc.) and components (valves, connectors, pump seals, flanges, etc.). More specifically, they can originate from various sources including ball valves, gate valves, needle valves, plug valves, pressure safety valves, pressure regulatory valves, flanges, joints, threads, valve stem packings, through-leaking valves (that pass the gas to on open-ended line) and connectors, amongst others.

Using this OGI camera, the experts have surveyed a multitude of components across the 5 Production Units and were able to identify gas leaks in real-time (through the viewfinder and LCD monitor). The embedded GPS data assisted in identifying the precise location of faults and leaks, which contributed to a faster and more efficient database management. As a secondary back up measure, GPS data from every identified and tagged leak was recorded by a backup device and also logged in the database.

Actual images of the detection & quantification team using the FLIR GFX320 OGI Camera for leak detection (at an oil production wellhead at the Bibiheybatneft OGPD)



Example of an actual leak identified, tagged and measured (at Gas Processing Plant)

Hi-Flow™ samplers capture the emissions from a leaking component to accurately quantify leak emissions rates. Leak emissions, plus a large volume sample of the air around the leaking component, are pulled into the instrument through a vacuum sampling hose. A dual-element hydrocarbon detector (catalytic-oxidation/ thermal-conductivity) measures hydrocarbon concentrations in the captured air stream ranging from 0.01 to 100 percent. Sample measurements are corrected for the ambient hydrocarbon concentration, and mass leak rate is calculated by multiplying the flow rate of the measured sample by the difference between the ambient gas concentration and the gas concentration in the measured sample. Hi-Flow™ samplers measure leak rates up to 10.5 cubic feet per minute (equivalent of 0.297 m^3/min), equal to 15.1 thousand cubic feet (428.2 m^3) per day, with the accuracy of calculated leak rate of ±5%.

Hi-Flow Sampler corrects the leak rate by taking into account the gas concentration in the ambient air (also referred to as "background concentration".

Figure below is taken from the manufacturer's specs, where it specifies how the background concentration is deducted from the leak rate calculations

$$Leak = Flow * (Gas_{sample} - Gas_{background}) * 10^{-2} \quad (1)$$

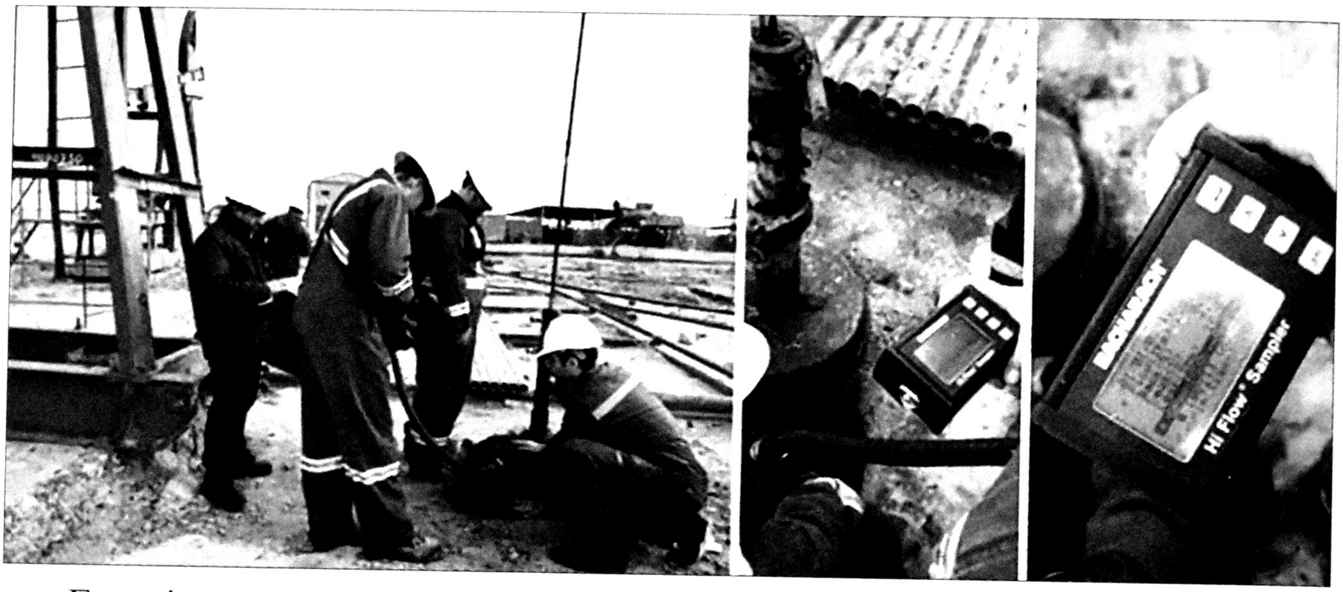
Where:

Leak = rate of gas leakage from source (cfm)

Flow = sample flow rate (cfm)

Gas_{sample} =concentration of gas from leak source (%)

$Gas_{background}$ =background gas concentrations (%)



Equation (1), were taken from the Hi-Flow Sampler manufacturer's specifications

Actual images of the team quantifying a methane leak from an oil wellhead (at the Bibiheybat oil field using the Bacharach Hi-Flow sampler)

When identified leaks were greater than the Hi-Flow™ sampler threshold, calibrated bag measurements were conducted (the method of measurement is logged for every leak within the database). The calibrated bags are made of anti-static plastic, have known volumes, and a specialized neck to fit over leaks. A low pressure drop measurement is made by timing the bag expansion to full capacity. In addition, the proportion of methane in the gas stream is used together with the ambient pressure and temperature to verify the proportion of methane in the emissions stream, and to correct the measured volume to standard conditions.

The measurement is repeated several times to ensure a result that is representative of the measurement sample. The use of these calibrated bags has been found accurate to within ±10%.

Actual images of the calibrated volume bag being used to measure the gas leak rate (from a stem packing valve prior to an associated gas liquid knock-out separator at the Bibiheybatneft OGPD)

The activity was assessed as large-scale and estimated potential amount of GHG upstream emission reductions during provisionally determined crediting period amounts to up to 53,224,169 kg CO2e. It must be mentioned that to be conservative Global Warming Potential value for methane (GWPCH4 = 25) was taken from IPCC Forth Assessment Report for 100-year time horizon. Monitoring methodology for large-scale CDM project activities AM0023 was used to ensure correctness of estimations.

In overall 177 leak points were detected amounted to 1830402 m^3 of annual gas emissions, which could be prevented only by timely leak repairs. In addition, the project design document (PDD) provides the possibility to carry out more leak detection and repair under this project throughout the monitoring period (expected to be a prospective volume of up to 1200000 m3 per year).

It should be mentioned that offshore facilities at 28 May OGPD and Neft Dashlari OGPD, as well as at onshore Siyyazanneft OGPD instrumental measurements were not carried out.

Name of NGPD	Number of leak points detected	Annual gas loses assessed (m^3)
Absheronneft	53	166300
named after N. Narimanov	60	562024
named after A. Amirov	17	91349
Bibiheybatneft	37	457009
named after Z.Taghiyev	10	553720

Number of leak points and gas loses by OGPDs

The leak repair program was prepared based on leak detection campaign and implemented by Azneft PU in February – January of 2020. The tagged leaks repaired using specialized materials, such as new sealing materials (e.g. GORE), replacement of parts (gaskets, seals, stem-packing materials, etc.), component re-building/refurbishment or even full component replacement.

On 01.11.2019 Carbon limits AS applied for approval of project activity and application documents were submitted to German Emission Trading Authority on 07.11.2019. In order to prepare validation report TUV NORD CERT GmbH company was hired by CL and field visit to SOCAR project areas was performed during 18-19 February of 2020. Positive validation report together with Project Design Document (PDD) were submitted to German Federal Environment Agency (DEHSt) and in early November approval for the LDAR project with the German authorities was obtained.

The pilot LDAR is actually the first project of its kind being approved under the Fuel Quality Directive (FQD) offset scheme and this could be considered as main achievement of CL and SOCAR international cooperation.

Best practices and lessons learned from this project activity, if applied to all areas of SOCAR's activities, will lead to a significant reduction in methane emissions and the fulfillment of obligations undertaken under the First NDC of the Republic of Azerbaijan.

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4. AM0023: Leak detection and repair in gas production, processing, transmission, storage and distribution systems and in refinery facilities --- Version 4.0.0 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32015L0652 https://ccacoalition.org/en/file/3385/download?token=vTrJd-N5

XÜLASƏ

PARİS RAZILAŞMASININ HƏYATA KEÇİRİLMƏSİNDƏ BEYNƏLXALQ ƏMƏKDAŞLIĞIN VƏ QABAQCIL TEXNOLOGİYALARIN TƏTBİQ EDİLMƏSİNİN ROLU

Məqalədə karbohidrogenlərin çıxarılması və emalı zamanı səmt və təbii qaz sızmalarının aşkarlanması və ölçülməsi metodlarından bəhs olunur. Təbii və səmt qazı sızmalarının qarşısının alınması iqlim dəyişmələrinə təsirlərin azaldılmasına yönəlmiş ən təsirli yumşaltma tədbirlərindən biridir. Paris Razılaşmasının 6-cı maddəsində nəzərdə tutulan yeni karbon emissiyası ticarət mexanizmlərinin istifadəsi ilə ətraf mühit layihələrinin alıcılıq qabiliyyəti məsələsi də müzakirə olunur.

Məqalədə həmiçinin metan sızmasının aşkarlanması üçün termal kameralar, metan detektorları – istənilən borukeçirici armaturdan təbii qazın sızmasının həcmi və intensivliyini ölçməyə imkan verən Hi Flow Sampler tipli seçilmiş nümumələrin, magistral xətlərdə, anbarlarda, kompressor stansiyalarda təbii qaz üçün flyans və kompressor birləşmələri kimi innovativ texnologiyaların tətbiqi məsələlərinə baxılır.

Məqalənin məqsədi – İstixana Effekti Yaradan Qazları (İEYQ) azaltmaq üçün neft və qaz sənayesinin potensialını qiymətləndirmək, o cümlədən, Paris Razılaşması çərçivəsində Azərbaycan tərəfindən istixana effektinin azaladılması ilə bağlı götürülmüş öhdəliklərin yerinə yetirilməsini təmin etmək üçün ən qənaətcil və ekoloji cəhətdən təmiz həll yolları paketini hazırlamaqdır.

Açar sözlər: *Paris razılaşması, Yumşaltma tədbirləri, emissiyaların mühəndis mənbələri, sızmaların aşkarlanması, karbon ticarəti, ətraf mühitə dost texnologiyalar*

РОЛЬ МЕЖДУНАРОДНОГО СОТРУДНИЧЕСТВА И ПЕРЕДАЧИ ПЕРЕДОВЫХ ТЕХНОЛОГИЙ В ВЫПОЛНЕНИИ ПАРИЖСКОГО СОГЛАШЕНИЯ

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В статье рассматриваются методы обнаружения и измерения утечек попутного и природного газа при добыче и переработке карбогидрогенов. Предотвращение утечек природного и попутного газа является одним из самых действеных митигационных мероприятий, направленных на смягчение последствий изменения климата. Также обсуждается вопрос окупаемости экологических проектов путем использования новых механизмов торговли карбоновыми выбросами, предусмотренных Статьей 6 Парижского Соглашения.

В статье рассматриваются вопросы применения инновационных технологий, таких как тепловизоры для обнаружения утечек метана, детекторов метана – пробоотборников типа Hi Flow Sampler позволяющих точно измерять объем и интенсивность утечки природного газа из любой трубопроводной арматуры, золотниковых уплотнений и компрессорных уплотнений в магистральных линиях, хранилищах, и компрессорных станциях для природного газа.

Цель статьи – оценить потенциал нефте-газовой отрасли по уменьшению эмиссий газов создающих парниковый эффект (ПГ), а также составить пакет наиболее экономичных и экологичных решений для обеспечения выполнения обязательств по уменьшению ПГ, взятых Азербайджаном в рамках Парижского Соглашения.

Ключевые слова: *Парижское соглашение, меры по смягчению последствий, инженерные источники выбросов, обнаружение утечек, торговля выбросами углерода, экологически чистые технологии*