IDENTIFYING BEST AVAILABLE TECHNIQUES FOR THE RUSSIAN OIL AND GAS EXTRACTION INSTALLATIONS

Yuliya Ukhina[1]
Olga Ezhova[1]
PhD Natalya Popadko[2]

[1] Research Institute "Environmental Industrial Policy Centre", **Russian Federation**
[2] National University of Oil and Gas "Gubkin University", **Russian Federation**

ABSTRACT

Upstream hydrocarbon exploration and production remains an important economic sector providing the necessary raw materials for several areas of Russian economy. To enhance the resource efficiency and environmental performance of the sector, researchers and practitioners develop approaches based on Best Available Techniques (BATs).

In Russia, the BAT concept has been rapidly developing since 2014. Unlike in the European Union, in Russia, upstream hydrocarbon exploration and production sector is regulated by IPPC-like legislation, and respective Reference Documents on BATs (BREFs) were issued in 2017. Enforcement lessons learnt in 2019-2020, show that to develop a decent application for the Integrated Environmental Permit (IEP), operators need well-substantiated BAT-Associated Emission Levels (BAT-AELs); BAT-AELs are also needed for the environmental authorities and experts for assessing applications and IEP granting. In 2021, stakeholders suggested reviewing the Russian BREF on Oil Exploration (ITS 28-2021) and the review process is nearly completed.

Draft ITS 28-2021 covers both onshore and offshore oil exploration. It contains information on the current consumption and emission levels, applied techniques and BATs. Both general and specific BATs are identified, eight of them being aimed at reducing emissions of associated petroleum gas which is very important in the wake of greenhouse gas emission reduction.

The article analyses key differences between the European BAT Guidance Document on Upstream Hydrocarbon Exploration and Production (2019) and ITS 28-2021. Principles of BAT identification and BAT-AELs as well as BAT-Associated Environmental Performance Levels are considered. Perspectives for the practical implementation of the new ITS 28-2021 are discussed.

Keywords: Best Available Techniques, Reference Documents, resource efficiency, environmental performance levels, associated petroleum gas

INTRODUCTION

The oil and gas industry plays a significant role in the Russian economy. According to official data, the sector has contributed to 15.2% of the Russian GDP [1]. The structure of the oil and gas sector is represented by oil and oil-well (associated petroleum) gas,

https://doi.org/10.5593/sgem2021V/3.2/s06.02

natural gas and gas condensate, oil products and gaseous fuels. 285 Russian organizations have licenses for extracting and producing hydrocarbons [2].

At the same time, hydrocarbon production can be characterized as a sector with high resource and energy intensity and, subsequently, high pollutant and greenhouse gas emission levels. In general, Russian oil and gas production installations are the sources of 4.8 million tonnes of pollutants and 147.8 million tonnes of $CO_{2\text{-eq}}$ [3-4], so these installations require appropriate management and government control in order to reduce the impact on the environment and climate.

The concept of the best available techniques (BAT) is a main component for management and control of environmental impact and climate change and a main tool for stimulating fundamental changes in resource efficiency and environmental performance of the industrial sector in Russia [5-8].

The Russian BATs for the oil and gas sector are identified in 2017 in special information and technical reference documents on the best available techniques (Russian BREFs): BREF ITS 28-2017 “Oil Exploration”, BREF ITS 29-2017 “Natural Gas Exploration”, BREF ITS 30-2017 “Oil Refining” and BREF ITS 50-2017 “Processing of Natural and Associated Gas”.

In 2020 the Ministry of Energy of the Russian Federation has initiated the process of review of the BREF ITS 28 “Oil Exploration” with the main idea to refine BAT-associated emissions levels for oil exploration for the purpose of obtaining integrated environmental permits.

1. Russia’s BREF 28: Materials and methods of updating

Even though the BREF drawing up and reviewing processes in Russia are somewhat different from the respective rules adopted in the European Union [9], key stages, i.e., problem statement, deciding on whether a reference document needs to be drawn up (reviewed), setting up of a Technical Working Group (TWG), surveying the respective sector, analysing the questionnaires filled in by the respondents, and elaborating joint approaches to the BAT establishment, are almost identical

The reviewing of BREF 28 “Oil Production”, similarly to the initial drawing up, is based on the analysis of information on the current state of oil production techniques in Russia.

A Technical Working Group (TWG) representing the hydrocarbon production sector, the academia, relevant federal authorities, and active members of Russia’s BAT expert community was set up to analyse the information [10].

The TWG’s objectives were to make trade-offs on the types of activity to be covered by the BREF, expand the list of techniques to include the use of the associated petroleum gas, and determine BAT-Associated Environmental Emission Levels (BAT-AELs) and BAT-Associated Environmental Performance Levels (BAT-AEPLs), in particular levels of resource and energy efficiency.

The reviewing was based on the results of the survey of Russian oil and gas production installations. The dedicated questionnaires included questions about the techniques / technologies used, production and resource consumption levels, environmental impact, mitigation measures, applicability of leading-edge techniques, etc. Information specifying the geographic location of the enterprises was also requested. Thus, operators

of the oil sector installations provided a wide range of data to specify their activity types at oil production enterprises, the list of BATs and their relevant parameters.

2. An overview of findings

The survey produced an analysis of over 250 questionnaires received from installations located anywhere in Russia from its western to eastern borders, of which 98% represented onshore oil production facilities with just 2% for offshore facilities.

All installations provided the data on their respective production levels of the oil and gas-water mixture, air emissions, and typical volumes of waste generation. About 70% of the installations were able to give their evaluations of the contribution of raw materials used in the primary oil production processes. All operators reported that wastewater formed in the production processes is pumped to the specialised wastewater treatments plant (normally being independent companies), therefore oil exploration installations do not discharge any wastewater directly into the natural waterbodies.

3. From the questionnaires to the BATs

New Russian BREF differs from the European BREF (2019) because it addresses exclusively oil exploration processes. It differs also from the older Russian BREF (2017). One of the decisions made by the TWG early on regarding the sectoral BATs, as included in the Draft BREF 28-2021, in contrast to Europe's "Best available techniques guidance document on upstream hydrocarbon exploration and production" [11] and BREF 28-2017, was only accounting for one stage of the oil production life cycle, i.e., Operations.

Thus, the scope of the Reference Document includes the following activities:

– oil extraction;

– extraction of associated petroleum gas;

– providing services relating to the extraction of oil or associated petroleum gas;

– oil or associated petroleum gas treatment, processing, and use for own consumption at the field.

The reasoning behind the above decision was that exploration and drilling are carried out by contractors hired for these types of work, while the operation of potential sources of adverse environmental impact from hydrocarbon extraction is the responsibility of the operator company who is required to obtain all the necessary operational permits, including the integrated environmental permit, for the entire life of the facility.

The initial amendments to the draft BREF concerned the list of generally applicable BATs characterising a unified approach to management decisions in environmental, energy, metrological, and human resources management when operating normally or in an emergency. Therefore, the BAT 1 – BAT 5 "Environmental management system", "Energy management system", "Measurement management system", "Preventive maintenance in standard situations and availability of an emergency action plan", and "Training and instruction of personnel" were added to the draft BREF. The above BATs are part of the enterprise management effort, aiming at preventing and steadily reducing the adverse environmental impact, improving the energy efficiency, product quality and qualifications of personnel.

https://doi.org/10.5593/sgem2021V/3.2/s06.02

Since oil extraction is a complex of integrated technological processes the boundaries of which are difficult to define, the general list of sectoral BATs includes the technological processes and installations describing the sub-stages of field operations:

- BAT 6. Extraction, collection, and transportation of wellbore fluids;
- BAT 7. Treatment of oil, gas, and water;
- BAT 8. Oil storage;
- BAT 9 - BAT 16. Techniques for the use of associated petroleum gas;
- BAT 17. Maintaining reservoir pressure (water injection);
- BAT 18. Hydrocarbon extraction from offshore oil platforms.

Importantly for defining the BAT, the draft BREF itemises offshore extraction techniques, or BAT 18 “Hydrocarbon extraction from offshore oil platforms”. Previously, the BREF 28-2017 did not cover these facilities, which generally prevented state-of-the-art techniques for offshore oil extraction using offshore oil platforms from being recognised as best available techniques, despite the stringent international environmental requirements applicable to those.

4. BATs for the use of associated petroleum gas

The draft BREF gives a high profile to the BATs for the use of associated petroleum gas.

The associated petroleum gas (APG) is known to be more than a mixture of various gaseous hydrocarbons (C_1-C_{10}) and other compounds dissolved in oil and released into the environment during oil extraction pre-treatment, for it is also a valuable energy resource, as well as a source for producing dry residues gas, a variety of light hydrocarbons, liquefied gaseous products, etc.

Methane accounts for 60-90 % of the total APG volume. According to the United Nations Framework Convention on Climate Change [12] and the Kyoto Protocol [13], methane is a greenhouse gas directly contributing to climate change. Methane has a 100-year global warming potential 28-34 times higher than that of CO_2. Therefore, all activities characterised by significant CH_4 emissions / leaks need to be closely monitored and controlled. On the other hand, in Russia, methane is also classified as a pollutant, which is subject to government environmental regulation.

Techniques for enhanced APG utilisation are widely used in Russia with a view to enhancing resource efficiency and reducing the adverse environmental (including the impact on the climate system) (Figure 1). Eight techniques are specified as BATs in the Russian BREF (ITS 28).

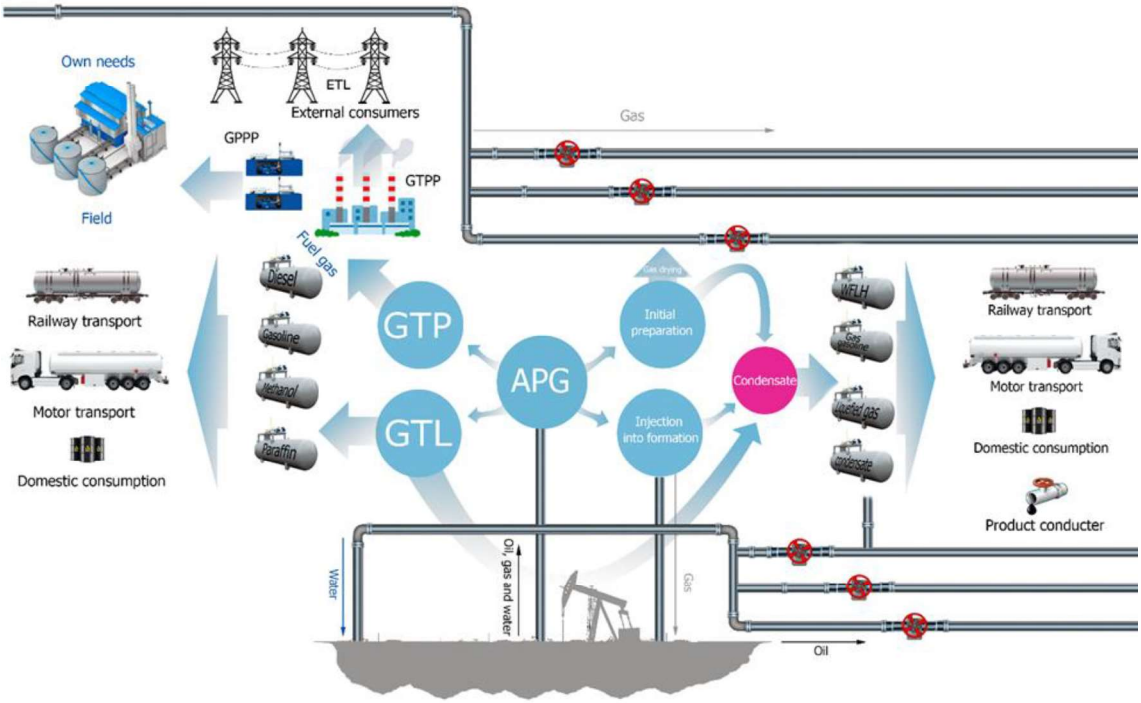

Figure 1. Production of oil and gas-water mixture and uses of associated petroleum gas

The reviewed (draft) Reference Document describes eight BATs for the use of associated petroleum gas for facility-level own process needs, as well as for pumping into the system of transfer pipelines and transferring to the refineries:

– BAT 9. Use of associated petroleum gas for heat generation;

– BAT 10. Use of associated petroleum gas for electric energy generation;

– BAT 11. Use of associated petroleum gas for underground gas storage;

– BAT 12. Use of associated petroleum gas for injection into reservoirs to maintain reservoir pressure;

– BAT 13. Injection of associated petroleum gas into the gas trunk-line system;

– BAT 14. Use of associated petroleum gas for its transfer to a gas-processing plant (for processing);

– BAT 15. Use of associated petroleum gas for oil treatment;

– BAT 16. Use of associated petroleum gas for oil transportation.

5. BAT-Associated Emission Levels

The BAT-Associated Emission Levels (BAT-AELs) to be found in the draft Reference Document were based on the results of the industry survey, in particular on the data on Key Environmental Issues (KEIs, or factors causing the negative environmental impacts). All data were received and analysed during the benchmarking process organized in accordance with the requirement of the RF BREF drawing up and review procedure (similar to that established in the EU).

https://doi.org/10.5593/sgem2021V/3.2/s06.02

Due to low wastewater discharges along with insignificant amounts of low-hazard wastes typical of most installations participated in the benchmarking, it was decided to set BAT-AELs only for air emissions. The data on pollutant emissions from point or nonpoint stationary sources were used to define the sector's environmental performance.

Methane, carbon oxide, saturated hydrocarbons C_6-C_{10}, saturated hydrocarbons C_1-C_5 (excluding methane), nitrogen dioxide, nitrogen oxide, sulphur oxide and hydrogen sulphide were included in the list of marker pollutants (similar to KEIs) specific for the oil production industry according to the questionnaire survey, i.e., based on their prevalent share in the total volume of enterprise emissions.

The following algorithm was used to define the BAT-AELs while reviewing BREF in 2021:

1. Analysis of the questionnaires aimed at the identification /selection of reliable and valid data;

2. Calculation of maximum values of the per-unit total emissions (emission factors or specific emissions) of the marker substances from point or nonpoint sources based on the ratio between the maximum annual mass emissions of pollutant marker substances (in kilograms) from the main equipment and installations used in the given technology and the annual output of products for the same year (in metric tonnes);

3. Setting BAT-AELs at the level of 90% of the maximum values of the per-unit total marker substance emissions from point or nonpoint sources. Description of BAT-AELs includes the necessary information on types of product for which marker pollutants and respective BAT-AELs are set.

The BREF provides specific guidance for the calculation of BAT-AELs for oil production regarding the associated petroleum gas. The government has specified a maximum admissible level of flaring and/or dispersion of the associated petroleum gas at 5% of the produced volume of associated petroleum gas while applying the mark-up factors in the pricing of the environmental fee for the excessive amounts. The BAT list does not include the above technological process of flaring and/or dispersion of the associated petroleum gas.

To improve resource efficiency of oil exploration processes, BAT-Associated Environmental Performance Levels characterizing consumption of material resources and energy are established. The material flows are described by the gaseous fuel / associated petroleum gas (widely available for both onshore and offshore oil exploration processes) and electricity. TWG analysed stages of oil exploration processes for which BAT-AEPs should be established. These stages include: oil, gas and water pre-treatment (preparation) stages, offshore hydrocarbon exploration stages (drilling, collection, and transportation). Specific consumption factors (BAT-AEPLs) were set for gas or electricity consumption per tonne of oil, gas or water pre-treated or tonne of oil-water mixture produced (m^3 per tonne or kWh per tonne).

It is necessary to emphasise that BAT-AELs and BAT-AEPLs established for the Russian oil exploration sector can be used to assess GHG emissions and thereby can serve as target values for regulating GHG emissions in this sector [14].

CONCLUSION

The review process of the Russian ITS 28-2021 “Oil Exploration” serves as an example of the practical implementation of the continual improvement principle, typical of the BAT concept in general.

The BAT determination process for Russian oil and gas exploration installations is based upon both international and national as well as sectoral experience.

BATs summarised in the Russian BREF 28-2021 represent the level environmental performance and resource efficiency of Russian oil exploration installations (BAT-AE(P)Ls) and provide the necessary basis for working out applications for Integrated Environmental Permits. At the same time, BATs and emerging techniques help to establish a strategy for the technological and environmental development (modernisation) of the whole sector.

Oil and gas experts (members of TWG 28) established the list of BATs, BAT-AELs, and BAT-AEPLs as the result of an information exchange, analysis, benchmarking and trade-off between all actors.

The reviewed version of Russian BREF ITS 28-2021 covers all operation stages of onshore and offshore oil exploration processes. Implementation of general (managerial) and sectoral BATs stimulates the continual improvement of the technological processes of oil exploration in Russia. Russian BREF ITS 28-2021 contains BAT-AE(P)Ls, which form also a basis for setting target (indicative) values for GHG emissions. The document includes a wide range of emerging techniques, including methods for increasing reservoir recovery rate by capturing, transporting, storing and using industrial carbon dioxide. The emerging techniques will establish a new list of oil extraction techniques and related BAT-AE(P)Ls in the nearest future.

The reviewed Russian BREF ITS 28-2021 reflects existing situation in the oil and gas industry. The reviewing process showed the existence of challenges that require further study, (e.g. expanding data gathering on separate stages of oil extraction will allow for a deeper analysis of the installation boundaries inside oil-extracting sites complexes and associated mass and energy balance.

REFERENCES

[1] Federal State Statistics Service, Determination of the share of the oil and gas sector in the gross domestic product of the Russian Federation, URL: https://rosstat.gov.ru/storage/mediabank/1b5RpebS/Maximov-tezisy.pdf (reference date 09.11.2021).

[2] Ministry of energy of Russian Federation, About the oil industry, URL: https://minenergo.gov.ru/node/910 (reference date 09.11.2021).

[3] Ministry of Natural Resources and Environment of the Russian Federation, State report on the state and protection of the environment of the Russian Federation in 2019, URL: https://www.mnr.gov.ru/docs/gosudarstvennye_doklady/proekt_gosudarstvennogo_doklada_o_sostoyanii_i_ob_okhrane_okruzhayushchey_sredy_rossiyskoy_federat2019/ (reference date 09.11.2021).

[4] United Nations Framework Convention on Climate Change, National Inventory Report Russian Federation (NIR), 2021, URL: https://unfccc.int/documents/273477 (reference date 09.11.2021).

[5] Skobelev D.O., Building the infrastructure for transforming Russian industry towards better resource efficiency and environmental performance, Procedia Environmental Science, Engineering and Management, vol. 8/issue 2, pp. 483-493, 2021.

[6] Almgren R., Skobelev D., Evolution of technology and technology governance, Journal of Open Innovation: Technology, Market, and Complexity, vol. 6/issue 2, pp. 22-34, 2020.

[7] Skobelev D., Environmental industrial policy in Russia: economic, resource efficiency and environmental aspects, Proceedings of the 19th International Multidisciplinary Scientific GeoConference SGEM 2019, Sofia, Bulgaria, Conference proceedings contents, Environmental Economics, vol. 19/issue 5.3, pp. 291-298, 2019.

[8] Hjort M., Skobelev D., Almgren R., Guseva T., Koh T., Best available techniques and sustainable development goals, Proceedings of the 19th International Multidisciplinary Scientific GeoConference SGEM Green 2019, Sofia, Bulgaria, Conference proceedings contents, Air Pollution and Climate Change, vol. 19/issue 4.2, pp. 185-192, 2019.

[9] Skobelev D., Guseva T., Chechevatova O., Sanzharovskiy A., Shchelchkov K., Begak M., Comparative Analysis of the Drawing up and Review of Reference Documents on Best Available Techniques in the European Union and in the Russian Federation, Moscow, Pero Publishing Hpouse, 89 p., 2018.

[10] Skobelev D., Guseva T., Chechevatova O., Begak M., Tsevelev V., Chartered experts in best available techniques in Russia: key principles and first practices. Proceedings of the 18th International Multidisciplinary Scientific GeoConference SGEM 2018, Albena, Bulgaria, Conference proceedings contents, Ecology and environmental protection, vol. 18/issue 5.1, p. A, pp. 183-190, 2018.

[11] Publications Office of the European Union, Best available techniques guidance document on upstream hydrocarbon exploration and production, Final guidance document, URL: https://op.europa.eu/en/publication-detail/-/publication/f9265d2b-574d-11e9-a8ed-01aa75ed71a1/language-en/format-PDF/source-93598867 (reference date 09.11.2021).

[12] United Nations, United Nations framework Convention on Climate Change, URL: https://unfccc.int/process-and-meetings/the-convention/what-is-the-united-nations-framework-convention-on-climate-change (reference date 09.11.2021).

[13] United Nations, Kyoto Protocol, URL: https://unfccc.int/kyoto_protocol (reference date 09.11.2021).

[14] Guseva T., Shchelchkov K., Sanzharovskiy A., Molchanova Ya. Best available techniques, energy efficiency enhancement and carbon emissions reduction. Proceedings of the 19th International Multidisciplinary Scientific GeoConference SGEM Green 2019, Sofia, Bulgaria, Conference proceedings contents, Ecology and Environmental Protection, vol. 19/issue 5.1, pp. 63-70, 2019.