

Analysis and Enlightenment of Methane Emission Reduction Control in Oil and Gas Industry

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Abstract: Methane is the second largest greenhouse gas in the world after carbon dioxide. In order to cope with the warming impact of methane emissions on climate issues, major oil and gas producing countries in the world have implemented methane emission control policies, supervising technical norms, emission reduction performance or results, economic means and information management. Through comparative analysis, the current problems of methane emission reduction control in China's oil and gas industry are summarized, and the enlightenment and guidance suggestions for methane emission reduction control in Daqing oilfield are further proposed.

Keywords: Oil and gas industry, Methane emission reduction, Greenhouse gas.

1. Introduction

Methane is the main component of natural gas and an important chemical raw material. Because of its close connection with the oil and gas industry, it has become the largest "politics" in the world's oil and gas industry today. After many countries and oil companies around the world announced "carbon neutrality" targets, the significance of controlling methane emission reduction has become more and more prominent.

Currently, methane is the second largest greenhouse gas in the world after carbon dioxide. Methane emitted into the atmosphere can naturally decompose into other products over 9-15 years, and according to the IPCC's Fifth Assessment Report, the 20-year global warming potential of methane is 84, that is, after 20 years, the warming effect of methane is 84 times that of carbon dioxide. Therefore, methane is an important short-lived strong climate pollutant, and the oil and gas industry, as the main source of methane emissions, promoting methane emission reduction actions has naturally become a key measure to mitigate climate change, which has a multiplier effect on reducing global warming.

Therefore, analyzing methane emission reduction control has far-reaching strategic significance for the future low-carbon transformation and development of Daqing.

2. Current Status of Methane Emission Reduction in The Oil and Gas Industry

According to official statistics from the International Energy Agency, the total global methane emissions in 2020 were 580 million tons, of which 390 million tons were caused by human activities, accounting for 67% of the total global methane emissions. The oil and gas sector is the largest source of methane emissions in the energy sector, accounting for 72.1 million tonnes or 19% of human-induced methane emissions.

There are four types of methane emissions from the oil and gas industry: venting, flare, escape and super sources. The oil and gas industry is considered to be the most practical and economical area for methane emission reduction, and because of the economic value of methane itself, oil companies have

taken corresponding measures to reduce emissions for four different emission sources to improve profits.

2.1. Venting emission sources

The operation process of overhauling the production line, cleaning the tank, replacing the equipment and other operations require the emptying of pipelines, storage tanks, equipment to be replaced, etc., which will discharge methane inside the equipment into the atmosphere. The use of VRUs to recover methane from exhaust air gases or to burn exhaust air gases through flares is an effective means of reducing such methane emissions. Tank gas reduction can also be achieved by adjusting the operating system and tank pressure.

2.2. Torch emission sources

Burning methane through a flare to avoid its direct emissions into the atmosphere is a common means of reducing methane emissions. But at the same time, incomplete combustion of the flare can cause serious methane emissions, and in recent years, reducing methane emissions from flare combustion has received more and more attention. Measures that can be taken include improving the burning efficiency of the flare and reducing the amount of flare used in the path. In recent years, Total has succeeded in reducing conventional flare burning by 80%.

The relatively direct treatment measures for such emissions are one is to prohibit the discharge of unburned natural gas into the atmosphere, and the other is to discharge the natural gas that has to be emitted after ignition and ensure that it is fully burned. Obviously, neither method can completely avoid methane emissions, so the final solution to such methane emissions is to fully consider the construction of infrastructure such as pipelines to ensure the full transportation and utilization of natural gas before the exploration and development of new blocks, so as to avoid venting and flare activities.

2.3. Escape emission sources

Methane escape occurs at all stages of the oil and gas industry chain, and governance is complex. The leakage source is mainly the flange, valve, compressor, pneumatic equipment, maintenance leakage, pipeline aging, etc. of the pipeline. The escape of this methane is mostly continuous, so

it is suitable to estimate its leakage using the emission factor method. At present, the better emission reduction technology is to establish a pipeline leakage, monitoring and repair (LDAR) system to detect and repair emission sources in a timely manner. Many companies have already adopted LDAR to enhance their emissions reductions, and research and optimization of LDAR is ongoing to enable a wider range of low-cost monitoring.

2.4. Super emission sources

Super emission sources are methane leaks caused by accidents such as blowouts, pipeline ruptures, and infrastructure destruction due to unexpected events. The methane leakage caused by such sources in a short period of

time can even exceed the annual leakage of conventional escape, which is highly sporadic and random, and requires special tools (such as satellite monitoring) to locate and treat.

In terms of technical means, major international oil companies have taken substantial measures (Table 1). For example, Total eliminated methane use in instrument gas, cold and exhaust systems in the CLOV project in Angola, the Moho Nord project in the Republic of Congo and the Egina project in Nigeria; ConocoPhillips' Montney development in Canada uses air instead of natural gas to drive equipment. Many U.S. oil companies have adopted a number of methane emission reduction technologies such as green completions, plunger lifting systems, and ethylene glycol dehydration emission control.

Table 1. Specific measures for methane emission reduction by major international oil companies.

Numble	Company	Measures already taken 2
1	Shell	Leak detection using drones, other aircraft equipped with optical gas imaging cameras, and satellites 1) Unmanned aircraft using optical natural gas imaging cameras, advanced sensor technology to identify leaks and repair them in a timely manner. 2) Pneumatic devices using low-emission technologies.
2	bp	3) In 2019, a three-year strategic partnership with the U.S. Environmental Protection Association on "Advancing Methane Reduction Technologies in the Global Oil and Gas Industry". 4) In 2020, a non-operational joint venture center of excellence (NOJV) was established to support bp and partner teams in "reducing methane emissions" 1) Adding methane detection equipment to operations, such as regular monitoring procedures using optical gas imaging cameras at high production wells and stand-alone compression stations.
3	CONOCOPHILLIPS	2) Driving equipment by using air rather than natural gas in the Montney development in Canada. 3) Installing vapor recovery systems to capture methane emissions 1) Elimination of methane use in instrument gases, cold exhaust systems at CLOV in Angola, Moho Nord in the Republic of Congo and Egina in Nigeria.
4	Total	2) Leak detection using ground-based infrared cameras, drones and satellites. 3) Establishing a test site in France for the technology for full TADI anomaly detection
5	Eni	Leak detection and repair program covering 95% of upstream production (corresponding to about 60 sites) Collaboration with the Norwegian Oil and Gas Association (NOROG) and other operators on the Norwegian Continental Shelf to jointly study potential methane leaks from abandoned wells and assess their size and potential impact
6	Equinor	

3. Analysis and Insight of The Problems Faced by Methane Emission Reduction Control

3.1. The oil and gas industry is under great pressure to reduce emissions

The oil and gas sector has been generally identified by the international community as a priority for carrying out methane reduction actions. The Glasgow Climate Convention's emphasis on the 1.5 °C target and the shift in national attitudes toward the target may see some of the more aggressive countries pushing to set the temperature control red line at 1.5 °C warming in the future, urging countries to take more measures to close the gap between the status quo and the emissions target, and implying that the oil and gas

industry, which is high in energy consumption and emissions, will face greater pressure to reduce emissions.

3.2. There is little basic methane emission data available for analysis

Internationally, the accounting of methane emissions from the oil and gas industry basically adopts the method of fixing some emission factors and updating them according to the data reported by oil and gas producers every year. From the field testing statistics of methane emissions in China's oil and gas industry, there are fewer relevant studies published in China, the research base is weak, and most of the studies mainly focus on individual aspects of oil and gas production, such as casing gas, extracted water, coalbed methane wellhead, etc. Comprehensive and systematic testing and analysis of the whole process is still rare. There is no

reference value for China's national GHG inventory, and there is still a need to continue to expand the sample size, clarify the representativeness of sampling and testing, and carry out data uncertainty analysis, etc. Methane emission inventories lack continuity and have not been updated for a long time, and the existing official methane emission inventories have major deficiencies in completeness, consistency and accuracy. Our methane emission inventory methodology needs to be improved, and the lack of field testing data makes localized inventories need to be improved in terms of completeness and accuracy. China's energy industry methane emissions monitoring, reporting and verification system is not yet fully established, and methane emission reduction actions are still lacking in scale and practice. Monitoring techniques and accounting factors and development within the industry need to be further strengthened to map the actual methane emissions from the oil and gas industry. The international community has generally made the oil and gas industry a priority for methane emission reduction, and China's oil and gas companies need to keep an eye on the situation.

3.3. Methane reduction technology shortcomings are prominent

The technical basis and important prerequisite for control is monitoring and detection. Reliable methane monitoring is important to improve the accuracy of emission inventory and support the localization of emission factors, and the status of methane monitoring in the process of emission inventory preparation is gradually increasing. The European Union, the United States and Canada have established an integrated air-space-space methane emission monitoring system, using satellites, aircraft, drones, fixed monitoring, handheld devices or vehicle-mounted, to monitor methane at national, regional, site and point sources, improving the accuracy of data. Currently, China has launched several greenhouse gas monitoring satellites and has the initial capability to monitor the distribution of methane and many other greenhouse gas concentrations. However, on the whole, there is still a large gap between China and European and American countries in terms of spatial resolution, measurement accuracy and revisit cycle. Although China has carried out methane emission monitoring at different levels, the quality control system for monitoring is not sound and still needs to be aligned with international standards, such as the suitability testing of instruments and equipment and the supply of standard artifacts.

3.4. Methane emission calculation methods are not uniform and the control ability is not strong

Since 2014, China has attached great importance to the control of methane emissions, and 11 departments including the State Council, National Development and Reform Commission, Ministry of Ecology and Environment and General Office of the CPC Central Committee have issued 14 policies related to methane emission reduction and control. Jiangxi and Henan provinces have also clearly proposed to carry out methane emission control. In May 2021, seven Chinese oil and gas companies, including China National Petroleum Corporation (CNPC) and China Petroleum & Chemical Corporation (CPC), jointly established the Methane Emission Control Alliance, aiming to promote industry-wide methane emission control actions. In June 2021, China Gas Holdings Limited joined the United Nations Environment

Programme-led Oil and Gas Methane In October 2021, ten domestic city gas enterprises signed the Methane Emission Control Initiative for Chinese City Gas Enterprises. In conjunction with the development and implementation of relevant plans and policies, more domestic enterprises will join the methane emission control initiative.

3.5. Methane emission control action plan proposal

In terms of boundary determination, firstly, comprehensively map the key areas of methane emission in Daqing oilfield, and test and account for them to ensure comprehensive and accurate data. Then, according to its own business characteristics and methane emission level, it will set different spatial boundary limits on the established emission reduction targets.

(2) In terms of target setting, the total emission target and methane emission intensity target need to be determined. Total emission means setting the upper limit of methane emission in the future period, and the calculation formula is the reduction percentage of the target year relative to the historical base year. 75% in the short term and 40-50% in the medium to long term. The IEA considers a 75% methane reduction target to be economically feasible and a milestone in the process of eliminating methane emissions. The Oil and Gas Methane Partnership "OGMP 2.0" also proposes a 60-75% reduction in methane emissions by 2030. Emissions intensity (the ratio of methane emissions from upstream fields to marketable gas volumes) is an important measure of an oil and gas operator's level of methane emissions control, allowing comparison of methane control performance within a company based on operating segments.

4. Conclusion

Daqing Oilfield should make reference to the existing international experience to increase the corresponding emission reduction efforts, start to set methane emission reduction targets suitable for its own development as soon as possible, implement the requirements of the 14th Five-Year Plan, increase methane control efforts, develop and implement methane action plans, actively participate in the collection of basic data on methane emissions in the oil and gas industry, explore the best applicable technology for methane emission reduction and carry out pilot demonstrations to promote it, establish a technology incubator for methane control and utilization, accelerate technological innovation, promote the marketization of methane emission reduction technology, and promote the green transformation of economic and social development.

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