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Understanding troll field operational practices contributing towards efficiency and sustainability

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Abstract

This paper explores the role of Baker Hughes in enhancing the efficiency of drilling operations at the Troll field in Norway and its contribution to the field's path toward net-zero emissions. The Troll field is a significant gas reservoir on the Norwegian Continental Shelf, crucial for Europe's energy supply. This study details the advanced drilling technologies and digital solutions provided by Baker Hughes that have optimized operations, reduced emissions, and supported the Troll field's sustainability objectives. Additionally, the paper presents a life cycle analysis (LCA) methodology to quantify the environmental impact of drilling activities, using the Troll field as a case study.

Keywords: Well Construction; Optimization; Drilling; Emissions; Life Cycle Analysis

1. Introduction

The Troll field, located on the Norwegian Continental Shelf, is one of the largest gas fields globally and a cornerstone of Norway's energy production. Managed by Equinor, the field plays a vital role in supplying natural gas to Europe. However, as the world moves toward a low-carbon future, there is increasing pressure on oil and gas operations to reduce their environmental impact. In response, the Troll field has set ambitious targets to achieve net-zero emissions, aligning with Norway's broader climate goals. Baker Hughes, a leader in energy technology, has been instrumental in helping the Troll field achieve these objectives. Through the deployment of advanced drilling technologies, digital solutions, and energy-efficient practices, Baker Hughes has enhanced the efficiency of drilling operations while minimizing the environmental footprint. This paper examines these contributions and presents a life cycle analysis (LCA) methodology to evaluate the environmental impact of drilling activities at the Troll field. ###

2. Life Cycle Analysis (LCA) Methodology

Life cycle analysis (LCA) is a comprehensive method used to assess the environmental impacts associated with all stages of a product's life, from raw material extraction through production, use, and disposal. In the context of oil and gas drilling, LCA can help quantify emissions and other environmental impacts throughout the entire drilling process.

2.1. Goal and Scope Definition

The goal of this LCA is to assess the environmental impact of drilling operations at the Troll field, focusing on greenhouse gas (GHG) emissions. The scope includes all activities related to drilling, such as equipment manufacturing, transportation, energy use during drilling, and waste management. The functional unit is defined as the drilling of one well at the Troll field (Kg CO_2/m^3).

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2.2. Inventory Analysis

The inventory analysis involves collecting data on energy consumption, material inputs, emissions, and waste generation associated with drilling activities. Data sources include field reports, equipment specifications, and industry databases. The inventory also considers emissions from transportation and logistics, as well as the production and disposal of drilling fluids and cuttings.

2.3. Impact Assessment

In the impact assessment phase, the collected data are used to calculate the environmental impacts, focusing on GHG emissions (CO2, CH4, and N2O) and energy consumption. The assessment employs standardized LCA software and databases to model the environmental impacts based on the inventory data.

2.4. Interpretation

The interpretation phase involves analyzing the results of the impact assessment to identify key contributors to environmental impacts. This phase also includes sensitivity analysis to determine the effect of different assumptions and scenarios on the results. The findings provide insights into areas where improvements can be made to reduce the environmental footprint of drilling operations.

3. Case Study: Troll Field, Norway

3.1. Background

The Troll field, discovered in 1979, is one of the largest gas fields on the Norwegian Continental Shelf, with substantial reserves of natural gas and oil. Managed by Equinor, the field has been a major contributor to Norway's energy exports for decades. As the industry shifts toward sustainability, the Troll field has set a target to reduce its emissions significantly, ultimately aiming for net-zero emissions by 2050.

3.2. Baker Hughes' Contribution to Efficient Drilling

Baker Hughes has been a key partner in the Troll field's journey toward sustainability, providing a range of advanced technologies and services to enhance drilling efficiency: -

Advanced Drilling Technologies: Baker Hughes deployed its rotary steerable systems, advanced drill bits, and wellbore placement technologies at the Troll field. These innovations enable precise wellbore targeting, reducing the time and energy required for drilling operations. As a result, there is a significant reduction in emissions associated with drilling activities. –

Digital Solutions: The integration of digital tools such as remote operations, real-time data analytics, and predictive maintenance has allowed for more efficient operations at the Troll field. These solutions have minimized downtime, reduced the need for on-site personnel, and optimized energy use, contributing to lower carbon emissions.

Energy Efficiency Initiatives: Baker Hughes' focus on energy efficiency in drilling operations has led to reduced fuel consumption and lower emissions. By optimizing the energy use of drilling rigs and other equipment, the overall carbon footprint of the drilling process has been minimized.

3.3. LCA Results and Discussion

The LCA of drilling operations at the Troll field highlights the environmental benefits of the technologies and practices implemented by Baker Hughes. The results indicate a substantial reduction in GHG emissions per well drilled, attributed to both the efficiency gains from advanced drilling technologies and the impact of digital solutions. The analysis also shows that energy consumption is a critical factor in the overall environmental impact of drilling operations. Baker Hughes' efforts to optimize energy use have proven effective in reducing the field's carbon footprint. Additionally, the LCA identifies opportunities for further improvements, such as adopting alternative energy sources for drilling rigs and enhancing waste management practices.

4. Conclusion

The Troll field's journey toward net-zero emissions is a testament to the power of innovation and collaboration in the oil and gas industry. Baker Hughes has played a crucial role in this journey, providing advanced drilling technologies,

digital solutions, and energy-efficient practices that have significantly reduced the environmental impact of drilling operations. The life cycle analysis conducted in this study underscores the importance of these contributions, demonstrating tangible reductions in GHG emissions and identifying pathways for continued improvement. As the industry continues to evolve, the case of the Troll field serves as a model for other operations seeking to balance energy production with environmental sustainability. The partnership between Equinor and Baker Hughes exemplifies how technology and innovation can drive the oil and gas sector toward a more sustainable future.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed. The paper has been presented at American Petroleum Institute Sub-Committee.

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