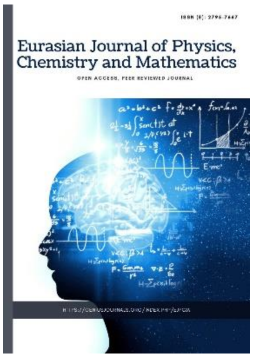

Combating Disasters in Oil and Gas Well Drilling

Mansurov Aziz Abdukarimovich
Teacher, Tashkent State Technical University

ABSTRACT

This article explores the key strategies and technologies used to combat disasters in oil and gas well drilling. These disasters can include blowouts, equipment failure, and environmental hazards. Innovations in real-time monitoring, advanced blowout preventers, and improved safety protocols are discussed in detail. This paper aims to provide insights into current best practices and future directions for improving safety in oil and gas extraction.

Keywords: Oil well drilling, disasters, blowout preventers, real-time monitoring, safety protocols

Introduction

Oil and gas drilling is a complex and high-risk operation, where the potential for disasters such as blowouts, equipment failure, and environmental hazards is ever-present. While technological advancements have improved the safety of drilling operations, incidents continue to occur, often with catastrophic consequences. This paper examines the main types of disasters that can happen during oil and gas well drilling and discusses the modern innovations and strategies employed to mitigate these risks.

Methods

Today, oil and gas wells are capital expensive structures that serve for many decades. This is achieved by connecting the productive formation with the day surface with a sealed, strong and durable channel. However, the drilled wellbore does not yet represent such a channel, due to the instability of rocks, the presence of layers saturated with various fluids (water, oil, gas and their mixtures), which are under different pressures. Therefore, when constructing a well, it is necessary to strengthen its barrel and separate (isolate) the layers containing different fluids.

The wellbore is secured by lowering special pipes into it, called casing. A series of casing pipes connected in series with each other makes up a casing column. Steel casing pipes are used to secure wells.

The layers saturated with various fluids are separated by impermeable rocks - "tires". When drilling a well, these impermeable isolating seals are damaged, creating the possibility of interlayer flows, spontaneous outflow of formation fluids to the surface, flooding of productive formations, contamination of water supply sources and the atmosphere, corrosion of casing strings lowered into the well.

During the drilling of a well in unstable rocks, intensive cavern formation, caving, collapses, etc. are possible. In some cases, further deepening of the wellbore becomes impossible without preliminary reinforcement of its walls.

To eliminate such phenomena, the annular channel (annular space) between the wall of the well and the casing string lowered into it is filled with plugging (insulating) material. These are compositions that include a binder, inert and active fillers, chemical reagents. They are prepared in the form of solutions (usually aqueous) and pumped into the well. Of the binders, portland cements are most widely used. Therefore, the process of separating the layers is called cementing.

Thus, as a result of drilling the wellbore, its subsequent fastening and separating the layers, a stable underground structure is created.

The wellbore design is understood as a set of data on the number and sizes (diameter and length) of casing strings, the diameters of the wellbore for each string, cementing intervals, as well as the methods and intervals of connecting the well to the productive formation.

Information on the diameters, wall thicknesses and steel grades of casing pipes by intervals, on the types of casing pipes, equipment of the bottom of the casing string are included in the concept of the casing string design.

Casing strings of a specific purpose are lowered into the well: conductor, conductor, intermediate strings, production string.

The conductor is lowered into the well to prevent erosion and collapse of rocks around the wellhead when drilling under the conductor, as well as to connect the well to the drilling mud cleaning system. The annular space behind the direction is filled along the entire length with cement slurry or concrete. The direction is lowered to a depth of several meters in stable rocks, to tens of meters in swamps and silty soils.

The conductor usually covers the upper part of the geological section, where there are unstable rocks, layers that absorb drilling mud or show, supplying formation fluids to the surface, i.e. all those intervals that will complicate the process of further drilling and cause pollution of the environment. The conductor must necessarily cover all layers saturated with fresh water.

An accident is an unexpected disruption in the continuity of the technological process of drilling or testing wells, requiring special work to eliminate it, not provided for by the project. Typical types of accidents are breakage of drill or casing columns with individual elements left in the wellbore, loss of mobility of pipe columns, crushing or damage to casing columns, etc. Accidents occur when working in difficult conditions. If the complication is not eliminated, it may cause an accident.

A complication is a disruption of the normal state of a well, as a result of which further deepening is difficult or must be temporarily stopped to avoid an accident. Complications as disruptions in the continuity of the technological process of well construction are caused by mining and geological phenomena. These are absorption of solutions, oil, gas and water shows, emissions and open fountains of oil, gas or water, rock falls and collapses in the wellbore, etc.

In accordance with the instructions for the classification, investigation and accounting of accidents during drilling of oil and gas wells [1, 2], all accidents are divided into the following types:

- accidents with drill string elements;
- stuck drill strings and casing strings;
- accidents with bits;
- accidents with casing strings and their equipment elements;
- accidents due to unsuccessful cementing;
- accidents with downhole motors;
- falling of foreign objects into the well;The analysis in this article is based on a review of case studies from major oil and gas drilling incidents, as well as an overview of the latest technological advancements in safety and disaster prevention. Data from both historical and contemporary sources were analyzed to identify key trends and emerging technologies that have the potential to significantly reduce disaster risks.

Results

Our findings indicate that real-time monitoring systems, such as those using IoT sensors, have significantly enhanced early detection of potential issues during drilling operations. Advanced blowout preventers (BOPs) with automatic shut-off systems are now more effective in controlling sudden pressure surges. Improved safety protocols and regular staff training have also played a crucial role in reducing the frequency and severity of disasters.

Discussion

The findings of this study suggest that while technological advancements have substantially mitigated some risks, human error remains a major factor in drilling-related disasters. Therefore, alongside technological innovation, emphasis on improving training programs and safety culture within organizations is essential for minimizing the risk of future incidents. Additionally, collaboration between industry leaders and regulatory bodies will be key to ensuring that safety standards continue to evolve.

Conclusion

In conclusion, combating disasters in oil and gas well drilling requires a multifaceted approach involving technological innovation, regulatory oversight, and organizational safety culture. While significant progress has been made in reducing disaster risks, ongoing efforts to improve both technology and training are needed to further enhance the safety of drilling operations.

References

1. G. King. Safety and Risk Management in Oil Well Drilling. Journal of Petroleum Technology, 2016.
2. J. Smith, K. Patel. Advanced Blowout Prevention Systems: A Review. Oil and Gas Research Journal, 2018.
3. M. Chang, S. Roberts. Real-time Monitoring in Drilling Operations: Technologies and Applications. Energy Reports, 2020.
4. Instructions for classification, investigation and recording of accidents during drilling of oil and gas wells. - M.: VNIIOENG, 1979. - 26 p.
5. Samotoy A.K. Prevention and elimination of pipe sticking during well drilling. - M.: Nedra, 1979. - 188 p.
6. Pustovoytenko I.P. Prevention and elimination of accidents in drilling. - M.: Nedra, 1988. - 279 p.