Impact of Ambyint's Machine Learning Closed Loop Optimization System on Horizontal Bakken Wells: Failure Analysis Case Study

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Failure rate analysis is a critical aspect of production engineering workflows that is conducted to evaluate the effectiveness of artificial lift designs, treatment programs and optimization technologies in order to determine where to drive operational excellence improvements. Methodologies to calculate Mean Time Between Failures and Failure Frequency vary between different operators leading to a lack of standardization across the industry. A robust, methodological approach to failure rate analysis is a critical need for operational success of artificial lift programs, the lack of which lead to higher operating costs and deferred production.

Ambyint's production optimization solution utilizes an autonomous closed loop edge device which works with existing pumpoff controllers to gather data and uses cloud-based machine learning algorithms to remotely analyze and optimize wells. Based on successful deployment in the Bakken over the period of 3 years Ambyint has developed an objective methodology to quantify the impact of closed loop optimization on failure rates.

The machine learning model dynamically classifies the operating state of a well into three categories: overpumping, underpumping and dialed-in. Based on this classification, an optimization algorithm adjusts the speed set points of the variable frequency drive (VFD) and pump off controller (POC) to continually keep the oil well in "dialed-in" or optimized state. For wells that are under-pumping, Ambyint is able to increase oil production. Whereas for over-pumping wells, Ambyint is able to decrease the number of strokes and increase pump efficiency while maintaining production. The purpose of this autonomous optimization model is to operate wells at peak efficiency. Increasing production and pump efficiency

significantly increases operator revenue. Reducing redundant strokes and detrimental pump offs is essential to extending the life of downhole equipment and reducing failures and therefore lowering OPEX.

This paper presents two different methodologies, which greatly increase the effectiveness of any failure analysis program. Unique to these methodologies is the inclusion of running lifespans. A ‘running lifespan’ is defined as the runtime of a well which has not failed at the time when the failure analysis is conducted. Running lifespans are usually not included in failure analysis, which results in inaccurate models since only wells that have failed are considered. This means that a well with a runtime of several years that has not failed is not included in the failure analysis, even if its runtime is greater than the previous runtime before the last failure. In this new approach, Mean Time Between Failures (MTBF) and Failure Frequency (FF) models are modified to include running lifespans and incomplete lifespans.

Results from the failure analysis study are presented with a scientific approach to quantify the impact of autonomous optimization and demonstrated the impact of such technologies to significantly improve Meantime Between Failures and Failure Frequency. Additionally, the paper outlines the workflow for structuring failure data, validating runtimes and correcting data anomalies before conducting failure analysis.