CASE STUDY | AI for Predictive Maintenance
Offshore production platform

Fault finding for rotating equipment on an upstream platform

Detecting a faulty temperature probe reduces the need for unplanned shutdown and gas flaring

Shell is comprised of a global group of energy and petrochemical companies with more than 80,000 employees in over 70 countries.

A Shell high-pressure, high-temperature oil and gas field asset team wanted proactive ways to discover and mitigate failures before they occurred.

The team selected the Shell Predictive Maintenance for Rotating Equipment application on the C3 AI Suite to deploy a scalable predictive maintenance solution. This solution would enable the team to predict the expected behaviour of centrifugal compressors at this upstream asset. The software flags anomalous behaviour for review by remote or onsite engineers who can pre-emptively address potential failures.

Project Objectives

An artificial intelligence diagnostic approach was applied at the platform to improve reliability and availability at this high-value production asset. Minimising unplanned downtime is a key objective in oil and gas production and a crucial factor in maximising operational efficiency.

Every Shell asset gathers huge volumes of data, too much for human engineers to analyse, but, by using the Shell Predictive Maintenance for Rotating Equipment application, engineers can predict and prevent equipment trips, thereby helping assets to achieve their full potential for reliability.

When process equipment malfunctions, the costs of production deferment and the environmental impact can be substantial. Predicting and helping to avoid critical equipment malfunction trips cuts waste, enhances process safety and protects the environment.

Results Summary

- Avoided the potential need for unplanned shutdown of the platform's gas compressors.
- Potentially prevented the risk of unnecessary flaring for maintenance from this event.
- Identified the problem more quickly than a conventional fault-tracking system.
- Key enabler for effective maintenance planning for major equipment.

Challenge

In October 2019, the Predictive Maintenance for Rotating Equipment application flagged an anomaly related to the temperature of the gearbox on the flash gas compressor at the platform. Flash gas compressors are used to compress gas that "flashes" from a hydrocarbon liquid when the liquid flows from the high- to the low-pressure separators.

Flash gas compressors typically handle low flow rates and produce high compression ratios. After compression, the gas can be exported for sale.

The Shell Predictive Maintenance for Rotating Equipment application generated an alert which prompted the asset team to investigate whether the anomaly was due to a problem in the gearbox or a defect in the temperature probe.

Approach

The platform in question was the first in Shell's portfolio to adopt an AI based approach to monitoring the condition of rotating equipment through a proof-of-concept project in 2018.

The Shell Predictive Maintenance for Rotating Equipment application on the C3.ai platform flagged a problem relating to the platform's flash gas compressor and reported this issue to an off-site engineer. The engineer assessed the alert and raised it with the platform's operations team, thus prompting them to diagnose the root cause of the problem and plan the correct maintenance.

The team on the platform analysed the bearing temperatures across the gearbox and established that the anomaly was due to a defect in the temperature instrument rather than the gearbox. Through a declining temperature indication, the site team was alerted to a damaged temperature indication on this side of the gearbox. Upon analysis, a team of remote experts, a recommendation was made to inspect and replace the temperature probe.

This intervention meant that proactive maintenance could be carried out on the faulty probe during an opportune window and enabled accurate detection of bearing temperatures in the gearbox.

Early warning and correct identification of the problem with the temperature probe meant that the team could adequately plan to carry out intrusive work on the flash gas compressor and avoid unnecessary flaring for maintenance work.

Application Highlights

- Successfully deployed in assets ranging from upstream to petrochemicals
- Works without investments in machine monitoring hardware
- Monitoring dozens of pumps, compressors and turbines every day in Shell
- Once data pipelines have been set up, additional equipment can be deployed within a week
- Designed for remote monitoring
- Designed using ML models and preconfigured algorithms tailored for rotating equipment and codified rotating equipment expert knowledge

Results

This intervention meant that proactive maintenance could be carried out on the faulty probe during an opportune window and enabled accurate detection of bearing temperatures in the gearbox.

Early warning and correct identification of the problem with the temperature probe meant that the team could adequately plan to carry out intrusive work on the flash gas compressor and avoid unnecessary flaring for maintenance work.

With Shell Predictive Maintenance Rotating Equipment, operators can:

- Monitor the health of key rotating equipment classes including centrifugal pumps, centrifugal compressors, dry gas seals and turbines, and mitigate their failure risk in advance through AI-driven alerts.
- Leverage specialist knowledge by using codified rotating equipment expert insights to detect anomaly events, assess possible causes and recommend preventative measures.
- Detect deviations from the baseline through AI alerts that indicate a potential fault in rotating equipment.
- Deploy and monitor machine learning models tailored for rotating equipment with preconfigured algorithms, hyperparameters and thresholds to reduce false positives.
- Understand rotating equipment health at enterprise scale, with simple and extensible rotating equipment onboarding process, asset templates, documentation and monitoring tools.
- Enable engineers to intervene before issues become uptime problems.
- Improve turnaround efficiency and focus areas by using a data-driven approach that highlights deviations between target and actual behaviors to prioritize maintenance tasks.
- Seamlessly embed insights on rotating equipment performance into BHC3 Reliability and exception based surveillance workflows.

Shell Predictive Maintenance Rotating Equipment Enhances Plant Performance

- Enable early detection of anomalies to reduce unscheduled deferment and unplanned downtime, increasing availability.
- Reduce maintenance costs through timely intervention.
- Provide assurance on the state of the equipment by generating a target behavior profile to support equipment care strategies and reduce preventive maintenance cost.
- Improve productivity, availability and performance of rotating equipment.