**CASE STUDY | AI for Predictive Maintenance**
Deepwater production platform

# Diagnosis for a process-critical temperature control valve

Enhancing reliability and availability for an oil and gas producing asset in the Gulf of Mexico

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

A Shell deepwater production platform, asset team wanted proactive ways to discover and mitigate failures before they occurred. The team selected the Shell Predictive Maintenance for Control Valves application on the BHC3 AI Suite to deploy a scalable predictive maintenance solution.

## Project Objectives

An artificial intelligence (AI) 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.

In this case, the Shell Predictive Maintenance for Control Valves application identified a problem, which was then diagnosed as hunting behaviour in a temperature control valve. This enabled the process control team to correct the behaviour. Predictive maintenance methods based on advanced data analytics and machine learning techniques for monitoring can help to prevent unscheduled deferment and enable smarter maintenance scheduling.

Using this solution, which has proven its value across multiple Shell assets, they can now implement machine learning models at scale to predict the expected behaviour of control valves at this upstream asset. The software flags any anomalous behaviour to remote or onsite engineers who can pre-emptively address failures.

## Results Summary

- Extended control valve life
- Enhanced process stability
- Avoided potential pressure and/or temperature related trips on the main gas compressor
- Increased production by reducing unplanned downtime

## Application Highlights

- Successfully deployed in assets ranging from upstream to petrochemicals
- Works on control valves of any type and age without additional hardware
- Monitoring more than 5000 control valves every day in Shell
- High level of automation makes it possible to deploy 100+ models in a day
- Designed for remote monitoring

## With Shell Predictive Maintenance for Control Valves, energy companies can:

- Enable early detection of anomalies to reduce unscheduled deferment and unplanned downtime, ultimately increasing availability.
- Reduce maintenance costs through timely intervention.
- Provide assurance on the state of the equipment to support proactive equipment care strategies and reduce maintenance costs
- Improve productivity, availability and performance of control valves.

## With Shell Predictive Maintenance for Control Valves, operators can:

- Monitor the health of control valves and associated instrumentation, identify assets at risk in advance, and mitigate risks through AI-driven alerts.
- Embed specialist knowledge using instrument engineers' expert knowledge about the equipment to tune model training and alerting.
- Compare multiple automatically trained models to select the best performing models to use for monitoring.
- Understand control valve health at enterprise scale with simple and extensible valve onboarding process and monitoring tools.
- Enable engineers to intervene early and take preventative action.
- Improve turnaround efficiency and focus areas by using a data-driven approach to prioritize equipment and maintenance tasks.
- Seamlessly embed insights on control valve performance into BHC3.ai Reliability and asset exception based surveillance workflows.

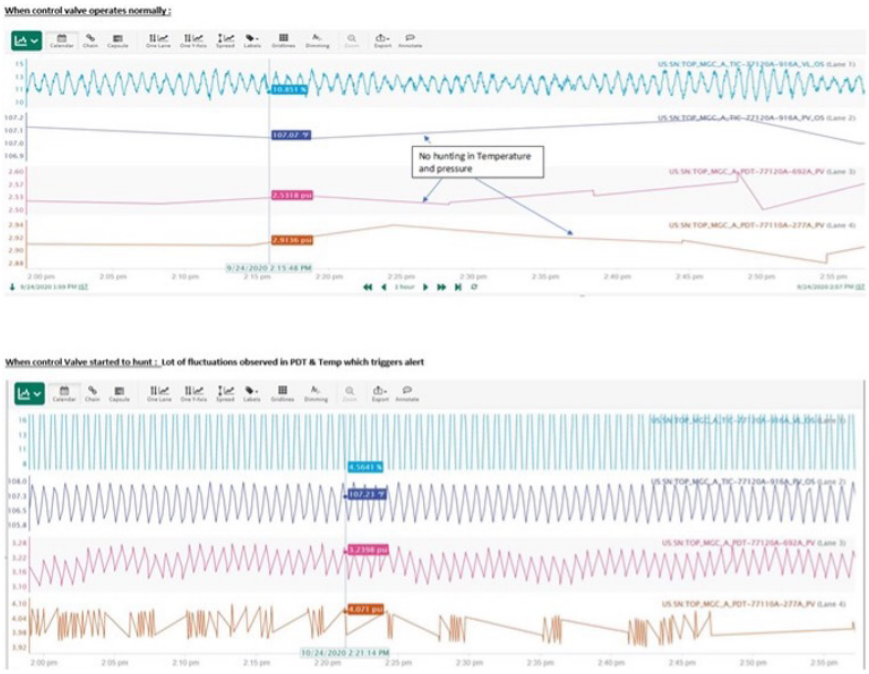


**FIGURE 1:**
The contrast between normal operation for the control valve (a) and when it exhibits hunting behaviour (b).

# Challenge

The Shell assets in this region had an availability gap to potential; reviews of previous downtime incidents indicated that the performance and reliability of control valves were factors. Maintenance on deepwater platforms requires careful planning to ensure that the work can be executed safely and successfully, so the ability to predict failures before they happen is particularly valuable.

The team implemented the Shell Predictive Maintenance for Control Valves application, an approach that had been applied successfully at other Shell locations, including a major refinery.

During the initial pilot project, the application detected minor issues that proved that the application worked. Shell decided to replicate the system across its entire asset base in the region.

# Approach

The platform has a few dozen critical control valves, fewer than in a typical refinery, but each has an important part to play in oil and gas production.

Within a few weeks of the application's installation, the Shell Predictive Maintenance for Control Valves application raised a preliminary alert that indicated abnormal performance in a temperature control valve associated with the main gas compressor. The alert showed that the control signal was fluctuating widely, as the control valve was opening and closing frequently, what engineers describe as valve hunting (Figure 1). The report, though based on AI monitoring on the C3.ai platform, was integrated into a standard reporting and alerting process that was already being used for rule-based alerts.

A predictive maintenance engineer, remotely based in India, reviewed this preliminary alert and raised it for escalation to the operations team in New Orleans, USA. There, the team recognised that the control valve in question had the potential to trip the main gas compressor. Consequently, they recommended that offshore technicians should check valve linkages, performance and tuning parameters.

This would have been difficult to detect using traditional monitoring methods. The valve and base layer performance monitoring tool did not flag this as an issue, because the valve was able to maintain setpoint, and to remain in automatic mode. As the valve was controlling the temperature within the operating envelope, the process alarm limits were not reached and, thus, not yet flagged in the alarm management system.

In addition, typical asset management systems would not have identified this as an issue because these systems look at the performance of the valve and actuator. In this case there were no functional issues with the valve or the actuator.

The root cause in this case was not a hardware issue, rather it was because the tuning parameters in the control valve software were off. The operations team was able to fix the issue without sending anyone to the platform. A simple adjustment of the parameters in the valve software reduced valve movement by 3,000%, thereby extending the lifetime of the component and substantially increasing process stability. Without software adjustment, the control valve could have tripped the main gas compressor. This would have resulted in two or more days of lost production as the compressor would need to have been checked and restarted.

**Results**

- Diagnosed hunting behaviour in a process-critical temperature control valve within a few weeks of installing the C3 system.
- Extended the working life of the control valve
- Enhanced process stability
- Avoided pressure and/or temperature related trips on the main gas compressor
- Increased production by reducing unplanned downtime due to valve failure