CASE STUDIES: APPLIED CONDITION MONITORING

Author: Carl Andre Olsen – ConditionALL AS

Date: Updated November 2025

INTRODUCTION 2
Case 1 : Gradual increase in torque 3
Case 2 : Water injection valve through leak 4
Case 3 : Valve is operated too often 5
Case 4 : Valve closing too fast 6
Case 5 : Rust inside actuator 7

INTRODUCTION

Critical valves, such as Emergency Shutdown (ESD) valves, blowdown valves, and HIPPS valves, play a fundamental role in maintaining operational integrity and safety in high-risk industries. Such as oil & gas, petrochemical, and power generation. Failures of these valves can lead to production downtime, safety incidents, and environmental hazards.

Condition monitoring systems (CMS) are employed to provide early warnings of valve degradation and ensure proactive maintenance. This collection of case studies gives examples of real issues found on valve assemblies using condition monitoring.

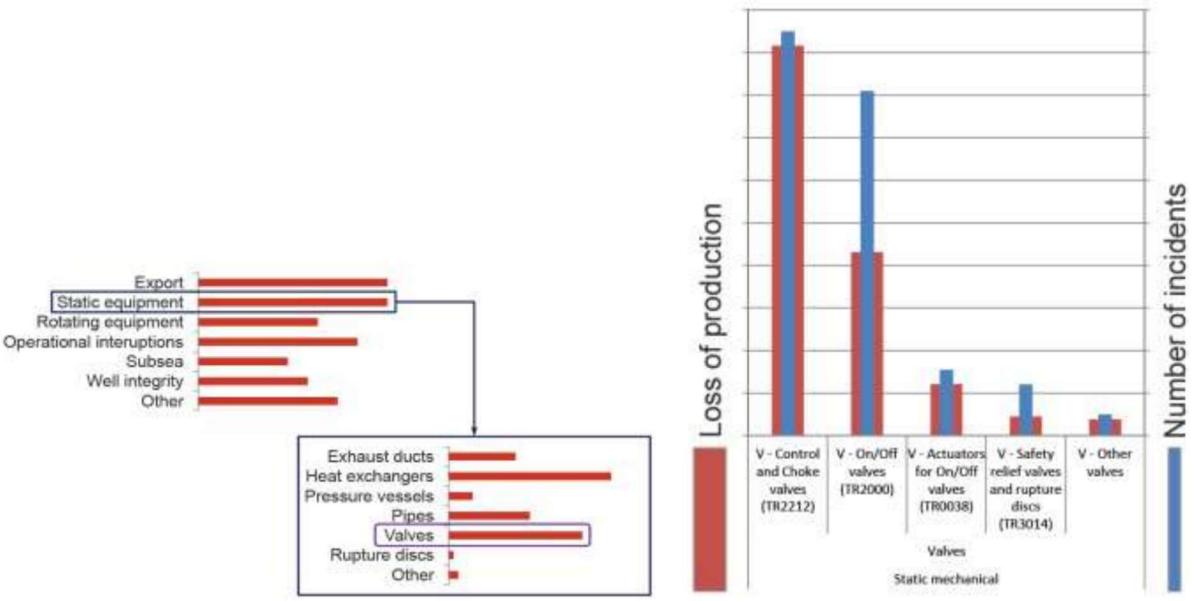

Figure 1 - Analysis of offshore equipment related to production losses (Equinor 2014)

On/off valve assemblies typically represent a major loss of production, but monitoring is not as widespread as for control valves, where lots of solutions are available.

CASE 1 : GRADUAL INCREASE IN TORQUE

A condensate pipeline, downstream from an ESV (Emergency Shutdown Valve), bursted. Causing a leak of ca 8 kg/s for a while, because the ESV that was the isolation barrier for the separator did not close.

The ESV is a ball valve with a pneumatic, spring return actuator, fail to closed.

Figure 2 - Emergency Shutdown valve for condensate after 1st stage separator

The monitoring system was active with analysis and data collection, but the end-user had not yet started using the system.

After the incident, various components in the facility was investigated by the police and government agencies, and data from the condition monitoring system shows that the ESV had developed more and more friction for each stroke since day 1 in operation.

Condition Monitoring benefit: If the condition monitoring system alerts had been forwarded to the systems the client used, they could have handled this issue much earlier. Only using the limit switches to calculate the travel time of the valve, would not have helped in this situation. The valve was stuck at 96% and after enough air was emptied, it slammed shut in less than a second.

CASE 2 : WATER INJECTION VALVE THROUGH LEAK

A water injection ESD (Emergency Shutdown) valve was leaking water into the oil-well while closed. This leak was detected by our **acoustic leak sensor** mounted directly on the valve body, encased in insulation. Location is inside the red circle in figure 3.

Figure 3 - Insulated water injection valve with acoustic leak sensor.

The leakage at the time of the discovery was small enough to continue production, without serious losses. If the leak had not been discovered earlier the initial leak at this pressure would lead to erosion and cavitation, that would worsen the leak exponentially, until the production would have gotten a huge hit from all the water pushed into the well.

Condition Monitoring benefits: Parts for the valve was ordered immediately after a borescope inspection had been made, verifying an issue with the valve seats. The valve was scheduled for maintenance very soon after, since the issue was developing. This issue could have caused major issues with the reservoir and production if not discovered soon enough.

CASE 3 : VALVE IS OPERATED TOO OFTEN

A flare valve offshore is operated too often because of new process conditions, compared to what it's designed for. To keep the SIL level up, the facility owner decided to install monitoring on the valve, to prove the function.

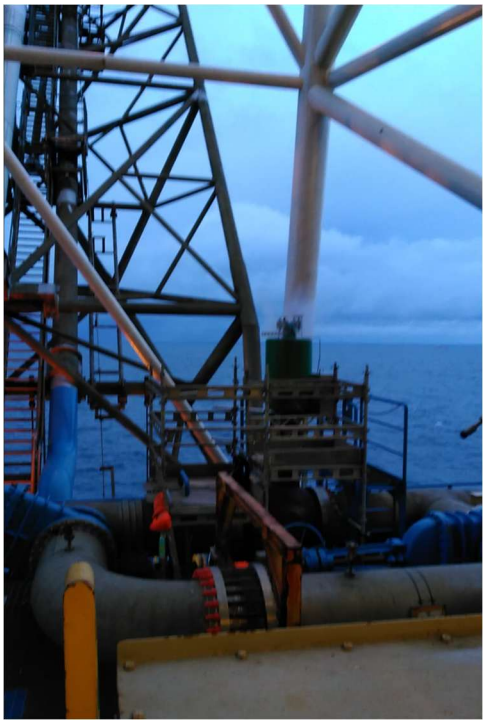

Figure 4 - Blowdown flare valve offshore during condition monitoring system installation

To get online travel times, forces and travel curve analysis an **actuator pressure sensor**, **a force sensor** and a **position monitor** was retrofitted onto the valve.

Condition Monitoring benefits: The alternative to monitoring the condition of the valve assembly was to increase the maintenance interval. The cost of doing increased maintenance would be greater than the cost of installing a monitoring system and keeping the original maintenance interval.

CASE 4 : VALVE CLOSING TOO FAST

A 4 inch full bore valve with monitoring, **actuator pressure sensor**, **valve force sensor** and valve cavity **acoustic leak monitor,** had undergone maintenance during a turnaround. The instrumentation had been upgraded and the valve now closed in less than 0.3 seconds.

This causes the seats to wear down quicker than planned for, and the valve is at an increased risk of passing or increased friction.

Figure 5 – The 4 inch ball valve closing much faster than both seats and stem is designed for

Because of logic delays and automatic functions in the DCS, this low travel time would not have been noticed by the DCS itself. After a conversation between ConditionALL and the instrument lead on the site, someone adjusted the instrument speed block so that the valve now closes in 2 seconds, reducing wear.

Condition Monitoring benefit: After monitoring hundreds of similar valves, this is a very common issue after modifying the instrumentation or trying to “fix” a valve that isn’t operating within limits. If a valve moves faster, it doesn’t mean that the friction and available force is better.

CASE 5 : RUST INSIDE ACTUATOR

Bad seals around a plate-cover on the actuator made water leak into the actuator and collect around the output shaft. After some cycles of drying and re-filling, the rust collecting inside was dried into the shaft collar and all the initial grease was washed away. The valve stem diameter is 3 inches and the ball valve bore is 24 inches.

This was detected as an actuator problem using **actuator pressure** and **force sensor.** Shortly after detecting the downwards trend of the functional margin in the actuator, the valve was stuck during a routine test. Since this is an emergency shutdown valve, this was a motivation to install monitoring in other facilities as well with the same valve+ actuator type.

Condition Monitoring benefit: The biggest impact condition monitoring had here, is that we could tell the issue was with the actuator, since the **force sensor** did not show increased valve friction. Saving the client from also doing work on the large valve.