

Case Study on V-MAP® Portable Test Unit



Innovative Test Unit helps customer avoid potential \$50m / day production losses

Background

Score were supplying a replacement actuator for the critical 36" 900# isolation ball valve located in a major UK pipeline. The pipeline transports oil and gas liquids from over 50 North Sea offshore fields with a nominal capacity in excess of one million barrels per day. Failure of this ball valve to operate during a safety critical shutdown, would cause major safety and environmental concerns as well as potentially huge profit losses, resulting from around \$50Million* per day in revenue reductions. (*at \$50/Barrel Equivalent)

The existing, original actuator had developed an external leak and, on further inspection, an internal leak across the piston. Score inspected the actuator and, after a comprehensive technical design review and investigation, concluded that there was a design flaw with the actuator piston cans. Had this actuator been left in service as it was, this could have resulted in a major safety incident and major losses. It was decided that a new design would be manufactured and installed by Score.

Challenges

The challenge for the client is that the safety and operation of the entire pipeline relies on the performance of this one critical valve. The functionality and performance of the new actuator therefore had to be tested and assured prior to supply, as well as its performance capabilities being tested, monitored, measured, and assured once it was installed on the valve and control system on site.

Due to the age of both the original and new actuators, the manufacturer had limited information on the torque output capability of this model of actuator and no torque data for this particular double piston, canted yolk design, making the required reassurances impossible to provide - especially using the usual industry standard "timed stroke tests" approach.

The client also had concerns about the condition and performance of the valve and the actuator control system, due to the length of time that it had been in service.

A new performance testing method was therefore needed to meet the assurance and integrity reliability required for this critical valve and actuator assembly as well as its control system.

Solution

Score recommended testing the actuator and valve assembly using Score Diagnostics Limited's V-MAP® Portable Monitoring Test Unit.



MIDAS® Sensor

The V-MAP® portable compact case can acquire data from 4-20 mA sensors and instruments, 0-5 Volt instruments, limit switches and torque, in order to monitor valve condition and performance, including through valve leak detection, quantification and trending, using Score's own unique MIDAS® Sensor.

This allows a fully flexible solution for condition monitoring, to create a bespoke test setup for any customer, on any valve type, at short notice, which can benchmark and trend performance over time.

V-MAP® Portable was used to record and display real time pressure from the hydraulic supply line, and across both actuator pistons. The valve analogue position was also observed throughout the entire valve stroke. During the in house actuator Factory Acceptance Testing, a duplicate stock valve, identical to the one installed onsite, was used to benchmark the actuator operating pressures. Using the pressure data and critical dimensions of the actuator components, Score Diagnostics Specialist Engineers were able to calculate the actuator output torques.



V-MAP® Portable Test Unit

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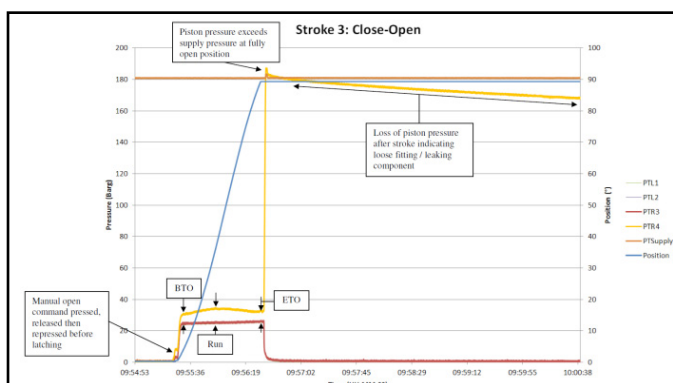
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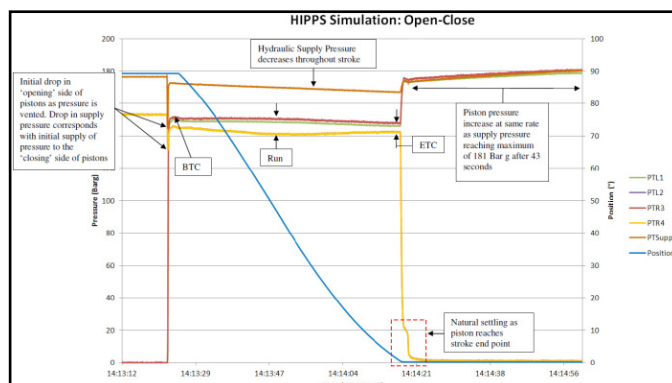
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Once the replacement actuator was assembled onto the valve, the V-MAP® Portable unit was again used on site to monitor the “as installed” performance of the actuator and its hydraulic control system. The valve/actuator assembly was first stroked to confirm that the actuator had been installed correctly and the travel stops were set to allow the correct 90° travel.

During this test, the V-MAP® Portable system identified that hydraulic pressure was leaking from the actuator control system during the opening stroke. Further investigation by the Score Diagnostics Specialist Engineer revealed a loose fitting which was not a suspected problem and, until closely inspected, showed no obvious signs of leak.



V-MAP® Portable Results Graph Identifying Loss of Pressure



V-MAP® Portable Analysis of Closure Stroke

The loose fitting problem was rectified before the actuator was monitored during an automatic valve closure stroke, which was initiated by a simulated “over pressurisation” of the pipeline. The V-MAP® Portable readings were used to monitor and confirm the valve response and closure times against the required performance standards and specifically the maximum allowable limits. The actuator output torques were then compared against the in house benchmarks to determine the condition of the valve onsite. This highlighted that the valve torque requirement was higher than expected throughout the entire valve stroke, but particularly during the mid point of the run, which was double the value observed during the in house benchmarking exercise. Although the torque was not yet significant enough to warrant an overhaul and repair of the valve, the results from the V MAP® Portable were an indication of valve condition/performance deterioration.

As an additional service, the Score Diagnostics Specialist Engineers performed a through valve leak detection survey, using Score’s MIDAS Meter®. This quick, non-invasive survey not only identified that the valve was leaking, but also highlighted that the main leak path was located at the 8 o’clock position of the upstream seat, showing possible damage to the leading edge of the ball bore. The ability of the MIDAS Meter® to quantify the leakage rate during testing enabled the customer’s onsite Maintenance Team Personnel to confidently make an informed evidence based decision quickly, on whether a maintenance intervention was required immediately or not. Since the reported leakage rate was still within the site’s design safety criteria, the decision was made to defer immediate intervention, but monitor the leakage rate change over time, to ensure that any required maintenance was carried out at the optimum time.

Conclusion

The condition and performance monitoring approach taken in this case study illustrates how important it is to be able to collect qualitative and quantitative evidence of in service valve condition, to ensure that valves, and their related equipment, operate correctly and safely within design limits and prescribed performance standards.



Had this testing not been carried out, an uncontrolled pressurised fluid release could have occurred, resulting in injury to personnel or a catastrophic failure of the hydraulic control system. The testing also highlighted and avoided significant risks of potential environmental damage and major losses resulting from production downtime.

The V-MAP® Portable and MIDAS Meter® results provided evidence that the valve was performing within the required and prescribed limits and operating correctly during a single stroke test. Additionally, the Score Diagnostics Specialist Engineers’ testing and analysis reports provided confidence that the actuator will operate the valve as expected and required, should an unplanned safety critical shutdown event occur in the forthcoming operational period.

Score Diagnostics Specialist Engineers recommended that regular valve condition monitoring be carried out to provide actionable evidence, allowing the onsite Maintenance Team Personnel to prioritise and plan targeted maintenance, well in advance of any failure. This simple and quick solution will reduce the likelihood of unplanned shutdowns, increasing efficiency which will maximise reliability and operating profits

Customer Feedback

“Both [Score Diagnostics Specialist Engineers] worked with motivation and flexibility far in excess of what would usually be expected of a vendor, and reflected excellently on Score. As a result, I am keen to further involve Score in other aspects of the pipeline and platform, and look forward to working closely in the future.”