Critical valve partial stroke testing using SVM

In this article, Richard Harvey (Rotork Fluid Systems) explains the increasing scope for critical duty valve testing provided by innovative partial stroke technologies.

What is SVM?

With many years experience as a leading manufacturer of heavy duty fluid power valve actuators for the international oil and gas industries, Rotork has first-hand knowledge of the importance of in-line valve testing to predict or prevent unplanned interruptions to production processes and the associated cost implications inherent in such interruptions. In critical valve duties including ESD (Emergency Shutdown), BDV (Blow Down), HIPPS (High Integrity Pressure Protection System) and SSIV (Sub Sea Isolation Valves) these breakdown cost implications are greatly magnified. It is therefore in most of these areas that the greatest attention has been paid to valve monitoring and partial stroke testing techniques.

Partial stroke testing is a technique that allows the operator to perform a diagnostic test on a valve without the need for a plant or process shut down. The majority of faults associated with isolating valves relate to the valve being in one position during long periods of inactivity. The operator can therefore verify operation by moving the valve by only a small percentage of its full travel.

Years of experience in the field has led to the development of the Rotork SVM (Smart Valve Monitoring) partial stroke critical valve testing system. The patented SVM technology performs real time partial stroke testing of the complete valve installation, enabling the user to assess not only whether the valve will open or close as required, but also the performance of all the final elements in the valve loop. The technology is unique amongst partial

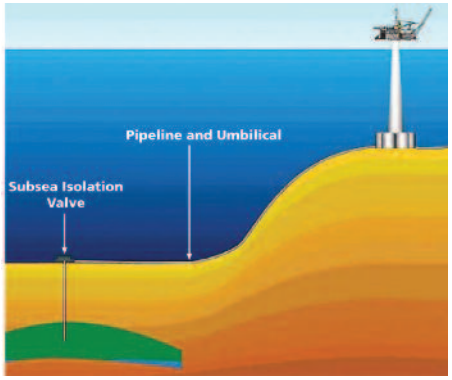

Fig.1: Typical SSIV installation configuration

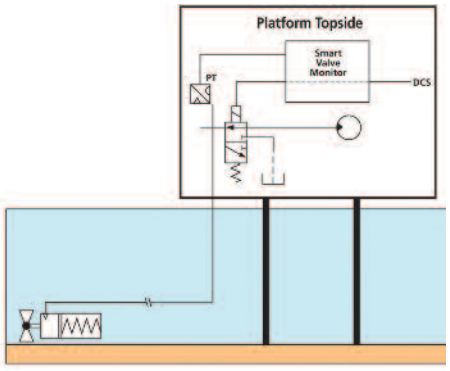

Fig. 2: Typical SVM system for SSIV

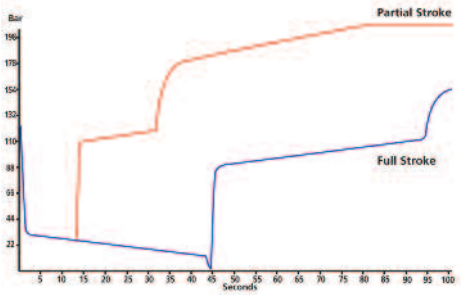

Fig. 3: Typical SSIV full and partial stroke curves

stroke testing techniques in that it does not alter the configuration of the valve in any way and, consequently, it cannot interfere with the normal operation of the valve. The technology has proved to be of great benefit in locations as disparate as Sakhalin Island and Saudi Arabia.

A "universal" solution

In any given plant there is always a diverse range of valves, actuators and control systems. One of the issues associated with partial stroke testing is therefore the need to test equipment from multiple manufacturers in a variety of configurations. The testing systems supplied by valve and actuator manufacturers tend to be specific to their own equipment, often dictating the requirement for several different test systems and protocols within a single plant, resulting in increased costs for procurement, installation, commissioning and user training.

The Rotork SVM system uses a different approach, consisting of a control unit that connects to the power supply of the actuator solenoid valve, and a pressure transmitter to provide feedback for the analysis of valve performance. There is no direct interaction with either the valve or the actuator and the installation can have no possible effect on the normal operation of the valve. According to Rotork, this design feature is unique among partial stroke testing techniques, enabling the system to be used on all valve types and virtually any fluid power valve actuator – quarter-turn or linear, pneumatic or hydraulic, spring-return or double-acting. The system can be either mounted in a hazardous area near the valve or remotely in a safe area, such as the control room. This flexibility is facilitated by the fact that the SVM does not mount directly on the actuator, valve or associated controls. Furthermore, any changes to the configuration of these components will not affect the manner in which tests are conducted.

In a typical test sequence, the SVM will de-energise the solenoid valve and monitor the pressure transmitter for a fixed time, set during the SVM commissioning process and relating to the percentage of valve test movement required. Once the required time is reached the solenoid valve is re-energised and the valve will return to its original position.

Application – SSIV

Historically, Sub Sea Isolation Valves (SSIV) have not utilised partial stroke testing because the benefit provided by the limited scope of available testing techniques was not sufficient to offset the installation costs associated with the shut down and diving required to attach control and monitoring equipment directly to the actuator and valve. This is a major potential problem for operators because the failure of an SSIV presents a significant maintenance task. Ideally, operators should be able to diagnose potential failures well in advance to allow for more strategically planned preventative maintenance routines.

In a typical SSIV installation, all the hydraulic and control signals from the platform are routed through the umbilical, as shown in Figure 1. The SVM system connects only to the hydraulic instrument supply and solenoid operating supply with nothing fitted to either the valve or the actuator. This ensures that all test equipment can be located topside, enabling easy installation on existing SSIVs. The use of SVM on SSIVs is further facilitated by the fact that most SSIV actuators are hydraulically operated. Since hydraulic fluid is non-compressible, there is no loss of resolution of data when monitoring is performed topside, as represented in Figure 2.

The graph in Figure 3 shows full and partial stroke curves for the SSIV. The re-opening cycle of the valve is also shown to give the operator increased diagnostic capabilities. In this case, the valve is fully closed after 43 seconds and the partial stroke is conducted for 14 seconds, representing approximately 33% of the full stroke.

Conclusion

With the Smart Valve Monitor, critical valves – including sub-sea valves – can now be partial stroke tested to provide key performance data essential for strategic planning and maintenance activities. The process is entirely transparent to normal valve operation and tests all the final valve elements as required by IEC 61508. In addition to facilitating strategic maintenance and extending the periods between shut down intervals, the process also assists with SIL compliance.

About the author

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