FINAL ELEMENT TESTING A WAY FORWARD

Derek Essam
Director
Sales & Marketing
Drallim Industries Ltd
Bexhill UK

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Abstract

A significant problem associated with the testing of final elements (Emergency Isolation Valves (EIV's)) within IEC 61508, is with the current methods of testing.

Introduction

A final element within the Safety Instrumented System (SIS) i.e. an EIV is usually a discrete device with either an open or closed state. This device itself is usually controlled from another discrete operating device, such as a Solenoid Valve (SOV). Fig 1. To ensure the functionality of these devices, it is essential that they are tested to ensure that their Probability of Failure (PFD) is kept to a minimum in relation to the Safety Integrity Level (SIL) associated with the EIV. Given that the devices only have an open or closed state, indicates that to test them, they have to move in one continuous movement from open to closed. The practicality of moving the devices, particularly the EIV to its closed state, within a continuous process environment leaves a lot to be desired.

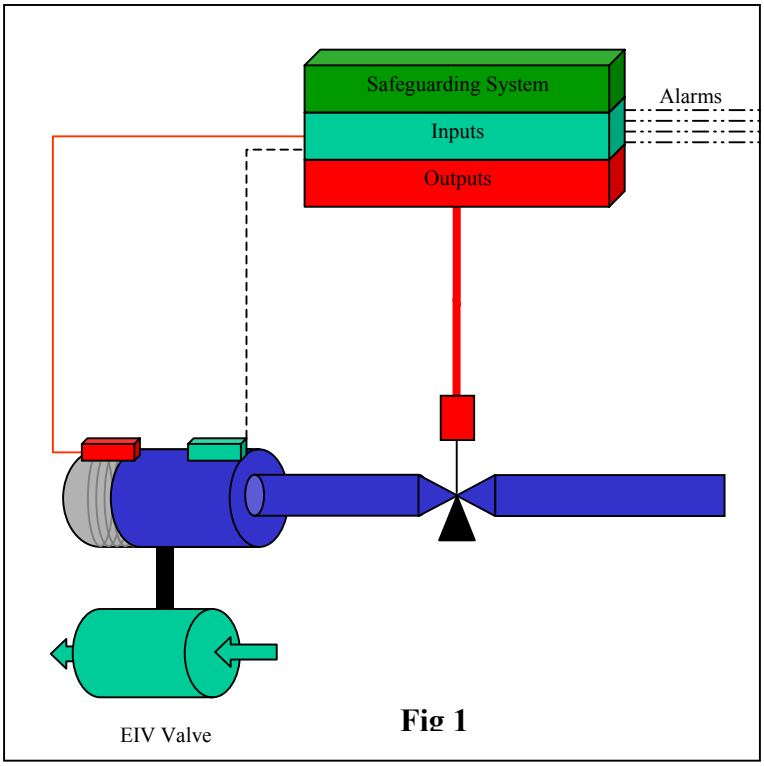

Fig 1

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Methods exist whereby it is possible to control the movement of the EIV, by introducing a feedback loop system to lower the pressure within the actuator until movement is detected, this method of testing is known proportional control; typically used in the control of process control valves. In order however to implement a testing regime using proportional control Fig 2 techniques it usually involves the introduction of additional components to the EIV.

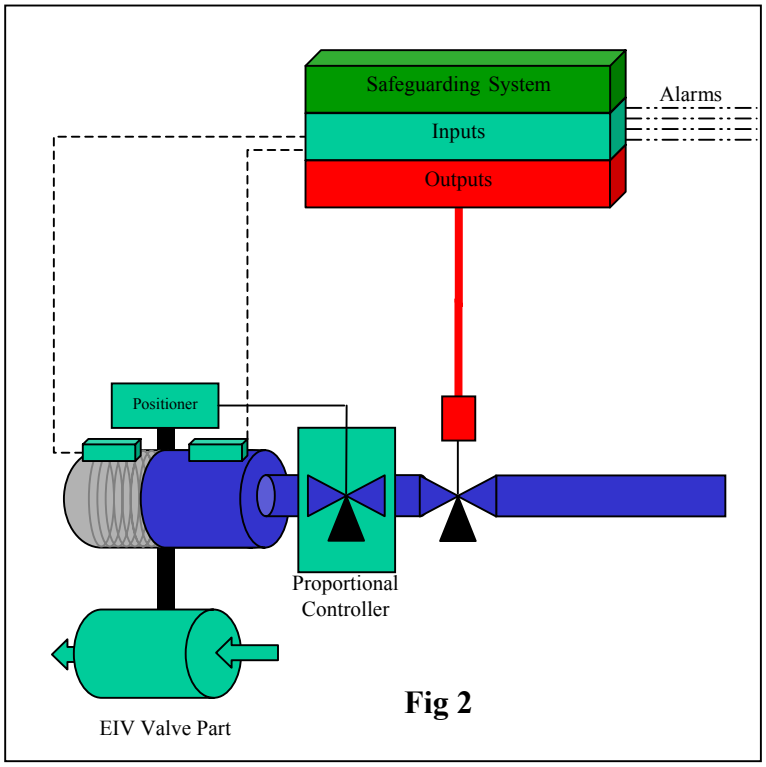

Fig 2

The addition of any components to the EIV will add to the PFD and subsequently will itself become part of the SIS and therefore needs to meet its own safety criteria i.e. at what SIL level can it be used. Additional problems occur in the proportional control method in that the test is artificial to the real world operation of the EIV.

Take the case of a High Integrity Protection System (HIPS) EIV that needs to close in say less than 1 second. The application of proportional control to a valve of this kind, means that the test could take as much as 2 or 3 times that of the operating speed of the EIV. What is actually desired is to test the EIV within a part of its normal operating speed Fig 3.

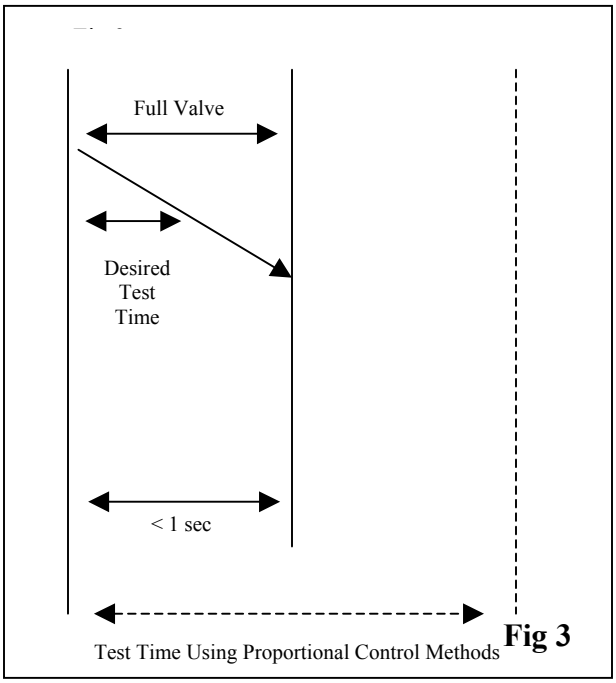

Fig 3

A way forward therefore is to devise a testing mechanism that in itself forms no part of the SIS, yet tests the devices under their normal operating conditions.

This can be achieved by the Safeguarding System powering the testing mechanism to apply a test to the discrete devices EIV and SOV. Arranged in this way the Safeguarding system always has control over the testing mechanism. Additionally the inserting of the Pressure Transducer does not add to the PFD. Fig 4

A way of achieving such a test would be to record the operation of the devices under normal operating conditions, by using [Reference I] non-invasive, non-contact, detection methods (already practiced in other industries) to detect out-of-normal conditions. The non-contact approach is achieved by connecting a pressure sensor in the supply line to the EIV's actuator Fig 4

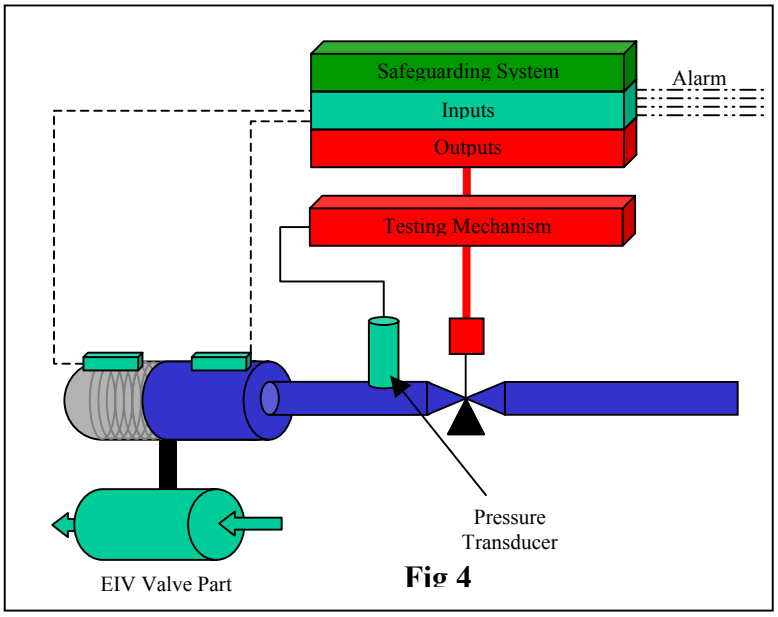

Fig 4

By observing voltage changes from pressure sensor as the pressure leaves and enters the EIV's actuator, we can create a signature Fig 5

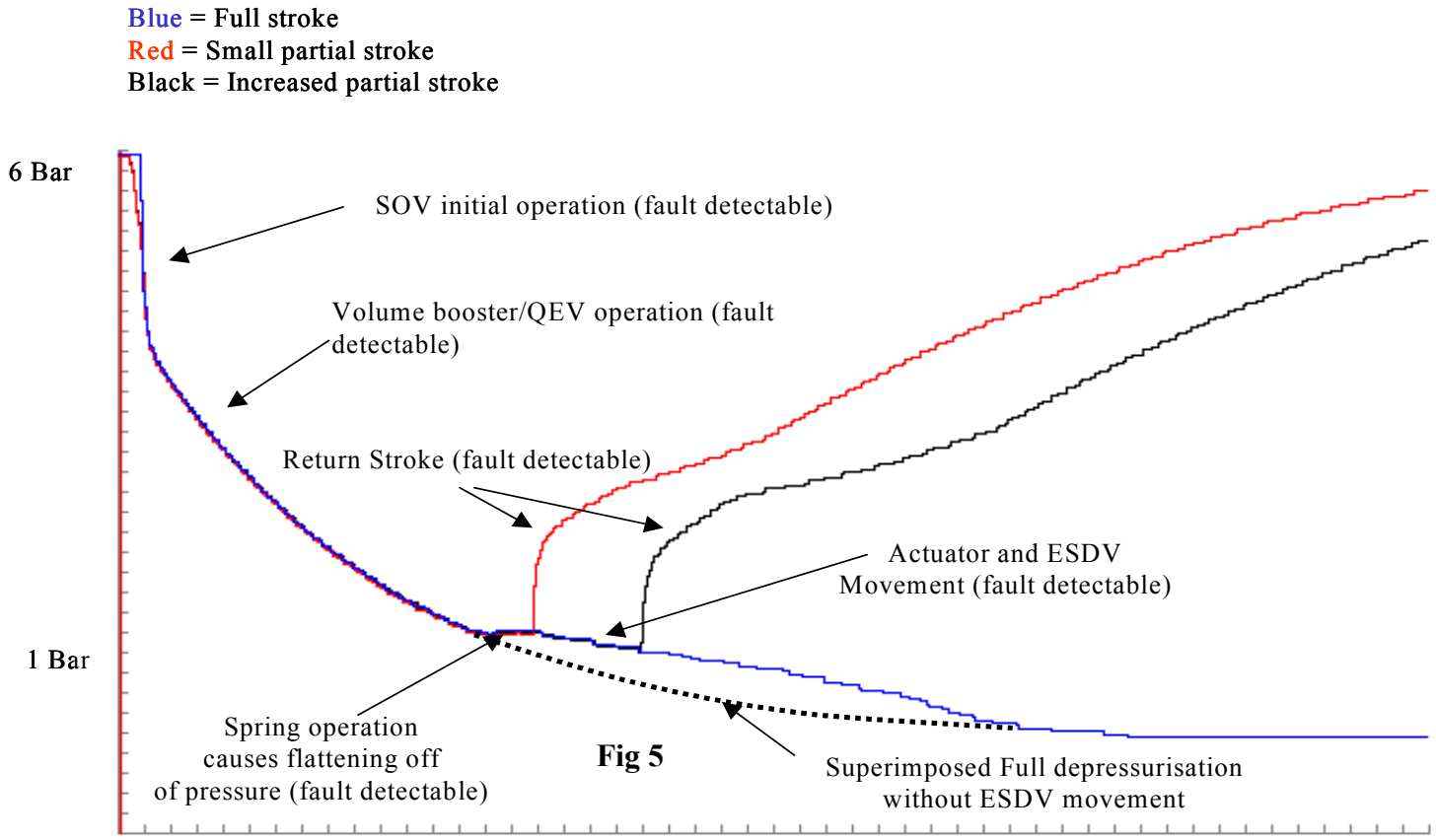

Fig 5

Once this signature is created, this can be used as a map to allow the EIV's SOV to be operated such that it can arrest and return the EIV to its normal state i.e. Partially Close the EIV. The part closure operation can be recorded and then be compared to subsequent part closure tests. Deviation from the original part closure signature can then be used to indicate any malfunction within the EIV and SOV assemblies.

By using the proposed scheme described, additional benefits can be derived, one of which would be to record the operation of the devices during say a plant nuisance trip, to record the full stroke signature of the EIV. The resulting signature can then be compared to the original full closure signature and be used as a comparison. Information derived in this manner could be used to produce Full Closure data, an important factor in the implementation of 61508.

Reference I. Monitoring Out Of Normal Conditions in Repetitive Cycle Production Machinery R C Castle, R Chakrabarti Brighton University. G T Jermy, C F Gimblett, Drallim Industries