

Introduction

Significant investments have been made in mechanical reliability and preventive maintenance programs for fixed equipment. These programs yielded significant performance improvements, demonstrating that it was acceptable to run the fixed equipment for longer periods between maintenance intervals (or turnarounds). The improvements have extended the maintenance interval to the point where, in some market sectors, the fixed equipment is no longer the weakest link for reliable process operation. Attention is now shifting to standby devices, such as automated block valves, which operate in a demand mode.

Standby devices are used in many critical applications, such as instrumented protective systems, safety instrumented systems, life safety systems, emergency shutdown systems, and fire and gas systems (see ref. 3.1). As critical equipment, reliability is important, since failure may result in significant process impact. A reliable standby device operates as intended when required, does not require frequent repair and maintenance, and does not cause an inadvertent process disruption or shutdown.

An important aspect of reliability is the capability to detect device failure, e.g., incipient, degraded, safe and dangerous failures, so that identified failures can be corrected, rendering the standby device in the "good as new" condition. For automated block valves, complete on-line proof testing is limited in many applications. The extension of fixed equipment maintenance intervals (unit outages) has resulted in reduced off-line proof test opportunities. Yet, the automated block valve must meet the required reliability in the operating environment.

Partial stroke testing can be used to identify certain failure modes associated with automated block valves. Partial stroke testing can be performed on-line with a wide variety of equipment and can be executed either manually or automatically. This technical report addresses the applications when partial stroke testing may be useful, the various methods used for partial stroke testing, and the advantages and disadvantages of each technology. Partial stroke testing identifies failure modes associated with the block valve actuator and a limited number of failure modes associated with the valve body or internals (e.g., valve stem damage and stem to valve connection).

Rising stem and rotary actuators operate differently, so they have a different distribution of failures across common failure modes and some unique failure modes. Consequently, the percentage of the overall valve failures detected is different for rising stem and rotary actuators. None of the partial stroke testing methods presented in this report detects failures associated with the valve seat, e.g., leak tightness.

1 Scope

ANSI/ISA-TR96.05.01 is informative and does not contain any mandatory requirements.

ANSI/ISA-TR96.05.01 is limited to automated valves normally operating in either a full open or full closed position.

The boundary of the automated valve includes the following:

- a) Limit switches and other monitoring devices
- b) Air regulation and filtration system
- c) Actuated valves whose fail position is specified as spring-return fail closed, spring-return fail open, or double acting
- d) Valve body specified to meet the functional requirements for its application

ANSI/ISA-TR96.05.01 does not address automated valves used for regulatory control applications.

Guidance is provided on the following:

- a) Identifying when partial stroke testing may be useful
- b) Various criteria to consider when selecting the partial stroke method, e.g., automated versus manual test execution, spurious trip potential, and on-line maintainability
- c) The advantages and disadvantages of three basic types of partial stroke test methods: mechanical limiting, positioners, and solenoid operated valves
- d) The use of diagnostic coverage factors in the performance calculations for an automated block valve being partial stroke tested periodically

2 References

Guidelines for Safe and Reliable Instrumented Protective Systems, Center for Chemical Process Safety, American Institute of Chemical Engineers, New York, NY 10017, 2006.

Offshore Reliability Data, OREDA, 3rd edition, ISBN: 82-14-00438-1, Det Norske Veritas, Veritasveien 1, N-1322 Høvik, Norway, 1997.

ANSI/ISA-TR84.00.02, "Safety Instrumented Systems (SIS) – Safety Integrity Level (SIL) Evaluation Techniques", ISA, Research Triangle Park, NC, 2002.

3 Abbreviations

DC – diagnostic coverage

ISA – Instrumentation, Systems, and Automation Society

λ_D – dangerous failure rate

MTTR – mean time to repair