IVS 2019 - Industrial Valve Summit Conference
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Lifecycle of the ESD valve – Install-and-forget device?
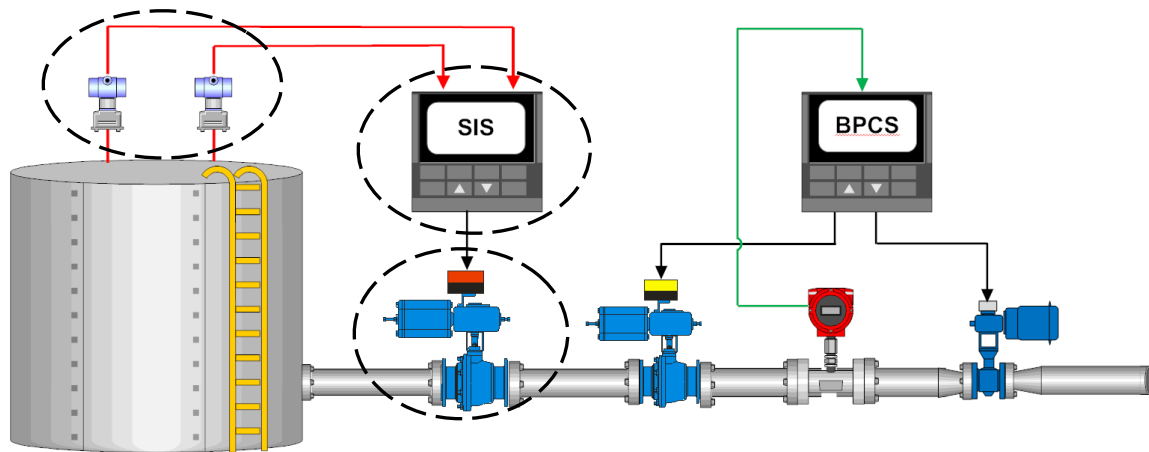
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Improving plant safety
Safety Instrumented System - SIS

- A SIF protects against a single hazard, but a Safety Instrumented System (SIS) implements one of more SIFs

- SIS takes the process to a safe state in case of emergency

- SIS consist of three elements: sensor, logic solver, final element

SIS = Safety Instrumented System
BPCS = Basic Process Control System

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Only ESD valve is considered in following examples even SIS has other components

What is SIS final element ?

- SIS final element consist of
  - Valve body,
  - Actuator
  - Instrumentation
    - VG (PST device) or/and SOV
    - Additional accessories e.g. LS, QEV, VB, AOV
  - Linkages
- Commonly called just ESD valve
- Defense against process upset, environment and personnel which operates only in trip situation. →   SIF
- Shutdown valves (SDV) or emergency shutdown valves (ESD) shutdown have safety position close.
- Blowdown (BDV) or emergency venting (ESV) or depressuring valves have safety position open.

SIS final element (SIS=Safety Instrumented System)

ESD valve selection

Valve selection
- Valve selection
  - Pressure class
  - Valve type
  - Materials & Coatings
  - Instrumentation
  - Sizing

Functional safety
- SIL capability
- PFD calculation (PST & Proof test interval)
- Architecture

Testing & Maintenance
- PST
- Proof test
- Maintenance

Perfectly selected valve for the process?

What kind of failures valves have

- Systematic failure
  - Valve not suitable for the process (e.g. Temperature too high)

- Random
  - Dangerous – Loss of protective function
  - Safe – Sprurious trip

What kind of failures valves have

Do Mechanical components have random failures?

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According to well known 3rd party certifications there are…

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Do Mechanical components have random failures?

According to well known 3rd party certifications there are...

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- Let's follow the current approach to include random errors for mechanical components

PFD calculations

When to do maintenance for ESD valve?

- "Maintenance?"
- "Usefull lifetime"
- "Not possible to do maintenance in each shutdown"
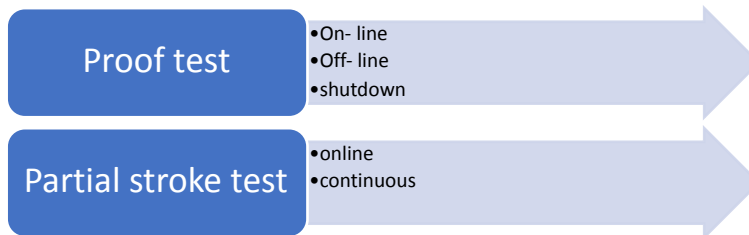- "When should we test the valve?"
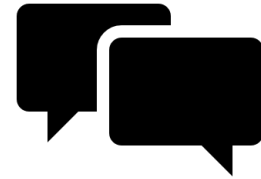
Process conditions
VS
PFD calculation

ESD valve testing

ESD valve will spend majority of its life in operational phase

- Testing is an essential activity to prove the integrity of Safety Instrumented System
- Testing secures that target SIL can be maintained
- Testing secures that the system can respond to true demand

Proof test	• On- line • Off- line • shutdown
Partial stroke test	• online • continuous

- Requirement SIL 2

- Shutdown period 48 months

- Original calculation to fulfill SIL 2 with 24 months testing period

Turn around schedule Vs. Proof test interval
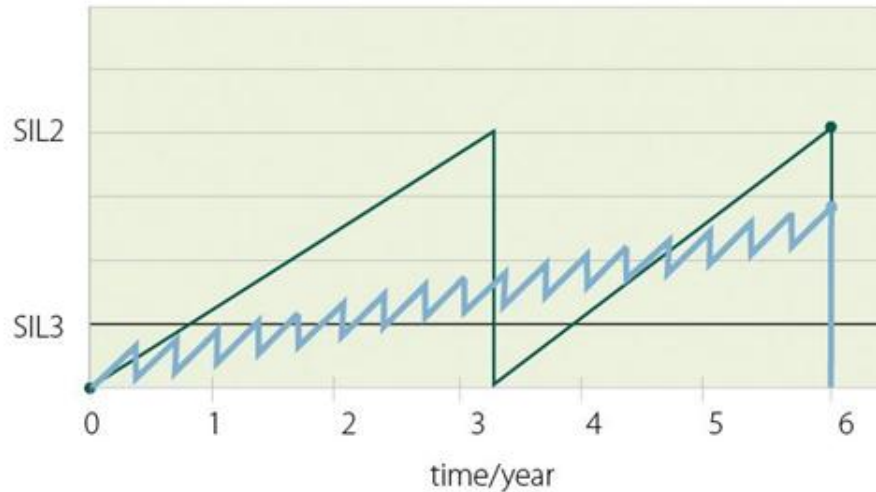
Turn around schedule Vs. Proof test interval

- To be able to use PFD avg calculations to determine proof test, partial stroke test and maintenance, valve selection must be done so that valve will be able to perform safety function
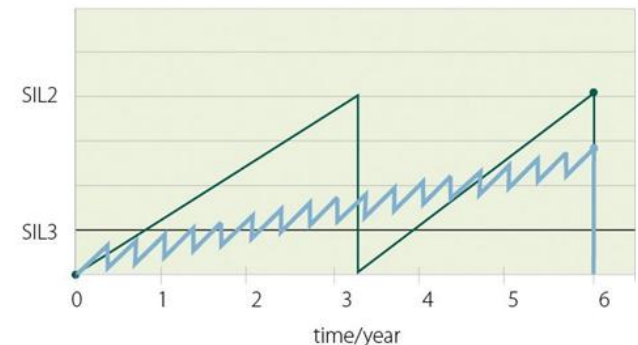
Partial stroke test

- By partial stroke test the proof test period can be extended
- But proof test cannot be avoided

Proof test, more than full stroke

1) The purpose of the proof testing is to detected failures of the complete final element subsystem. Metso recommends the following proof test procedure:

2) Visual inspection. Check that there are no unauthorized modifications in SIS final element. Check that the SIS final element is in the normal position and that verify all accessories 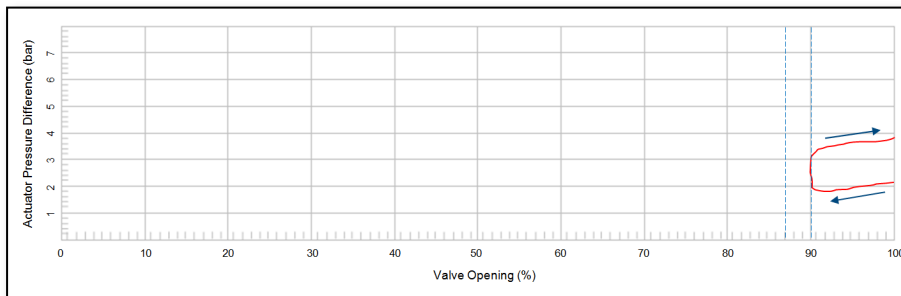are according the specification for the SIS valve normal operation. Verify that there are no observable deterioration in SIS valve, such as pneumatic leakages, visible damages or impurities on the SIS valve.

3) Bypass the SIS final element, if full stroke may cause an unnecessary process shutdown or other negative effects.

4) Perform the safety action (full stroke) preferably using the safety system. Verify that the SIS valve achieves the safe position within the required time specified by the application. Verify also the shutoff tightness for tightness critical applications. Note, that tightness measurements might require removing the valve from the pipeline. If the valve is removed from the pipeline repeat full stroke test after re-installation.

5) Restore the SIS valve into normal position.

6) Visual inspection. Check the SIS final element is in normal position and verify all accessories are according the specification for the SIS valve normal operation. Inspect visually there is no observable deterioration in SIS final element.

7) Record all results and observations into corresponding database with necessary audit trail information.

8) Remove the SIS final element bypassing.

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Conclusion

- Never think that ESD valve is install and forget device

- PST and Proof testing

- Turn around vs. PFD calculations

- **Valve selection and controlling systematic failures is the most important part of ensuring safety!!**

Thank you!

Do you have questions?

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