SIS Valves Reliability Prediction

SVRP (*)

workshop

Wednesday 27 Jan 2016 3:30 – 4:45 pm  Workshop 2  MSC2404

Henk Hinssen, retired, ex ExxonMobil
Andreas Vogt, F.I.R.S.T GmbH

(*) in analogy of the CVRP workshop a decade ago!
SVRP Workshop Outline

• 3:30 Introduction
• 3:40 SVRP vs CVRP – discussion on what differentiates the sizing & selection of SIS valves from control valves?
• 3:55 SVRP – it is all about torque and safety factors!!
• 4:10 Critical Success Factors – discussion + my “10 commandments” to all of you when dealing with SIS valves!
• 4:25 Controversies listing – discussion + a summary of major disagreements between various parties + my personal top 3 ones
• 4:40 Take-away
INTRODUCTION
Terminology

- **SIS**  Safety Instrumented System
- **SIF**  Safety Instrumented Function
- **ABV**  Automated Block Valve
- **(SIS) ABV**
- **(SIS) ABV assemblies**, i.e. the valve, the actuator and the drive train
- **ESDV**  Emergency Shutdown Valve
- **SY**  Scotch Yoke
- **NPQC**  Non process Quality Control
- **CSF**  Critical Success Factor
- **Drive train**  the bracket / coupling in between the valve and the actuator
- **GBU**  the GOOD, the BAD and the UGLY, not to be confused with the internet slang

**GBU Definition / GBU Means**

The [definition](#) of GBU is "God Bless You"
SVRP: some background

• 2004: got on the radar of plant managers due to valve issues. Introduced IFDB. Learned the trade and tricks of control valves the hard way with help from (mostly) retired individuals

• 2005: introduced HPCV, mainly holding the pen of those retired individuals

• 2005: convened a CVRP workshop trying to bridge the ocean between ISA and IEC when dealing with reliability prediction under the wings of WIB (end user group) and Valve World
SVRP: some background

• 2006: Approached KCI, the organization behind Valve World, to setup *SIS World* conference in analogy to Valve World. They agreed if I would take the lead on the content, which I did.

• Thanks to KM / RL, Dow Chemical, dropped that SIS World idea, kept my feet on the ground and focused on the real SIF challenge, i.e. the SIS ABV

• Focused the last decade on several aspects around SIS ABV assemblies
  – Understanding the SIS ABV assembly **TORQUE BUDGET**
  – The GBU of **PARTIAL STROKING**
  – The GBU of **SIS ABV assembly CERTIFICATION**
  – SEAT LEAKAGE testing (work in progress)
Sizing and Selection of Automated On/Off Valve Assemblies: “it’s a hurdle race!”

And end-user perspective……….

Kees Meliefste
Roy Lim
Dow Benelux Terneuzen BV
Guidance Report: M-2789-X-11
Published by WIB, November 2011

AUTOMATED BLOCK-VALVE (ABV) ASSEMBLIES:
PART-I: Valve Torque Requirements

"The good, bad and ugly of Partial Stroking"
Workshop

Leo Minervini Tyco Westlock, NJ USA
Angela Summers SIS-TECH Solutions, TX USA
Ryohei Furuta Kitz, Japan
Kees Meliefste Dow Chemical, the Netherlands
Stan Hale Score Atlanta, GA USA
Steve Farmer Emerson Valve Automation, USA
Henk Hinssen ex ExxonMobil, Belgium (moderator)

22 June 2011 Final

Workshop
"PST SIL certificates are creating a would-be safety!"

DRAFT Rev 11

Automated block valves (ABV) Assemblies
Part II:
Partial Stroke Testing Devices (PSTD)
User Requirements
SVRP: looking ahead

• How safe and reliable are your ESDV assemblies?
• Are you doing the right things during your ESDV sizing & selection process?
• Moving towards a dedicated SVRP conference or conferences in the 2016 – 2018 timeframe aiming for a happy “marriage” between piping and instrumentation
  – How to fall in love? Enjoying that period learning and exploring each other qualities and weak spots...
  – How to give and take without getting into a fighting?
  – How to live together in harmony?
  – ... Time will tell
Valve World started publishing a series of SVRP interviews in their magazine leading to a series of SVRP Conferences in 2016-18

– Dusseldorf 2016
– Houston 2017
– Suzhou 2017
– Bergamo 2018
SVRP vs CVRP
SVRP vs CVRP: differences?

• What differentiates the sizing & selection of SIS valves from control valves?
SVRP
TORQUE!!!
TORQUE!

- "THE" MOST ESSENTIAL PARAMETER FOR SIS VALVE ASSEMBLIES

- NOT AN ISSUE FOR MANUAL OPERATED VALVES
SVRP: Focus for the purpose of this workshop

Upstream ESDV application (but not subsea – API 6C)

- **FAIL CLOSE** APPLICATION
- BALL VALVE, METAL SEATED, TRUNNION MOUNT (API 6D)
- SCOTCH YOKE ACTUATOR
SVRP – sizing based on torque: What is it all about?

• It is all about matching actual valve torque requirements with the most appropriate actuator torque while while
  – Ensuring *valve torque uncertainties* are accounted for
  – Minimizing the *actuator pressure range*!
  – Applying *realistic safety factors* to balance actuator over-dimensioning (weight, eccentricity, MAST ...) vs under-dimensioning (not able to move)
SVRP: TORQUE + SAFETY FACTORS

CONVAL 10

Quarter Turn Valve Inputs

<table>
<thead>
<tr>
<th>Safety Factor</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve MAST</td>
<td>25000</td>
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Valve Torques without safety factors

<table>
<thead>
<tr>
<th>BTO</th>
<th>RTO</th>
<th>ETO</th>
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<tbody>
<tr>
<td>7000</td>
<td>2500</td>
<td>3500</td>
</tr>
<tr>
<td>5000</td>
<td>2500</td>
<td>6000</td>
</tr>
<tr>
<td>ETC</td>
<td>RTC</td>
<td>ETC</td>
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Scotch Yoke Quarter Turn Actuator Selection

<table>
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<tr>
<th>Actuator Type</th>
<th>Pneumatic</th>
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<tbody>
<tr>
<td>Actuator Supply Pressure</td>
<td>3 Min</td>
</tr>
<tr>
<td>Actuator Fail Mode</td>
<td>CLOSE</td>
</tr>
<tr>
<td>Manual Override</td>
<td>NO</td>
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</table>

SIZING

Process: [Value]
Reset: [Value]

Actuator Model

P55/A-A/230/C1

Pneumatic actuator torques

<table>
<thead>
<tr>
<th>Nm</th>
<th>BTO</th>
<th>RTO</th>
<th>ETO</th>
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<tbody>
<tr>
<td>13880</td>
<td>3314</td>
<td>3458</td>
<td>0</td>
</tr>
<tr>
<td>18206</td>
<td>6440</td>
<td>15227</td>
<td>ETC</td>
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</table>

Actual Safety Factors

| Safety Factors | 2.0 | 1.3 | 0.99 |

Max Actuator Pressure

Relief Pressure Set

<table>
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<tr>
<td>2362</td>
<td>7006</td>
<td>8662</td>
<td>0</td>
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<tr>
<td>13265</td>
<td>6440</td>
<td>15227</td>
<td>ETC</td>
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Max. Allowable Actuator Torques

<table>
<thead>
<tr>
<th>Nm</th>
<th>BTO</th>
<th>RTO</th>
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<tbody>
<tr>
<td>1.1</td>
<td>-</td>
<td>-</td>
<td></td>
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</table>

Actuator displacement

Valve travel: * Open

Work in Progress
SVRP: TORQUE + SAFETY FACTORS

- ETC END TO CLOSE
- RTC RUN TO CLOSE
- BTC BREAK TO CLOSE
- BTO BREAK TO OPEN
- RTO RUN TO OPEN
- ETO END TO OPEN

![Diagram showing valve torques and pneumatic actuator torques with safety factors.]

MAST!
SVRP: TORQUE + PMAX/PMIN
SVRP: VALVE BTC / BTO

Valve travel: ° open

Work in Progress
SVRP
CSF
SIS VALVES: sizing & selection

- What are your key suggestions regarding SIS valve assemblies sizing & selection? Those critical success factors, say “commandments” you would like to put in cast & concrete?
To achieve safe and reliable ESDV assemblies one shall:

I. Size & select them as engineered products
II. Create dedicated QML classes and ESDV QML combinations
III. Prequalify those classes and combinations
IV. Clarify roles & responsibilities and foster teamwork
V. Clarify the application in minute detail
VI. Ensure NPQC support during all phases
VII. Size & select actuator/value combinations based on torque
VIII. Address all environmental mitigating factors
IX. Address the essential integration requirements
X. Perform assembly functional testing @ operating conditions
SVRP

CONTROVERSIES
SVRP CONTROVERSIES:

- Are you getting conflicting opinions, recommendations? I call them controversies.
### 10. general

<table>
<thead>
<tr>
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<th>characteristic / parameter</th>
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<td>130.3. application criteria</td>
<td>service</td>
<td>ESDV</td>
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<td>127</td>
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<td>leakage class</td>
<td>tight shut-off</td>
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<td>4</td>
<td>130.2. response time</td>
<td>criteria</td>
<td>realistic stroke requirements</td>
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#### 10.4. process criteria

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<td>163</td>
<td>1</td>
<td>1304. fluid properties</td>
<td>dp @ 9%; 100% valve open</td>
<td>In dp data provided realistically?</td>
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#### 10.5. type criteria

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<td>VALVE</td>
<td>ball valve</td>
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<td>166</td>
<td>4</td>
<td>1305. type criteria</td>
<td>ball valve size</td>
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<td>2</td>
<td>1305. type criteria</td>
<td>valve closing member</td>
<td>other type ball valve</td>
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<td>168</td>
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<td>1305. type criteria</td>
<td>valve seating type</td>
<td>metal seats</td>
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<td>169</td>
<td>5</td>
<td>1305. type criteria</td>
<td>seat material</td>
<td>not for dirty service</td>
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<td>170</td>
<td>3</td>
<td>1305. type criteria</td>
<td>seat type</td>
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#### 10.6. medium

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<tr>
<td>203</td>
<td>4</td>
<td>1307. medium ACTUATOR</td>
<td>supply pressure range</td>
<td>max - min as small as practically possible</td>
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<tr>
<td>204</td>
<td></td>
<td>1307. medium ACTUATOR</td>
<td>filter / regulator y/n</td>
<td>no in all possible</td>
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#### 10.8. construction

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<td>211</td>
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<td>1308. construction VALVE</td>
<td>equalizing hole y/n?</td>
<td>yes for torque considerations</td>
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<tr>
<td>212</td>
<td>3</td>
<td>1308. construction VALVE</td>
<td>flow direction</td>
<td>bidirectional</td>
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#### 10.9. construction materials

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<td>1309. construction materials</td>
<td>material selection method</td>
<td>verify DOM for incompatible materials</td>
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### 11. procurement

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<td>1310. procurement</td>
<td>procurement approach</td>
<td>predefined valve/actuator combination</td>
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<td>219</td>
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<td>1310. procurement</td>
<td>valve manufacturer</td>
<td></td>
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<tr>
<td>220</td>
<td>1</td>
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<td>valve manufacturer</td>
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### 13. sizing & selection

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<td>mandatory</td>
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<td>531</td>
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<td>BRACKET / COUPLIN</td>
<td>drive train calculation method</td>
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<td>BRACKET / COUPLIN</td>
<td>drive train sizing method</td>
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### 15. components bracket

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<td>316</td>
<td>3</td>
<td>1315. mountingActuator</td>
<td>bracket</td>
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### 16. components actuator

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| 326 | 1   | 1321. design | SCARF | brasch }
| 327 | 1   | 1321. design | SCARF | brasch }
| 328 | 1   | 1321. design | SCARF | brasch }

### 90. prequalifications

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<tr>
<td>751</td>
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<td>1300. prequalifications</td>
<td>testing focus</td>
<td>value</td>
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</table>
SVRP CONTROVERSIES:
Scotch Yoke vs Rack & Pinnion
SVRP CONTROVERSIES:
Canted Yoke vs Symmetric Yoke
SVRP CONTROVERSIES:
Metal vs Soft seated
SVRP CONTROVERSIES:

Pneumatic $P_{max} / P_{min}$ range
SVRP CONTROVERSIES:
SIS vs non-SIS
SVRP
TAKE AWAY