VALVE AUTOMATION & INTERLOCK SYSTEMS

COKING.COM SEMINAR 2009

VELAN
VELAN CORPORATE PROFILE

- Velan was founded in 1950
- We manufacture in 16 plants worldwide
- Our current work force is in excess of 1700 employees
- We manufacture Cast and Forged Steel Ball, Gate, Globe and Check valves in sizes 1/4 - 72”
- Velan is an ISO 9001 accredited company
  - It is approved by ASME to design and manufacture to NCA 4000 under their Nuclear program
  - TUV for design and manufacture to the German pressure vessel code TRB 801, No. 45
- Velan has maintained a technical group completely dedicated to Coker Valve technology for the past 21 years
INSTALLED IN OVER 110 DELAYED COKERS WORLDWIDE

NORTH AMERICA...38 COKERS
SOUTH AMERICA...17 COKERS
ASIA...49 COKERS
EUROPE...14 COKERS
1983 - Velan installs its first electrically operated Switch Valve in the USA
1984 – Velan installs its first hard wired Panel complete with Switch and Inlet Iso Interlocks
1998 – Velan installs its first diagnostics package on a 2-wire loop
2001 - Velan installs its first PLC driven Interlock system
2003 – Velan installs local disconnects switches to prevent spurious Valve movement
2004 – Velan incorporates remote starters into its control loop
2005 – Velan incorporates a disconnect switch without cutting power to the control circuits
2007 - Velan supplies its first intrinsically safe PLC driven control Panel system
2008 - Velan starts working on an SIL 3 rated unit for a Coker in Europe
## CURRENT LIST OF CONTROL PANEL INSTALLATIONS

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>NUMBER OF DELAYED COKER FACILITIES</th>
<th>QTY OF PANELS</th>
<th>DIAG-NOSTICS</th>
<th>PLC</th>
<th>Intrinsic Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>21</td>
<td>111</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ASIA</td>
<td>46</td>
<td>197</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>EUROPE</td>
<td>5</td>
<td>17</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>SOUTH AMERICA</td>
<td>14</td>
<td>185</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>86</strong></td>
<td><strong>510</strong></td>
<td><strong>13</strong></td>
<td><strong>5</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>
ISOLATION VALVES FOR DELAYED COKER SERVICE

1. INLET TRANSFER LINES
   (6-18", CL.300-600-900)

2. QUENCH & DRAIN
   (3-14", CL.300-600-900)

3. BYPASS
   (3-18", CL.300-600-900)

4. OVERHEAD VAPOR
   (14-36", CL.150-300)

5. BLOWDOWN
   (14-36", CL.150-300)

6. BACKPRESSURE CONTROL

7. HEATER ISOLATION

OVER 1700 VALVES INSTALLED IN DELAYED COKERS WORLDWIDE
4 WAY SWITCH VALVE

APPROXIMATELY 90% OF THE VALVES WE SUPPLY ARE ELECTRICALLY OPERATED

6 – 18”
POSITION INDICATION

- Positive Positioning For Local and Remote Indication
- Typically 3 - 4 - 6 - 8 Position Indication Provided
- Positive indication directly from the stem
- Class 1, Div 1 or CENELEC Explosive Proof Construction
- Signal available for local panel and/or remote DCS location
- Signal redundancy available
INTEGRAL MECHANICAL STOPS

- Will yield before stem is damaged
- Dissipates Process Heat: protects actuator lubrication
- Jammer Plate mechanically stops accidental switch to bypass
- Pins are easily removed to allow switch to bypass
TYPICAL ACTUATOR REQUIREMENTS

• OVER 90% OF THE ACTUATORS WE SUPPLY ARE ELECTRIC

• ACTUATORS ARE EXPLOSION PROOF; CLASS 1, DIV 1 OR 2

• ACTUATORS ARE SUPPLIED WITH MANUAL OVERRIDES WHICH ARE PADLOCKABLE

• M.O. CAN BE SUPPLIED WITH AN OPERATING NUT TO FACILITATE PNEUMATIC WRENCH OPERATION

• ACTUATORS ARE SUPPLIED WITH A LOCAL PB STATION FOR LOCAL OPERATION
TYPICAL ELECTRIC ACTUATOR WIRING

• ACTUATOR WIRING ALLOWS END USER TO CUT POWER LOCALLY OR REMOTELY TO INSURE THAT THERE IS NO POSSIBILITY FOR SPURIOUS MOVEMENT OF THE VALVES.

• SEPARATE CONTROL CIRCUIT ALLOWS FOR THE CONTINUITY OF STATUS SIGNALS AND DIAGNOSTICS DESPITE CUTTING MAIN POWER TO THE UNIT.

• POWER MAY BE CUT OFF FROM THE DECK, LOCAL PANEL OR THE CONTROL ROOM.
• Panels are Hardwired and powered by the Actuator.

• Panels are used for (a) Very Basic Interlocking of Valves and (b) Easier access to the Valves by the operator

• Relays send signal back to DCS

• Panels are typically Explosion Proof; Class 1 Div 1 or 2 or CENELEC

• Interlocks are fairly basic due to the limitations on space

• Signals are internal from actuator or proximity type
EXAMPLES OF CONTROL PANELS

Classification: Class 1 Div 1, Class 1 Div 2, Class 1 Zone 1, Class 1 Zone 2
Certifications: IEC, CE, CSA, UL, ATEX, CELENEC, IEC

- **Push Buttons**
  - Open, Close, Stop
  - Signal to others

- **Selector Switch**
  - Bypass ON/OFF
  - Mid Point ON/OFF
  - Other Permissives

- **Light status**
  - Opened, Closed, MOVs
  - Permissives, Interlocks
  - Alarms

- **Analog Signals**
  - Drum Pressure
  - Drum Temperature
  - Valve Position
  - Valve Torque
TYPICAL 2-WIRE LOOP LAYOUT

- PROVIDES VALVE DIAGNOSTICS
  - Valve Status/ Torque Feedback
  - Monitors Faults
  - Can be included as part of signal redundancy
2 WIRE LOOP LAYOUT
TYPICAL PLC DRIVEN INTERLOCK SYSTEM
# Typical Interlock System

## Interlock Matrix

### DRUM A

<table>
<thead>
<tr>
<th>ACTIONS</th>
<th>FCSS/ES</th>
<th>DRUM A</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-4101 Pressure Test &amp; Warmup</td>
<td>Drained</td>
<td>Closed</td>
</tr>
<tr>
<td>Eductor Block Valve XV-913</td>
<td>Close</td>
<td>Open</td>
</tr>
<tr>
<td>PSV Outlet Block XV-814</td>
<td>Open</td>
<td>Open</td>
</tr>
<tr>
<td>PSV Outlet Block XV-816</td>
<td>Open</td>
<td>Closed</td>
</tr>
<tr>
<td>Vent Valve XV-811</td>
<td>Open</td>
<td>Closed</td>
</tr>
<tr>
<td>Vent Valve XV-812</td>
<td>Closed</td>
<td>Closed</td>
</tr>
<tr>
<td>Secondary Utility Manifold XV-819</td>
<td>Closed</td>
<td>Closed</td>
</tr>
<tr>
<td>Blowdown Valve XV-804</td>
<td>Open</td>
<td>Open</td>
</tr>
<tr>
<td>Fractiometer Valve XV-801</td>
<td>Open</td>
<td>Open</td>
</tr>
<tr>
<td>Fractiometer Valve XV-802</td>
<td>Open</td>
<td>Closed</td>
</tr>
<tr>
<td>Coke Condensate Valve XV-809</td>
<td>Open</td>
<td>Open</td>
</tr>
</tbody>
</table>

### Switch from D-4102 to D-4101

<table>
<thead>
<tr>
<th>ACTIONS</th>
<th>FCSS/ES</th>
<th>DRUM A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Utility Manifold XV-807</td>
<td>Close</td>
<td>Close</td>
</tr>
<tr>
<td>Switch Valve XV-801</td>
<td>D-4102</td>
<td>D-4102</td>
</tr>
<tr>
<td>Coke Condensate Valve XV-809</td>
<td>Close</td>
<td>Closed</td>
</tr>
<tr>
<td>Secondary Utility Manifold XV-819</td>
<td>Open</td>
<td>Closed</td>
</tr>
<tr>
<td>Main Utility Manifold XV-807</td>
<td>Open</td>
<td>Open</td>
</tr>
</tbody>
</table>

### D-4102 Switch to Blowdown

<table>
<thead>
<tr>
<th>ACTIONS</th>
<th>FCSS/ES</th>
<th>DRUM A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blowdown Valve XV-804</td>
<td>Open</td>
<td>Open</td>
</tr>
<tr>
<td>Blowdown Valve XV-805</td>
<td>Open</td>
<td>Open</td>
</tr>
<tr>
<td>Fractiometer Valve XV-801</td>
<td>Close</td>
<td>Closed</td>
</tr>
<tr>
<td>Fractiometer Valve XV-802</td>
<td>Close</td>
<td>Close</td>
</tr>
</tbody>
</table>

### D-4102 Vent & Drain

<table>
<thead>
<tr>
<th>ACTIONS</th>
<th>FCSS/ES</th>
<th>DRUM A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blowdown Valve XV-804</td>
<td>Close</td>
<td>Close</td>
</tr>
<tr>
<td>Blowdown Valve XV-805</td>
<td>Closed</td>
<td>Open</td>
</tr>
<tr>
<td>Vent Valve XV-811</td>
<td>Open</td>
<td>Open</td>
</tr>
<tr>
<td>Vent Valve XV-812</td>
<td>Open</td>
<td>Open</td>
</tr>
<tr>
<td>PSV Outlet Block XV-814</td>
<td>Closed</td>
<td>Closed</td>
</tr>
<tr>
<td>PSV Outlet Block XV-816</td>
<td>Closed</td>
<td>Closed</td>
</tr>
</tbody>
</table>

### D-4102 Unheading

<table>
<thead>
<tr>
<th>ACTIONS</th>
<th>FCSS/ES</th>
<th>DRUM A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eductor Block Valve XV-913</td>
<td>Open</td>
<td>Open</td>
</tr>
</tbody>
</table>
TYPICAL PLC REQUIREMENTS

- CONTROL OF INTERLOCK & PERMISSIVES
- REDUNDANCY
  - POWER
  - PROCESSOR
  - I/O
  - INTRINSICALLY SAFE SIGNALS
- HMI SCREEN FOR SYSTEM MONITORING
- DCS COMMUNICATION & HANDSHAKING

VELAN
TYPICAL SYSTEM ARCHITECTURE

- SWITCH VALVE ARCHITECTURE

- COMBINATORY LOGIC LEGEND:
  - SEQUENCE PERMISSIVES
  - INTERLOCK PERMISSIVE
  - MOV READY
  - PHYSICAL POSITIONS
  - BUTTONS
  - RESET COMMAND
  - OPEN COMMAND
  - CLOSE COMMAND
TYPICAL SYSTEM ARCHITECTURE

- **SEQUENCE PERMISSIVE ACTUATION**
  - **SEQUENCE #1**
    - D-3001 STEAM PURGE
  - **SEQUENCE #2**
    - D-3001 STEAM PREICAT AND PRESSURE TEST
  - **SEQUENCE #3**
    - D 3001 HYDROCARBON PREHEAT

- **OPEN/CLOSE INTERLOCK PERMISSIVE**

- **SEQUENCE PERMISSIVE OVERWRITE**

- **BUTTON OPEN/CLOSE**

SIMILAR FOR ALL ACTUATED VALVES
PERMISSIVE OVERRIDE

ACTUATOR POSITION CONDITIONING AND PANEL LIGHT LOGIC

<table>
<thead>
<tr>
<th>INPUT</th>
<th>LOCAL PANEL</th>
<th>CONTROL ROOM</th>
<th>PLC LOGIC</th>
<th>OUTPUT</th>
</tr>
</thead>
</table>

- **Input**:
  - Valve XV-33mm position (open or close)
  - Valve XV-30mm position (open or close)

- **Logic**:
  - Hold momentary bypass signal active for 5 minutes
  - AND

- **Output**:
  - Valve XV-33mm local panel light (open or close)
  - Flashing bit
  - Conditioned actuator position used later in sequence logic
  - Flash when actuator position is being bypassed.

VELAN
BASIC LOGIC LAYOUT

GATE AND BALL VALVE ACTUATION LOGIC

<table>
<thead>
<tr>
<th>LOCAL PANEL</th>
<th>CONTROL ROOM</th>
<th>PLC LOGIC</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>CONTROL ROOM</td>
</tr>
</tbody>
</table>

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GATE AND BALL VALVE ACTUATION LOGIC

- ZSO: Valve XU-30mm Open Position
- XS: Valve XU-30mm Close Position
- Sequence Permissives
- 2 position push-to-run electric actuator
SEQUENCE AND INTERLOCK PERMISSIVE LOGIC

Sequence permissive logic  Safeguard permissive logic
- Detail of Valve status & other critical equipment
- Drum Pressure & Temperature
- Sequence Monitoring
- Provides Full Diagnostic Package

**ACTIVE SEQUENCES**

<table>
<thead>
<tr>
<th>DRUM 3001</th>
<th>DRUM 3002</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1 steam purge</td>
<td>D2 steam purge</td>
</tr>
<tr>
<td>D1 steam test</td>
<td>D2 steam test</td>
</tr>
<tr>
<td>D1 hydrocarbon preheat</td>
<td>D2 hydrocarbon preheat</td>
</tr>
<tr>
<td>Switch D2 to D1</td>
<td>Switch D1 to D2</td>
</tr>
<tr>
<td>D2 to fractionator</td>
<td>D1 to fractionator</td>
</tr>
<tr>
<td>D2 blowdown</td>
<td>D1 blowdown</td>
</tr>
<tr>
<td>D2 quench</td>
<td>D1 quench</td>
</tr>
<tr>
<td>D2 drain</td>
<td>D1 drain</td>
</tr>
</tbody>
</table>

**SEQUENCE MESSAGES**

16.2 WAITING FOR NEW SEQUENCE
SEQ#16 ENDED

**VELAN**
FULL FACTORY ACCEPTANCE TEST

- Valves are tested in local and remote settings
- Torques are recorded to provide a baseline for future PM
- Test of hardwired interlocks
- Test of software interlocks
- Test of 2 wire loop (if applicable)
BASIC FAT LAYOUT
FULL SITE ACCEPTANCE TEST

& STARTUP ASSISTANCE
SCOPE OF SITE ACCEPTANCE TEST

- Valves are tested in local and remote settings
- Torques are recorded to provide a baseline for future PM
- Verification of all field connections
- Test of hardwired interlocks
- Test of software interlocks
- Test of 2 wire loop (if applicable)
TRENDS

- SIL RATINGS ARE GAINING GREATER ACCEPTANCE AS THE MARKET’S GUIDELINES WHEN DESIGNING NEW SYSTEMS

- THE PROSPECT OF A FULL REMOTE OPERATION COKER IS BEING ENTERTAINED MORE EVERYDAY. WITH TODAY’S COKER TECHNOLOGY THIS IS BECOMING INCREASINGLY ACHIEVABLE.
THANK YOU!