Equipment to Improve the Safety and Reliability in FCC Units

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Flue Gas Line Typical Layout

Diverter Valve

Flue Gas Isolation Valves

STACK

FLUE GAS COOLER

CO BOILER

ESP

STACK
Seal Pots may seem a good alternative to more complex three way valve such as a Diverter:

- No moving parts
- No complex hydraulic or controls
- No purging, spares, maintenance
- No Valves vendors bothering you at Refcomm

Seal Pots, however, pose subtle but severe reliability issues.

A user case from a South American Plant is resumed in following section.
High Gas Temperature requires Refractory lining and abrasion Resistant lining, but refractory absorbs water. Water trapped inside the refractory pores increases rapidly its volume, causing the explosion of the refractory.

Water also needs to be neutralized, Flue Gas from the Regenerator condensates increasing the acidity of water. The acidic water corrodes the refractory anchors.

Water Level control system/ transmitter may be plugged by catalyst and fails. Loss of level control can overflow water to the other pot. In this conditions, the central duct is subject to thermal shocks, leading to internal collapses.
Typical Seal Pots Failures Modes

- Internal Duct Rupture (Thermal Shock)
- Thermal Fatigue
- Cracks on Bottom
- Nozzle
- Internal Duct Buckling obstructing Gas Flow
Typical Seal Pots Failures Modes

- Thermal Fatigue Cracks on Bottom Nozzle
Shaft is made of ALLOY X750, a nickel based high performance steel, with outstanding stress/corrosion strength at high temperature.

Disc Arm connection to Disc consists of two pins, which allow both the motion transfer between Disc Arm and Disc, and constrain the disc against its rotation.

A special sloped profile of disc and guides allows a smooth sliding during stroke even with under not uniform temperature distribution.
Installation Sequence
Flue Gas Isolation and Bypass

- Isolating Low Pressure Side of Flue Gas Line
  - Co Boiler
  - Electrostatic Precipitator
  - Flue Gas Scrubber

- Different Technical Solutions are available. Selection of the best one will depend on many side parameters and will require a dedicated Technical Analysis for each application.

- Main features, pros/cons are resumed in the following slides.
Flue Gas Isolation Valves

Triple Eccentric Butterfly Valve
Goggle Valve – Stroking Sequence
Goggle Valve – Internal Components

- **Body** - Blue
- **Bellows** - Blue, single wave
- **Guide tube** - Cyan
- **Refractory Lining** - Light Green
- **Clamping Cylinders** - spring / hydraulic
- **Guide System** - Black
  - upper
- **Pushing Cylinders** - hydraulic
- **Seating Ring** - Yellow
  - stationary
  - slides in / out of line
  - spring / bellows / cylinder
- **Seal Ring** - Red (small)
  - Ceramic
- **Seal Ring** - Red (large)
  - Graphite
- **Metal Sealing** – hard facing
- **Pushing Cylinders** - hydraulic
- **Guide System** - Black
  - Lower
Triple Eccentric Valve

- Up to ANSI FCI 70-2 Class V
- Hot / Cold Wall design
- Disc 0 to 90°
- Electro - hydraulic or electrical actuation
- Up to 780°C

Inconel Alloy gasket ring

Seat with Stellite overlay

Nitronic Bushing

Graphite Gasket

Shaft
Quarter Turn Actuator

Alloy X-750 Shaft

Body

Lantern

Bearing

Stuffing Box
<table>
<thead>
<tr>
<th>Feature List</th>
<th>Goggle Valve</th>
<th>Triple Eccentric Butterfly Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>On/Off</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Control</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Design Pressure</td>
<td>Low – Medium</td>
<td>Low – High</td>
</tr>
<tr>
<td>Pressure Drop</td>
<td>Zero</td>
<td>Low</td>
</tr>
<tr>
<td>Double Block and Vent</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Horizontal/Vertical Line</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Retrofittable on existing line w/o Structural works</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Can do ESD or Fast Action</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
North America Customer

- The existing CO-Boiler isolation valve where Class II (step seated butterfly) and the leakage in closed position was posing safety issues.
- A Triple Offset Valve was the correct solution.
- IMI Remosa designed also the custom CW/HW transitions.
User Experience – CO Boiler Isolation Valve
User Experience – Google Valve

- **Project Requirements**
- **North American Plant**
  - Construction of new Flue Gas Scrubber system
  - Treat emissions from both the FCK & FCC by reducing the following:
    - $SO_2$, $SO_3$, and $NO_X$
    - Greenhouse Gases
    - Reduce Overall Flaring
  - Safe and Reliable Isolation and Control of the following equipment:
    - Existing Flue Gas Stack
    - 2x Vacuum Furnaces
    - 2x SCR’s
    - Waste Heat Boiler
    - Bypass Lines
    - New Scrubber Stack
**Project Highlights**

- **Scope of Supply**
  - (11) Goggle Valves:
    - (1) 60", (1) 70", (3) 96", (4) 126", (1) 144" (1) 166"
  - (5) Butterfly Valves:
    - (1) 60", (1) 68", (1) 82", (1) 91", (1) 122"

- **Goggle Valve design conditions:**
  - 800°F to 1450°F and 5 psi(g) to 8 psig
  - Seismic Loads

- Entire project completed on time
- Delivery sequenced according to the site’s construction and installation schedule. Each valve was rigged, removed from trailer and lifted into position upon arrival to minimize handling and crane movement.
- First T/A was recently completed without the need for any major maintenance or repairs. Visual inspection, basic PM activities, internal seal rings were replaced, and each valve was function tested.
Flue Gas Scrubber Project
Thank You!