State-Of-The-Art Delayed Coking Unheading Technology To Improve Safety During Operation

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Design Evaluation
Design Evaluation II

1950 Manual

1990 Swing Away

2001 Totally Enclosed

2004 Double Disc – Multiple Seal Automatic Unheading
Design Evaluation III

Single Plate Design

Double Disc Design
Z&J’s Unique Unheading Technology
Rectangular Plate vs. Disc

Rectangular Plate
- Contact between plate & seat only by springs
- Commonly used in Ethylene service

Innovative Disc
- Double disc design with wedges
- Tightness created between discs & seats by split-wedge & springs in addition to spring loaded upper seat
- Extended life time

Patented Design
Design Evaluation V

Calculation Model Rectangular Plate

- Warm-up
- Coking operation
- Steamout
- Quenching

Warm-up: 2h
Coking operation: 12h
Steamout: 3h
Quenching: 5h

Petroleum residue (500 °C) - convection
Superheated steam (200 °C) - convection
Cooling water (25 °C) - convection
Superheated steam (200 °C) - convection
Environment (25 °C) - convection + radiation
Design Evaluation VI

Calculation Model Disc

- Warm-up
- Coking operation
- Steamout
- Quenching
- Body purge

- 2h: Superheated steam (200 °C) - convection
- 12h: Petroleum residue (500 °C) - convection
- 3h: Superheated steam (200 °C) - convection
- 5h: Cooling water (25 °C) - convection
- Superheated steam (200 °C) - convection
Design Evaluation VIII

Temperature Profile

Rectangular Plate

Disc

- A: warm-up
- B: coking operation
- C: decoking operation
- $t_1$: end of warm-up
- $t_2$: start of coking
- $t_3$: end of coking
- $t_4$: start of steamout
- $t_5$: end of steamout
- $t_6$: start of quenching
- $t_7$: end of quenching
- $t_8$: start of drain/unhead
Deflection Diagram

Ratio of leakage area: 3 (!)
Rectangular Plate erosion due to excessive leakage
Design Evaluation XIII

True Double Block - Multiple Seal & Purge Design

- removable upper seat
- body purge
- inspection cover
- split wedge & central ball
- two independent discs
- hardfaced seats body & discs
- guide plates
- body drain
- throughput
- body purge
Removable Upper Seat Assembly - *Multiple Seal Technology*

**DETAIL A**
- removable upper seat assembly
- body
- upper guide plate
- disc cage (carrier)
- spring loaded seat
- surface overlaid
- upper disc
- scraper seat
- seal-steam camber

**Removable Upper Seat Assembly**

**Design Evaluation XIV**
Double Disc Multiple Seal & Purge
and active mechanical seating

Positive steam pressure between the two discs
Typical Steam Consumption Calculation per Drum
Comparing Single Disc with Double Disc Unheading Devices

Cycle Time (cooking plus drilling)
Steam Price
Number of Drums
Return of Investment

Cost Savings if Double Disc is Used \(1,601,377\) €

Please note that for Double Disc Design NO water cooling is required!
Water Cooling Consumption and System Cost, which are only required for Single Disc Design, are NOT included in this calculation! These costs have to be added on top!
Conclusions and Prospects of Design Evaluation

Rectangular Plate

- Random temperature distribution
- Very sensitive to thermal distortion
- Areas of excessive leakage
- Apparently no true *double block* capability
- High steam consumption & energy costs
- High erosion & maintenance costs

Innovative Z&J Disc Design

- Equal temperature distribution
- Insensitive to thermal distortion
- Area of leakage 3 x smaller
- True *double block* capability
- Reduced steam consumption & energy costs
- Low erosion & maintenance costs
- Less downtime
IMI Z&J Revamp Solution for Bottom Unheading

IMI Z&J Compact Footprint Design (CFD)
Sealing Principle

- Preloaded Spring-Packages pressing Upper & Lower Disc against corresponding body-
- Purge steam applying additional sealing force to both discs
- REAL Double-Block and Purge Functionality
## Compact Footprint Design V

### IMI Z&J Bottom Unheading Device and IMI Z&J Compact Bottom Unheading Device common features

<table>
<thead>
<tr>
<th>1. General</th>
<th>IMI Z&amp;J Bottom Unheading Device</th>
<th>IMI Z&amp;J Compact Bottom Unheading Device</th>
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<tbody>
<tr>
<td>Product Name</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size NPS</td>
<td>NPS 60&quot;</td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td>per ASME section VIII Div. 1, 2</td>
<td></td>
</tr>
<tr>
<td>Actuator types</td>
<td>Electric or Hydraulic</td>
<td></td>
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</tbody>
</table>

| 2. Conditions, Technical Performance | | |
| Design | Double Disc Through Conduit | |
| Full Bore | Yes | |
| On-Off Service | Yes | |
| Body | Bonnet - Body - Bonnet | |
| Sealing System | Double Block & Purge | |
| Seating Force activation | Split-Wedge-Ball Arrangement | Preloaded Disc Arrangement |
| Multiple Seal | Yes | |
| Leakage Rate | API 598 | |

### Maintenance

| On-Deck Maintenance System | Yes | |
| On-Deck Seat Replacement (upper Seat) | Yes | |
| On-Deck Disc Replacement | Yes | |

### 3. Dimensions of Valve

<table>
<thead>
<tr>
<th>Weight incl. Actuator (Compact Electric)</th>
<th>135600 lbs / 61500 kg</th>
<th>88 000 lbs / 40 000 kg</th>
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</thead>
<tbody>
<tr>
<td>Length</td>
<td>390&quot; / 9900 mm</td>
<td>388&quot; / 9850 mm</td>
</tr>
<tr>
<td>Width</td>
<td>115&quot; / 2920 mm</td>
<td>101&quot; / 2560 mm</td>
</tr>
<tr>
<td>Height</td>
<td>51&quot; / 1308 mm</td>
<td>37&quot; / 950 mm</td>
</tr>
<tr>
<td>Face-to-face</td>
<td>51&quot; / 1308 mm</td>
<td>31&quot; / 790 mm</td>
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</tbody>
</table>
Compact Footprint Design VI
Z&J’s Compact BUD Design

- Compact Footprint – Low weight
- Real Double Block and Purge Functionality
- => Reduced steam consumption => energy savings => safe environments
- => Less erosion => less maintenance => less downtime
- Easy Inspection / maintenance on deck – Valve remains connected to drum

Preferred choice for DC Revamp

- Easy to combine with / integrate into existing installations
- Easy to operate in combination with all existing feed systems
Typical Site Installation – Compact Hydraulic Actuator
Site Installation II

IMI Z&J Bottom Unheading Site Installation
IMI Z&J Bottom Unheading in Operation
Maintenance can be performed while unheading valve remains assembled. No need to remove valve bonnets!
Operation Position -> Maintenance Position

- Remove all piping, tubing and wiring from the Bottom Unheading Valve and its actuator
- Block all constant hangers. For detailed information observe supplementary manual
- Support the discharge chute, for example by means of hydraulic jacks
- Remove bolting of chute
- Lower the chute and let it rest on wooden beams. Close the chute opening by means of cover / lid.
- Support the valve weight by means of equally arranged hydraulic jacks (only if unheading deck is able to bear the load) or chain hoist between I-beams and valve
Displacement of Seat Ring Arrangement / Upper Disc

- Upper SEAT ASSEMBLY DETAIL A
- PURGE
- REMOVABLE UPPER BODY SEAT
- INSPECTION PORT
- PURGE
- WEDGE BALL (mechanical lock)
- 2 INDEPENDENT DISCS
- HARDFACED SEATS - BODY & DISCS
- GUIDE PLATES
- CONDENSATE / DRAIN
- THROUGHWAY
When the valve is located in service position, the following can be performed:
- remove / replace the Upper Body Seat Arrangement
- remove / replace the Upper Disc
Displacement of Seat Ring Arrangement / Upper Disc

Upper Body Seat Arrangement

Upper Disc
Maintenance XV

- Maintenance
  - Easy access from top
    - Seat-Ring-Insert
    - Upper Disc
    - Lower Disc
  - Removal of bonnets is NOT required
End-customer: BP Oil Castellon
Site: Castellon
Country: Spain
Installed equipment: 2 x 36“ TUD el. & 2 x 60“ BUD hyd.
1st TAR: May/June 2012 (TAR interval extended from 4 to 5-6 years)
2nd TAR planned: Oct. 2017 Results:
- Extremely low contamination
- No scratches and cracks on sealing ring and disc
- No exchange of any cup springs required (recommended to change only after appr. 8-10 years)
- No repair works on purge system required
End-customer: Statoil Hydro
Site: Mongstad
Country: Norway
Installed equipment: 2 x 36“ TUD el. & 2 x 60“ BUD el. (single spindle)
Commissioned: 2012 (Nov.)
2nd TAR planned: 2021/2022 (TAR interval extended from 4 to 6 years)
Results:
- Extremely low contamination
- No scratches and cracks on sealing ring and disc
- No exchange of any cup springs required (recommended to change only after appr. 8-10 years)
- No repair works on purge system required
- On BUD spindle and drive nut were still in excellent condition (recommended to change only after appr. 5-6 years)
TAR Statoil, Mongstad, Norway III
Conclusions I

Design
✓ Per ASME Section VIII Div. 1, 2

Leakage rate
✓ Full compliance with API 598

Safety
✓ Fully remote operation, no operator on deck during unheading
✓ True double block & purge - 2 independent discs provide individual sealing

Efficiency
✓ Cycle time reduction - optimized production output
Conclusions II

Environment
✓ Low to no emissions to atmosphere

Cost Savings
✓ Extremely low steam consumption
✓ Minimum downtime
✓ Lowest maintenance costs

Reliability
✓ Extremely low steam consumption
✓ Well proven design
✓ TARs show excellent results
Company Key Data I
IMI plc Group

IMI Critical Engineering
(Formerly Severe Service)

IMI Precision Engineering
(Formerly Fluid Power)

IMI Hydronic Engineering
(Formerly Indoor Climate)
IMI Z&J Group - Product Lines

More than 135 years experience in specific valve design for severe service applications

- In-house Design, Engineering, Fabrication
- Certified Quality Management
- Extensive Testing Facilities
- Field & Shop Service

Iron & Steel
  - Blast Furnaces

Glass
  - Glass Industry

Petrochemical & Refining
  - Delayed Coking
  - Ethylene
  - PDH / Catofin
  - FCC

Controls
  - Instruments & Controls

Service
  - Service
THANK YOU!

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