Coke Cutting Systems
for
Cokers in India

Dr. Wolfgang Paul, wpaul_dr@ruhrpumpen.com

RUHRPUMPEN
Location: RuhRPumpen Witten, Germany

1950  Founded in Witten / Germany
      Specialist for:  API Process pumps
                      API Pipeline pumps for Crude Oil,
                      Products, Water

1963  Part of THYSSEN AG
      THYSSEN RUHRPUMPEN

1997  Part of Cooperation EG, Monterrey,
      Mexico

Our Mission: Become a worldwide company

2000  Start with Hydraulic Decoking System

2001  First Order: Petroleras Ameriven /04
      ConocoPhillips, PdVSA, Chevron Texaco

Since that time orders for revamps, new Units and Components
Ruhrpumpen Business Units

Witten, Germany
Area: 48,000 m²
Testing: 8,850 HP

Tulsa, USA
Area: 28,000 m²
Testing: 2,000 HP

Monterrey, Mexico
Area: 14,370 m²
Testing: 7,500 HP

Changzhou, China
Area: 7,500 m²
Testing: 6,000 HP

Chennai, India
Area: 7,500 m²
Testing: 6,000 HP

Orland, California
Area: 2,500 m²

Rio de Janeiro, Brazil
Area: 7,500 m²
Testing: 6,000 HP

Buenos Aires, Argentina
Area: 7,500 m²
Testing: 1,500 HP

Suez, Egypt
Area: 2,280 m²
Testing: 2,680 HP

RUHRPUMPEN Specialist for Pump Technology
Decoking Systems in extreme Areas

More and more Delayed Coker Units (DCUs) are built in extreme ambient. All equipment including the Coke Cutting Systems have to meet these requirements.

The requirements are summarized as

a) Ambient and Design conditions in warm areas
   - temperature ranges from \(-3^\circ C\) to \(+50^\circ C\), wetted parts \(3^\circ C\) to \(120^\circ C\)
   - sun, wind, rain, dust, humidity
   - Humidity above 90%, often 100%

b) Refinery conditions
   - hazardous, corrosive atmosphere, sea side
   - operation mode manual / remote / automated

c) Company specification
   - specification of final user, contractor, licensor

d) Local codes and standards
   - other local codes

In the project and design phase items c) and d) are most important and should be met later. a) and b) are most important.
RP classifies the Decoking Systems into 3 classes

• **Class I.** area in warm temperatures  Warm-Warm Area
  – Mech. equipment  T design  $>0^\circ C$ to $+50^\circ C$  WWA
  – Instruments

• **Class II.** area in medium temperatures  Cold Area
  – Mech. equipment  Tdesign $>-29^\circ C/-20^\circ F$  CA
  – Instruments  Tdesign $>-29^\circ C/-20^\circ F$  CA

• **Class III.** area in low temperatures  Cold-Cold Area
  – Mech. equipment  Tdesign $>-50^\circ C/-59^\circ F$  CCA
  – Instruments  Tdesign $>-60^\circ C/-76^\circ F$  CCA
<table>
<thead>
<tr>
<th>Location</th>
<th>Hazardous area</th>
<th>Design Temp.</th>
<th>Instruments</th>
<th>Comments / Special requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle East</td>
<td>Pump area</td>
<td>65°C/120°C</td>
<td>50°C CATEX</td>
<td>Humidity 100% Dust, sand (Seaside atmosp) Refinery atmosp.</td>
</tr>
<tr>
<td>India WWA</td>
<td>Cutting Deck</td>
<td>65°C/120°C</td>
<td>50°C CATEX</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Derrick</td>
<td>65°C/120°C</td>
<td>50°C CATEX</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operator Shelter</td>
<td></td>
<td></td>
<td>2x HVAC, inside 1°C to 35°C</td>
</tr>
<tr>
<td></td>
<td>Control Room</td>
<td>Control house, safe area</td>
<td>PLC &lt;40°C Safe area</td>
<td></td>
</tr>
</tbody>
</table>
### Summary

**Design conditions**
Installation in Hazardous area, Zone 2

<table>
<thead>
<tr>
<th>Component</th>
<th>Temperature Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump and wetted parts</td>
<td>rated 65°C, max 120°C</td>
</tr>
<tr>
<td>Mechanical equipment, outside</td>
<td>1°C to 50°C</td>
</tr>
<tr>
<td>Instrumentation, outside</td>
<td>1°C to 50°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>80%, up to 100%</td>
</tr>
<tr>
<td>Instrumentation and control</td>
<td>1°C to 35°C</td>
</tr>
<tr>
<td>inside shelter</td>
<td></td>
</tr>
<tr>
<td>HVAC for shelter, 2x 100% redundant</td>
<td></td>
</tr>
</tbody>
</table>
## Decoking Systems in Warm-Warm Areas

<table>
<thead>
<tr>
<th>Year</th>
<th>Area</th>
<th>Company</th>
<th>outside T,</th>
<th>Design T (wet pats)</th>
<th>Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>India, North</td>
<td>HMEL</td>
<td>+ 1 to +46°C</td>
<td>+65°C / max 93°C</td>
<td>85%</td>
</tr>
<tr>
<td>2008</td>
<td>Saudi-Arabia</td>
<td>Yanbu</td>
<td>+ 0 to +45°C</td>
<td>+60°C / max 100°C</td>
<td>100%</td>
</tr>
<tr>
<td>2009</td>
<td>India, South-West</td>
<td>MRPL</td>
<td>+17 to +40°C</td>
<td>+66°C / max 93°C</td>
<td>91%</td>
</tr>
<tr>
<td>2009</td>
<td>Egypt</td>
<td>ERC</td>
<td>+ 2 to +45°C</td>
<td>+60°C / max 75°C</td>
<td>85%</td>
</tr>
<tr>
<td>2009</td>
<td>Saudi-Arabia</td>
<td>Satorp</td>
<td>+ 6 to +47°C</td>
<td>+66°C</td>
<td>100%</td>
</tr>
<tr>
<td>2009</td>
<td>India, South-East</td>
<td>Paradip</td>
<td>+11 to +44°C</td>
<td>+65°C / max 90°C</td>
<td>99.7%</td>
</tr>
<tr>
<td>2012</td>
<td>India, South-East</td>
<td>CPCL</td>
<td>+18 to +45°C</td>
<td>+66°C / max 93°C</td>
<td>80%</td>
</tr>
<tr>
<td>2012</td>
<td>UAE</td>
<td>Takreer</td>
<td>+ 7 to +48°C</td>
<td>+66°C</td>
<td>100%</td>
</tr>
<tr>
<td>2014</td>
<td>Oman</td>
<td>SOHAR</td>
<td>+ 5 to +50°C</td>
<td>+65°C</td>
<td>100%</td>
</tr>
<tr>
<td>2014</td>
<td>India, East</td>
<td>Barauni</td>
<td>+5°C to +46°C</td>
<td>+65°C / max 90°C</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>Kuwait</td>
<td>KNPC</td>
<td>-3°C to +50°C</td>
<td>+65°C / max 90°C</td>
<td>100%</td>
</tr>
<tr>
<td>2015</td>
<td>Jamnagar</td>
<td>Reliance</td>
<td>1°C to +50°C</td>
<td>+65°C / max 90°C</td>
<td>80%</td>
</tr>
<tr>
<td>2016</td>
<td>India, North-East</td>
<td>Haldia</td>
<td>1°C to +50°C</td>
<td>+65°C / max 120°C</td>
<td>100%</td>
</tr>
</tbody>
</table>
**Coker Units**

**Coker in India**
- Numarligarh
- Bongaigaon
- Guwahati
- Dig Boi
- Reliance I / II
- Gujarat
- Digboi
- Panipat
- Binar
- Essar
- HMEL
- MRPL
- NOCL
- Paradip
- CPCL
- BPCL
- Barauni
- Haldia

*Coking.com, Mumbai 2016*
Coker HMEL

Installation: India
HMEL
Jet Pump area

Jet Pump unit sheltered

Installation: India

Coking.com, Mumbai 2016
HMEL
Jet Pump area
- Jet Pump unit sheltered

Installation: India
Coker IOCL Paradip

Installation: India

Coking.com, Mumbai 2016
## Hydraulic system

- **Features**
  - Hydraulic power unit HPU
    - Redundant m-p
    - Designed for hoist and DSD operation
  - Hyd. Driven hoist + DSD

- **Special features for WWA**

## Electrical system

- **Features**
  - VFD for hoists and DSD
    - Redundant
    - Installed in safe area
    - Or on cutting deck (DSD)
  - Motors + brakes explosion proof

- **No limitation due to Temperature**

### +/-

<table>
<thead>
<tr>
<th>+/−</th>
<th>HPU design to refinery standard</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>hydraulic oil is needed in the derrick</td>
</tr>
<tr>
<td></td>
<td>flammable</td>
</tr>
<tr>
<td></td>
<td>3 Pipes per line required</td>
</tr>
<tr>
<td></td>
<td>Cooling in WWA</td>
</tr>
<tr>
<td></td>
<td>powerful, precise controllable</td>
</tr>
</tbody>
</table>

### +/−

- VFD set is needed with limited cable
- Not flammable
- ATEX required
- Cabling is cheaper than piping
- Powerful, precise controllable
- More space required
Control and process instrumentation

- Hoist,
- Operation
- Variable Frequency Converter VFD
- Hoist ATEX, CSA, CCOE
- Rope tension in the rope
  - indication at the operator panel
  - avoiding of overload
- Variable Frequency Converter VFC
  - Installed in purged cabinet
Hoist and Rope

- Hoist with integral cartridge gear
  - drum with grooves
  - Pull force 5000 kg
  - slack rope device and indicator
    - locks the hoist

- Rope
  - 16/18 mm
  - measurement of tension in the rope
  - indication at the operator panel
  - avoiding of overload
Lifting System

HMEL Cutting Deck
- Hoist electrical driven protected equipment

Capacity pull force 5000 kg

Installation: India

Coking.com, Mumbai 2016
Crosshead with DSD

Derrick

Crosshead
  wheel type
  Free Fall Arrestor

Meeting larger tolerances in derricks compared to shoe type crossheads

Drill Stem Drive
  - Electrical driven

All weather protected

Installation: Egypt

Coking.com, Mumbai 2016
Crosshead with DSD

Derrick

Crosshead
wheel type
Free Fall Arrestor

Meeting larger tolerances in derricks compared to shoe type crossheads

Drill Stem Drive
- hydraulic driven

All weather protected

Installation: India

Coking.com, Mumbai 2016
RUHRPUMPEN – auto-combination Tool

**Basic design**
- Slim tool, OD 13"
- Low lift force
- Low torque

**Switching devices**
- Manual / Automated
- At the top of the tool

**Valves**
- Puck valves
- No seals
- Pressure operated

**Nozzles, cutting**
- 0°
- 10° up both cutting nozzles

**Nozzles, drilling**
- 1 strong centre nozzle
- 3 periphery nozzles
Control system

HMEL
Cutting Deck

Operator Shelter
2 x 100% HVAC
fire resistant material
safety glass

Operator Panel
- VFD Cabinet for hoist
purged, cooled

Installation: India

Coking.com, Mumbai 2016
Control and process visualisation

Operator Panel

Control of hoist and DSD

With monitor interactive PID tendency

Installation: India
Control and process visualisation

Operator Panel

Control of hoist and DSD

With monitor interactive PID tendency

Installation: India
Project Situation

**Mechanical Design**

Target:
- high safety of the complete system

Result:
- 

**RUHRPUMPELEN:**
- Design of a mechanical system with high safety and reliability
- For project requirement
- Related to project costs

- **NOT:** just technical acceptable to minimum costs (EPC)
### Mechanical Design

<table>
<thead>
<tr>
<th>Jet Pump unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design related to coke cutting system (API 610, 613, 614)</td>
</tr>
<tr>
<td>Flow and Head defined very precise,</td>
</tr>
<tr>
<td>often without relation to detailed piping</td>
</tr>
</tbody>
</table>

### Instrumentation, PLC design

<table>
<thead>
<tr>
<th>Control System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Licensor spec. often not up to date</td>
</tr>
<tr>
<td>Long project time</td>
</tr>
<tr>
<td>PLC redundant</td>
</tr>
<tr>
<td>Basic Logic-Safety requirements</td>
</tr>
</tbody>
</table>

### Cutting System

<table>
<thead>
<tr>
<th>Design spec. with basic requirem.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic / electric</td>
</tr>
<tr>
<td>Basic spec. of CCS-components</td>
</tr>
<tr>
<td>ie.: Auto-Tool, CH-FFA, (hoist), logic</td>
</tr>
<tr>
<td>Detail design responsibility by CCS vendor</td>
</tr>
</tbody>
</table>

### Instrumentation

<table>
<thead>
<tr>
<th>Project P&amp;ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detailed design by CCS vendor</td>
</tr>
</tbody>
</table>
# Project Specification - EPC

## Mechanical Design

**Jet Pump unit + auxiliaries**
1. Design acc. API 610, 613, 614
2. Client specification
3. EPC specification (- no deviation )
4. Manufacturer standard / Experience

## Instrumentation, PLC design

**Control System**
- Licensor spec.
- Client specification
- EPC requirement
  - High safety -> QMR/TMR
  - SIL rated (Safety) PLC

## Cutting System
- No deviation
  - All components to 1.- 3.
- Special components
  - to Client / EPC standard
  - ie: Auto-Tool, CH-FFA, hoist, HPU, VFD

## Instrumentation
- No deviation
  - All components to 1.- 3.
  - All to AVL (App-Vendor-List)
  - 100% to licensor P&ID
## Project Situation

### Mechanical Design

<table>
<thead>
<tr>
<th>Target:</th>
<th>- increased safety of the complete system</th>
</tr>
</thead>
</table>
| Result: | - oriented to project specification and documentation  
- not oriented to a strong mechanical system  
- overdesigned and complicate control and instruments  
- High Level Control System for a weak mechanical system |

### Instrumentation, PLC design

**RUHRPUMPEN:**

Design of a mechanical system with double mechanical safety via different components (not 2003) acc. project needs  
Control System to operate the mechanical system.
Summary and Conclusion

Target should be a safe and strong Coke Cutting System

Focus
- strong mechanical system
  - meeting the actual requirements of the local plant
  - controlled from a safe and reliable control system
  - redundant with redundant I/Os for safety signal only

RUHRPUMPEN:
Designs and manufactures a mechanical system with double mechanical safety via different components (not 2oo3) acc. project needs
Control System is built to operate the mechanical system.
THANKS FOR YOUR ATTENTION

Questions?