Coke Cutting Systems for India
Technology, experiences and lessons learned

Mumbai, 13\textsuperscript{th}-14\textsuperscript{th} November 2019

Dr. Wolfgang Paul,
\textit{RUHRPumpen}
Introduction

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
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

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

Orland, California
Area: 2,500 m²

Suez, Egypt
Area: 2,280 m²
Testing: 2,680 HP
Coker in India

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Coke Drums</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOCL Bau1</td>
<td>Barauni</td>
<td>2 drum</td>
</tr>
<tr>
<td>IOCL Guw</td>
<td>Guwahati</td>
<td>2 drum</td>
</tr>
<tr>
<td>IOCL Bon1</td>
<td>Bongaigon</td>
<td>2 drum</td>
</tr>
<tr>
<td>IOCL Bon2</td>
<td>Bongaigon</td>
<td>2 drum</td>
</tr>
<tr>
<td>RIL DTA</td>
<td>Jamnagar</td>
<td>8 drum</td>
</tr>
<tr>
<td>NRL 1</td>
<td>Numaligarh</td>
<td>2 drum</td>
</tr>
<tr>
<td>IOCL Digboi</td>
<td>Digboi</td>
<td>2 drum</td>
</tr>
<tr>
<td>IOCL Pan</td>
<td>Panipat</td>
<td>4 drum</td>
</tr>
<tr>
<td>RIL SEZ</td>
<td>Jamnagar</td>
<td>8 drum</td>
</tr>
<tr>
<td>BORL Bina</td>
<td>Bina</td>
<td>2 drum</td>
</tr>
<tr>
<td>IOCL Guj</td>
<td>Gujarat</td>
<td>4 drum</td>
</tr>
<tr>
<td>HMEL</td>
<td>Bhatinda</td>
<td>4 drum</td>
</tr>
<tr>
<td>MRPL</td>
<td>Mangalore</td>
<td>4 drum</td>
</tr>
<tr>
<td>IOCL Par</td>
<td>Paradip</td>
<td>4 drum</td>
</tr>
<tr>
<td>Essar</td>
<td>Vadinar</td>
<td>6 drum</td>
</tr>
<tr>
<td>BPCL</td>
<td>Kochi</td>
<td>4 drum</td>
</tr>
<tr>
<td>CPCL</td>
<td>Chennai</td>
<td>2 drum</td>
</tr>
<tr>
<td>IOCL Bau2</td>
<td>Barauni</td>
<td>2 drum</td>
</tr>
<tr>
<td>RIL DTA</td>
<td>Jamnagar</td>
<td>2 drum</td>
</tr>
<tr>
<td>IOCL Hal</td>
<td>Haldia</td>
<td>2 drum</td>
</tr>
</tbody>
</table>

Coking.com, Mumbai 2019
Coke per drum

Mass of coke per drum to cut

Coke (t) per drum,
RuhrPumpen - Cutting systems in India
## Project Schedule, Live cycle

<table>
<thead>
<tr>
<th>Live cycle</th>
<th>years</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Decision by owner and financing</td>
<td>0</td>
</tr>
<tr>
<td>• Licensor</td>
<td>1</td>
</tr>
<tr>
<td>• EPC</td>
<td></td>
</tr>
<tr>
<td>• Purchasing</td>
<td></td>
</tr>
<tr>
<td>– Long lead items</td>
<td>4</td>
</tr>
<tr>
<td>– Bulk material</td>
<td></td>
</tr>
<tr>
<td>• Construction</td>
<td>6</td>
</tr>
<tr>
<td>– Commissioning</td>
<td></td>
</tr>
<tr>
<td>• Start up, start of operation</td>
<td>8</td>
</tr>
<tr>
<td>– Warranty</td>
<td>10</td>
</tr>
<tr>
<td>– Post warranty</td>
<td>10 + 5</td>
</tr>
<tr>
<td>• Modernization and upgrade</td>
<td></td>
</tr>
</tbody>
</table>
India

Projects with state own companies

No deviation bids
JUST TECHNICAL ACCEPTABLE,
we don’t pay a premium
100% according specification

Result

• Required technology with PTR is more than 10 years old
• Basic Requirements don’t support deviations and improvements

• New technologies and improvements will be considered late
  – 1990 – 2000  acceptable
  – 2000 – 2010  changes in private companies influenced the state own sector
  – 2010 – 2020  moderate changes in specification
  – 2020 -     not according the fast growing demands of economy in India
### Mechanical Design

**Jet Pump unit**
- Design related to coke cutting system (API 610, 613, 614)
- Flow and Head defined very precise,
  - often without relation to detailed piping

### Instrumentation and Control

**Control System**
- Licensor spec., basic
- PLC redundant,
- Basic Logic and Safety requirements

### Cutting System

**Design spec. with basic requirement**
- Pneumatic / hydraulic / electric
**Basic spec. of CCS-components**
- Detail design responsibility by CCS vendor
- NO definition of power of Cutting System

### Instrumentation

**Project P&ID**
- Detailed design by CCS supplier
**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

**Cutting System**
- No deviation
  - All components to 1.- 3.
- Special components
  - NO detail definition
  - ie: Auto-Tool, CH-FFA, hoist, HPU, VFD

**Instrumentation and Control**

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

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

### Mechanical Design

**Jet Pump unit**
- acc. Licensor / EPC and Decoking Service requirements

### Cutting System

- Main differences
  - Power, Features
- Hoists
- Drill Stem Drives, RJ
- Crosshead and FFA
  - Free Fall Arrestors
- Cutting Tool
  - Important is pressure at the Tool

### Instrumentation and Control

**Control System**
- Licensor and EPC spec.
- PLC redundant
- Safety requirements by Licensor
- Logic by supplier
  - System responsibility
- Data analysis

**Instrumentation**
- Project P&ID
- RP improvements
  - Additional instruments
Power of Cutting System

- Hoist
- Pulleys
- Rope
- Load in derrick

Power Cutting System related to drum size and jet pump power

Jet Pump Power %
Drum Volume %
Power Cutting System (exist. Standard) %
Power Cutting System (RP) %
Development of Technology

Drive of Cutting Systems

Coke Cutting Systems, pneum - hyd - electric western systems

- pneumatic Coke Cutting Systems
- hydraulic Coke Cutting Systems
- electric Coke Cutting Systems

Coking.com, Mumbai 2019
Development of Technology

Drive of Cutting Systems

Coke Cutting Systems, pneum - hyd - electric western systems

- pneumatic
- hydraulic
- electric

Coking.com, Mumbai 2019
Ruhrpumpen to Owner / PMC / EPC

Cutting System Drive

**Electrical**
- technical and commercial advantages
- costs for hydraulic or electric systems are equal
- total costs are lower
  - cabling is much cheaper than piping
- less risk

**Live cycle costs**
- maintenance costs are much lower with electrical equipment
- no oil consumption, no oil treatment

**Benefits have not been balanced to the supplier**
Supply of Ruhrpumpen to Projects in India

**Cutting System**
- Crosshead: Wheel type
- Free Fall Arrestor: Rail type system, certified as elevator component
- Control System: Monitors at Pumps and Cutting deck with interactive P&IDs
- Tool: Automatic Drilling / Cutting Tool

Most of the features are now standard feature because they were just implemented not specified
Projects in India with RP influence

RIL II - Hydraulic driven cutting system
IOCL Gujarat - Spec. change to hydraulic driven cutting system
HMEL - Cutting System with 5t/20t pullforce of hoist/Crosshead
- first electrical driven cutting system in India
- designed for remote and automatic operation
MRPL - Hydr. Cutting System with 5t/20t pullforce of hoist/Crosshead
NOCL - Electrical Cutting System with 5t/20t pullforce of hoist/CH
IOCL Paradip - Hyd Cutting System with 5t/20t pullforce of hoist/Crosshead
IOCL Barauni - Electrical Cutting System with 5t/20t pullforce of hoist/CH
CPCL - Hydraulic Cutting System with 5t/20t pullforce of hoist/CH
IOCL Haldia - Electrical Cutting System with 5t/20t pullforce of hoist/CH

Since then, all Cutting Systems are specified electrical driven
Example

Licensor pid: “detail design according Coke Cutting System supplier”
PMC: “no deviation to licensor pid“
EPC: “Deviation with approval of PMC only“

Piping:
- Suction Line
  - 2 Jet Pump - installation
  - Jet Pump: Suction flange and area with MAWP
- Discharge Line
  - Size of discharge line
Project Situation, Pump arrangement

**India**

**Project:** all projects are designed with TWO PUMP arrangement
increase of reliability of coker

**Licensor:** Suction and Discharge design to full MAWP

**EPC:** Deviation only with approval of PMC and licensor

**Problem:**
- Full pressure suction line
- Reduced inside, effective diameter
- Suction pressure instrumentation away from the suction flange

**Situation**
- Pressure drop in pump suction is much higher than measured
Client 1
Jet Pump area
- 2 Pumps installed
- Jet Pump unit sheltered
Client 1
Jet Pump area

2x Jet Pumps installed
- Sheltered

Suction Line
- Low Pressure
- High Pressure

Tank
- Suction Inlet Basket

Coking.com, Mumbai 2019
India: Client 1
Start up 2010
Problem: Cavitation
Investigation of
   Tank
   Suction Line
   Pump

Result:
Change of
- Suction Line
- Suction Basket
- Pumps run ok
<table>
<thead>
<tr>
<th>Coker</th>
<th>Client 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>state owned</td>
</tr>
<tr>
<td>Drum</td>
<td>4</td>
</tr>
<tr>
<td>Dia</td>
<td>max</td>
</tr>
<tr>
<td>FF</td>
<td>max</td>
</tr>
<tr>
<td>Pump</td>
<td>2</td>
</tr>
<tr>
<td>Flow</td>
<td>max</td>
</tr>
<tr>
<td>Pressure</td>
<td>max</td>
</tr>
</tbody>
</table>
India: Installation 2015
India:
Suction Line Investigation
Start up 2017
Check 2018
Ruhrpumpen

Project bid: according spec, but lowest costs and high competitive situation

Selection of suppliers:

- **start 2000**: castings for pump internals from Germany
- **2005 - 2010**: castings, high quality, from SK
- **2010 - 2015**: castings from low cost foundry, country 1
- **2015 - 2019**: castings from low cost foundry, country 2
- **2019 -**: castings from high quality foundry, country SK

RP had to develop the low cost supplier

this was painful

long time of correction due to project schedule

Meanwhile the quality of casting is good, acceptable and acc. RP spec
Project

Specification:

- no definition of pullforce nor lifting system
- no relation to size of coker

Ruhrpumpen has always provided the strong Cutting / Lifting System

- according Ruhrpumpen standard,
- above requirements, 5 t / 20 t Lift System, 0 to high speed
- accepted by all parties, because on RP costs

Lessons learned

- we did not went away from our high standard for cost savings
- we want to keep high performance and high reliability
Lifting System

India: Client 4

Cutting Deck

- Hoist
  - electrical driven
  - slack rope device
  - 3 brake system
  - safety cage
  - full baseframe

Capacity

- pull force hoist 5 t
- pull force at tool 20 t
- pull speed 0 – 1 m/s

Operation

- local
- (remote / auto)
Client 4
Derrick

Crosshead
wheel type
Free Fall Arrestor

Meeting larger tolerances in derricks compared to shoe type crossheads

Drill Stem Drive
- electrical driven
- No oiled main bearing

All weather protected
Automatic Cutting Tool

Basic design
- Slim tool, OD 13”
- Low lift force, low torque

- Switching devices
- Mode Indicator
  - At the top of the tool

- Valves
  - No seals
  - Pressure operated

- Nozzles, cutting
  - 0° / 0°

- Nozzles, drilling
  - 1 strong centre nozzle
  - 3 periphery nozzles
Ruhrpumpen

Project bid: according spec, with acceptable costs with additional features

RP has increased level of Control System and Operation
acc. RP standard, above requirements
monitors with all available data and information
interactive P&ID’s
high acceptance by all operators
ready for remote and auto cutting, even when not specified

Meanwhile, most of the features are standard for Coke Cutting Systems
Control system

Client 4
Operator cubicle

- Operation in
  - heated
  - prewired
  - Fire resistant material
  - Safety glass
  - Round and top view
Operator Panel

Control building
Lessons learned

System Design

Target: Mechanical System on high safety level of the entire system
Create a Standard NOT JUST TECHNICAL ACCEPTABLE

Discuss with Licensors to implement improvements
Convince Final Clients about benefits of additional features
EPC’s go for low costs, EPCs don’t implement advantages
provide costs savings to EPC

RUHRPUMPEN: Complete System responsibility out of one hand

Design: Strong mechanical system with double mechanical safety
Control System is just to operate the mechanical system.
It cannot balance mechanical weakness.
Costs Don’t go to the lowest cost level.
Coke Cutting System

Design: Modification of RP standard to specific needs of Indian Clients

Discussion, relation and contacts on high level with
- Client with high expertise and experiences in coker business
- EPC’s with very good knowledge to meet local requirements
- It is necessary to understand Indian mentality

RUHRPUMPEN:
- we formed a strong relation to our clients
- System responsibility not only in good times

Start: We started to work out of Germany, but now
Actual: RUHRPUMPEN INDIA with manufacturing facility in Chennai
- growing support team for coker
THANKS FOR YOUR ATTENTION

Questions?