SPECIFYING SAFETY & MAINTENANCE TECHNOLOGY INTO NEW PROJECTS

PRODUCT MANAGER
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Agenda:

• Decoking System Introduction
• Mechanical & Structural Specifications  
  – Access  
  – Equipment
• Safety  
  – Remote Drum Monitoring (What/Why?)  
  – Automation
• Summary
Decoking System Introduction:
Decoking System Introduction

Coke Boring Stage
Decoking System Introduction

Coke Cutting Stage
Access

• Grade Maintenance Access
  – Pump train
    • Overhead Crane
  – DCV
    • No P-Trap
  – Bleed Valve
Access

• Tower Maintenance Access
  – Rotary Joint
    • Lubrication & Change out
  – Crosshead
    • Maintenance & Change out
    • Limit Switch Access
  – Pulley Blocks
    • Guide Block
    • Multiple Drum Access
Access

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  - Rotary Joint
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Equipment
Equipment Repair Maintenance

• Considerations
  – MTBR
  – Field Repairs
• Cartridge-Design
  – Pump
  – Decoking Control Valve
  – Rotary Joint Dual Seal
  – Autoshift Cartridge
Standard Decoking Jet Pump
Follow proper Bolt Torquing Procedure (IOM Table)

Note: Rotor Assembly is “pre-set” at the factory by Flowserve. No additional setting is required.
Control Valve: Cartridge DCV Upgrade & ADCV
Rotary Joint Dual Seal Cartridge
Equipment Preventative Maintenance
Cutting System Drivers

Rotary Joint

Winch
Hydraulic Motors

Main technical reasons (1994):
• Improve general working conditions for operation personnel (handling, safety)
• Eliminate operation issues in very cold climate
• Precision control of equipment for operator

Cons:
• Space for Hydraulic Power Unit on the deck
• Intensive piping (3 lines from HPU to each motor)
• Cleanness of the hydraulic oil is key for trouble free operation
Hydraulic Driven Decoking Equipment

Scope (supplied by Flowserve)

- Hydraulic motors with Winch & Rotary Joint
- Supply, Return & Drain line hydraulic hose bundle (running along the Decoking hose)
- Hydraulic power unit (HPU) approx. 3000 psi (211 kg/cm²)

Utilities (by refinery)

- Electrical LV power supply – 100 HP (75 kW) for HPU
- Cooling air or water for HPU
Why Electric Motors?

Main technical reasons (2008):
• Proven technic was available and affordable
• Reduce installation and maintenance efforts

Cons:
• Space for electric motors
• Limitation in cable length
Key Design Parameter Electric Driven Winch

Climate conditions:
- Temperature: -76 °F (-60°C) ... +130°F (+55°C)
- Ambient: heavy duty industrial conditions with high exposure to dust and steam

Coker specific operation requirements:
- 9.900 lbs line pull
  - 39.600 lbs (18 t) pullout force at drill stem
- High torque at low speed
- 130 ft/min (40 m/min) line speed
  - 4 minutes transfer time top to bottom in largest drums
- Minimum stall capability of 10 min
  - Required for cases of Coke Bed Collapse
  - Tested for 55 min without significant temperature increase (ambient 68°F)
Electric Motor - Design Features

- E-motor, flameproof
  (ATEX II 2 G EX DE IIC T4)
- Low voltage squirrel cage induction motor
  Winch: 40 hp (30 kW)
  Rotary Joint: 15 hp (11 kW)
- Winding temperature 3x PTC
- Internal shaft encoder (for winch)
- Forced ventilation by separate fan motor (if applicable)
- Rated Stall capability for 10 min (tested for 55 minutes)
Design Parameter Electric Driven Rotary Joint

Climate conditions:
• Temperature: -76 °F (-60°C) ... +130°F (+55°C)
• Ambient: heavy duty industrial conditions with high exposure to dust and steam

Coker specific operation requirements:
• Drill Stem speed range 0-18rpm
  • Average Boring Speed 10-15 rpm
  • Average Cutting Speed 5-10 rpm
• Stall Torque at drill stem of 9.000 ft-lbs (12.200 Nm)
• Minimum stall capability of 10 minutes
  • Required for cases of Coke Bed Collapse
  • Tested for 55 min without significant temperature increase (ambient 68°F)
Basic Layout Electric Drives

- Low voltage E-Motor
- Additional fan motor (if applicable)
- Encoder (for winch)
- Spring return electromagnetic disc brake (for winch)
- Variable frequency drive with brake resistance
Variable Frequency Drive - Design Features

- Redundant set of VFDs: selectable for OPERATION or STANDBY

- Panel mounted preferred in safe area (Area rated panels available)

- Max. cable distance between VFD and motor 3,250 ft (1000 m)

- Field oriented control with Set / Actual speed value comparison
  - “Anti slip” for winch motor – motor can hold the cutting equipment in position without movement (rotation); standstill operation while the brake is fully open

- Fast stop function (for winch) to lower motor speed quickly
Safety
Remote Drum Monitoring: Why?

The water jet creates a specific sound on a clean drum wall

- By Their Ears
- By Their Eyes
- By Their Personality
Remote Drum Monitoring: Why?

**Challenges Posed:**
- Low Visibility
- Noise Variation / Inaudible
- Safety:
  - High Temperature/Pressure Gases & Liquids Present
  - Combustible Materials/Gases

**Goal:** Eliminate challenges, heighten safety through remote cutting, and increase operator efficiency by quantifying drum cleanliness & enhancing operator awareness.
Remote Drum Monitoring: Vibration
Remote Drum Monitoring: Vibration

- Vibration sensors designed for high temperature application
- Area rated
- Minimum invasive attachment
- Easy replacement/maintenance
- Standard Drum Vibration Monitoring System Consists of 5 Probes
Remote Monitoring: Vibration & Audio

DAQ System

- Reprogrammable Embedded System (Real-Time OS & FPGA)
- High Speed:
  - Data Acquisition/Signal Processing
  - Data Analysis (FFT, RMS, Filter)
- (x8) Slot Rack For Custom I/O (customizable.2-4-6 drum system)
- (x3) MODBUS Serial Communication Interface
Drum Monitoring: Audio

- Standard Audio System Consists of 3 Microphones
- Surface Mounted on Junction Box for Easy Installation/Replacement
Drum Monitoring: Video

- Standard Camera Issues
  - Corrosion
  - Coke Fine Accumulation
- Self Cleaning
- Pan – Tilt – Zoom
- Area Certification
- Engineered Placement
  - Cutting Deck
  - Winches
  - Pit
Drum Monitoring: Video

- Local cutting console for maintenance or manual cutting
- Winch camera - (6) mounted on cutting deck monitoring winch (Fixed)
- Deck camera - (5/6) mounted on cutting deck monitoring the top of the drum (Pan Tilt Zoom)
- Pit camera (5) - mounted between drums or near grade monitoring pit and chutes (Pan Tilt Zoom)
Drum Monitoring: HMI Overview

- Vibration Strip Charts
- Instantaneous Vibrations
Drum Monitoring: HMI Overview

Field Information

Push Button Controls
Drum Monitoring: HMI Overview

Drum Cleanliness Will Be Indicated Here
Drum Monitoring: HMI Overview

Example Indicating Cone Section is Clean
Drum Monitoring: Operator Control Panel
Drum Monitoring: Operator Control Panel
Drum Monitoring: Operator Control Panel
Automation

What:
Automatically transitions the Autoshift tool from *bore* to *cut* mode and completes the decoking process by accurately monitoring drum cleanliness.

How:
Utilizing the Vibration Monitoring System, along with the PLC interlocks, *Automation* can be achieved.
Automation: Benefits

– **Improved cutting personnel safety**
  - Automated cutting system integrated with PLC interlocks
    – Minimize probability of operator mistake
    – Eliminates shortcuts sometimes taken by cutting personnel
  - Standardized cutting procedures reduce risk of aggressive cutting practices

– **Improved equipment reliability**

– **Process efficiency and consistency**
  - Advance program and cutting tool as soon as possible
  - Consistent cutting times with standardized cutting procedure

– **Data recording for process optimization or troubleshooting**
  - Cycle Time Optimization
  - Ability to access data for troubleshooting in case of event
Summary

• Access
  – Ensure Structure Access is part of the specifications
  – Participation with equipment vendor feedback in Model Reviews

• Maintenance
  – Consider PM work & MTBR in Equipment Selection

• Safety
  – Remote Cutting & Automation MUST be specified into the contract
THANK YOU.

QUESTIONS?