Remote & Automated Coke Cutting

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Flowserve FSG
Agenda

- Flowserve Overview
- Decoking System Overview
- Process Benefits
- Remote Cutting Requirements
- Automation Requirements

- Required Equipment
- Drum Monitoring
- Automation Process
- Lessons Learned
Simplified 2 Drum Decoking System
The Goal...is ... transition from
To…. modern systems
Remote Coke Cutting

Move operator from the cutting deck to a remote location

Benefits

Increased Safety

Personnel no longer exposed to:

- High-pressure water
- Hot spots or steam eruptions
- Fire and mechanical hazards
- Hydrogen sulfide vapors
- Noxious vapors

Improved Operator Information
Automated Decoking

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
Remote Coke Cutting Requirements

**Information required for the Operator**
Data sent remotely to operator

- Cutting tool position and rotational speed
- Cable tension and AutoShift mode
- Drum status

**Equipment required**

- Unheading valve
- AutoShift™ cutting tool
- Remote operator shelter or location
- Automated tool enclosure and drill stem guide
- Remote winch and rotary joint operation
- Vibration/acoustic/video drum monitoring
Automation Coke Cutting Requirements

**Equipment required**

- Unheading valve
- AutoShift™ cutting tool
- Remote operator shelter or location
- Automated tool enclosure and drill stem guide
- Remote winch and rotary joint operation
- Vibration drum monitoring
Remote Winch & Rotary Joint Operation
Drive Options

- **Hydraulic** – introduced by Flowserve in 1994
  - Higher Initial installed cost
  - Low maintenance during operation
  - Can combine with unheading valve HPU for cost savings.
  - Best option for remote & automated cutting with electric actuation

- **E-motor (with VFD)** – In operation since 2008
  - Approximately same initial cost as hydraulic
  - Low maintenance during operation
  - Requires electrical installation in tower by contractor.
  - Best option for remote & automated cutting with hydraulic actuation

- **Air piston motor** – Original power option
  - Lower initial installed cost
  - Requires frequent repair if lubrication is not maintained frequently or dry, clean air is not used.
  - Suitable for remote & automated cutting
Why Air Motors?

Main technical reason (1938):
• No problems for operation in hazardous areas (Ex zones)

Cons:
• Dependence on plant air (potential low pressure issues)
• Air quality (moisture problems in freezing temperatures)
• Low equipment control precision
• Noise and oil mist
• Intensive maintenance required
Hydraulic Motors in 1994

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
Why Electric Motors?

Main technical reasons (2008):
• Proven technology is available and affordable
• Reduces installation and maintenance efforts

Cons:
• Space for electric motors
Electric Motor Design Features

- E-motor, flameproof (Ex‘de‘)
- Low voltage squirrel cage induction motor
  - Winch: 30 kW
  - Rotary Joint: 11 kW
- Winding temperature 3x PTC
- Internal shaft encoder (for winch)
- Forced ventilation by separate fan motor
- Rated Stall capability for 10 min (tested for 35 minutes)
## Comparison Of Actuators

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Flowserve Innovation

Drum Monitoring – Audio, Video & Vibration
Operator feedback for Cutting progress

- Personal Cutting Style & Experience
- Visual Feedback
- Audio Feedback

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Confusing Environment

- Decoking is an extremely *NOISY* service:
  - Refinery machinery and coke cutting equipment
    - Winches / Crossheads
    - Weather / Wind
  - Area surrounding high noise activities
    - Equipment: pumps/motors
    - Trains / Skip loaders / Cranes
    - Steam / air / process noise
    - Alarms / Sirens/
Challenging Layouts & Situations

- Decoking is also a **LOW VISIBILITY** service:
  - Outdoor unsheltered area
    - Inclement weather fog / rain / snow / storms
    - Process produces steam, vapors & explosions
  - Area surrounding has visual obstructions
    - Piping / structural beams / wiring / equipment
Solutions: Provide Same or Improved Information To Remote Locations

- **Provide reasonable reproduction of the Sounds**
  - Remote Audio Systems

- **Provide reasonable duplication of the Sights**
  - Remote Camera Systems

- **Provide additional detailed information on the process activity to manage better decisions.**
  - Remote Drum monitoring information
Updated & Simplified Audio system

- Compact/simple arrangement
- Area rated
**Video Design Equipment Challenges**

- **Video Camera**
  - Standard Camera Issues
    - Corrosion
    - Coke Fine Accumulation
  - Self Cleaning
  - Pan – Tilt – Zoom when necessary
  - Area Certification

**Engineered Placement**

- Cutting Deck
- Winches
- Pit
Automation System Architecture

Coker Drums → Vibration Sensors → IPS APEX

Serial Modbus communication

HMI

Decoking Control System

Field Devices

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Cutting Overview on HMI

Vibration Strip Charts

Instantaneous Vibrations
Cutting Overview on HMI

Field Information

Push Button Controls

Flowserve

Hydraulic Decoking Systems
Cutting Overview on HMI

Drum Cleanliness Will Be Indicated Here
History - Pre-programmed cutting

First used in early 1980s
PLC programmed to operate equipment at pre-defined parameters
Limited feedback signals about cutting progress
Program is customized based on the established best practices of the operators
Operator interface required
Automated Decoking

**Flexibility**
- Cutting Style Options
- Coke Type Options
- Multiple Backup Options
- Start/Stop/Pause Operator Control

**Exception Handling**
- Coke Bed Collapses
- Slack Cable

**Reliable**
- Clean Drum Sensing
- Auto-calibration