Improved Safety & Efficiency through Remote and Automated Coke Cutting

Coking and CatCracking Conference, New Delhi, India October 2013

Subramanya Prasad
Engineering Manager, Instrumentation and Controls
Agenda

- Company overview
- Introduction
- Environments
- System Options
- Capabilities and benefits
- System installation
- System operation
Flowserve Overview

• **With over 15000 employees in over 55 countries, we combine our global reach with a local presence**

• **Serving the process industry with a strong history of brand names and industry experience**
Hydraulic Decoking Systems History

1938  Process patented by Shell
1938  Original Jet pumps & valves by Worthington
1940  PACIFIC® enters the market
1985  Pacific & Worthington merge
1992  Pump Divisions of Ingersoll-Rand & Dresser form joint venture
2000  Flowserve acquires IDP
Introduction

• Safety, Remote Cutting & Process optimization
  • HDS process overview
    – Boring
    – Cutting
  • Remote cutting
    – Equipment/Shelters
  • Coke Drum monitoring
    – Audio
    – Video
    – Vibration
  • Automated Decoking
    – Preprogrammed
    – Fully Automated
Hydraulic decoking system simplified schematic -2
Drum decoking system
Hydraulic Decoking

Removing coke from the drum

Fracture coke bed hydraulically using high-pressure water
Cutting water is recycled

2-Step process

1. Boring
Hydraulic Decoking

Removing coke from the drum

Fracture coke bed hydraulically using high-pressure water
Cutting water is recycled

2-Step process

2. Cutting
The Goal...is ... transition from
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
Transition to modern systems
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

❖ Provide the ability to automate the process while providing additional detailed information
  ◦ Automated Decoking
Audio Systems

- Use microphones to replicate the sound heard by the operator on the deck

- System comprises of
  - Microphone
  - Processing module
  - Speakers
  - Analysis systems (optional)
Video Systems

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

Engineered Placement
• Cutting Deck
• Winches
• Pit
Vibration Based Drum Monitoring

- **Uses vibration sensors as feedback on the cutting operation**
- **Vibration based Drum monitoring system gives additional information to the operator**

**Components**
- Vibration probes
- Processing module
- HMI
Remote Coke Cutting benefits

Move operator from the cutting deck to a remote location

• Improved cutting personnel 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
Remote Coke Cutting Requirements

**Equipment required**

- AutoShift™ cutting tool
- Remote operator shelter or location
- Remote winch and rotary joint operation
- Automated tool enclosure and drill stem guide
- Vibration/acoustic based drum monitoring
- Control system
- Video monitoring
**AutoShift™ cutting tool**

- Mode changes automatically and remotely by pressurization and depressurization of water WITHOUT lifting the tool out of the drum
- Shift is achieved when decoking valve changes from full flow to by pass
- No need for operator to manually switch the tool
Remote operator shelter
Remote Coke Cutting

Equipment required

Remote winch and rotary joint operation

- Upgrade or install hydraulic or electric drive systems
Remote Coke Cutting

Equipment required

Automated tool enclosure and guide plate
Control Systems
Vibration sensors

- Vibration sensors designed for high temperature application
- 5 Probes
- Minimum invasive attachment
- Easy replacement/maintenance
- Area rated
Vibration sensors
Automated decoking

• **Ultimate safety – complete automation of the coke removal process**

• **Operator observes the cutting process and can intervene at any time**

• **Automated decoking implemented as**
  
  • Preprogrammed cutting
  
  • Fully Automated cutting
Automated Decoking

Basic operation

• Use vibration sensors mounted on the coke drum to provide feedback on the state of cleanliness of the drum wall
• Sensors provide interactive feedback on the cutting status that can optimize the cutting time
• Program is customized based on site-specific cutting practices and configured with end user
Automated Decoking

Winch and drill stem are operated via PLC control unit and depend upon signals monitoring:

- Position of the cutting tool
- Speed for lowering and lifting the cutting tool
- Wire rope tension
- Rotation of the drill stem
- Coke cutting progress
IPS APEX

- **Flowserve designed hardware to embed algorithms such**
  - Decoking Drum monitoring
  - Automated decoking
  - Type PR/Ebullator monitoring
- **High speed data processing capability**
- **Serial Modbus RTU communication protocol**
- **Software customized based customized to customer site specific information**
IPS APEX

• **Features currently incorporated in the IPS APEX for automated decoking includes**
  • Coke type and cut type options
  • Tool mode verification
  • Tool recovery
  • User options to control the process
  • progress indication on the operation on the HMI
  • Error indicators
  • Clean drum verification
  • Drum cut simulate
  • Drum signature calibration
System Design & Installation Process

- **System configuration**
  - Drum parameters
  - Typical cut style/procedure
  - Coke type
- **System test**
  - System FAT/SAT
- **System commissioning**
  - Clean drum signature
  - Cut signature
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

• **Process efficiency and consistency**
  – Advance program and cutting tool as soon as possible
  – Consistent cutting times with standardized cutting procedure
Automated Decoking Benefits

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

• **Improved equipment reliability**
  – Aggressive cutting techniques are eliminated
  – Can monitor performance of jet pump and other equipment for performance
References and Site locations (not a complete list)

- **Drum monitoring Systems - Vibration**
  - Suncor Energy, Canada
  - Shell PSR, Anacortes, Washington
  - Motiva, Port Arthur, Texas
  - Essar, Jamnagar India
  - Tupras, Turkey
  - Petrobras, Rnst, Brazil
  - Ecopetrol, Venezuela
  - Chevron, El Segudo, California

- **Automated Decoking**
  - BP whiting Indiana
  - Repsol Cartegana
  - Petron, Philippines
  - Sinopec, China

- **Audio Systems**
  - Motiva
  - Shell PSR
  - COP Wood river
Summary

• **Remote cutting leads to improved personnel safety**
• **Remote cutting can be achieved using**
  • Audio
  • Video
  • Vibration
• **Equipment for remote and automated cutting**
• **Automated Decoking**
  • Process Efficiency consistency
  • Ultimate safety systems
Questions ?