Improved Safety & Efficiency through Remote and Automated Coke Cutting

Coking.com
MORE PRODUCTION - LESS RISK!

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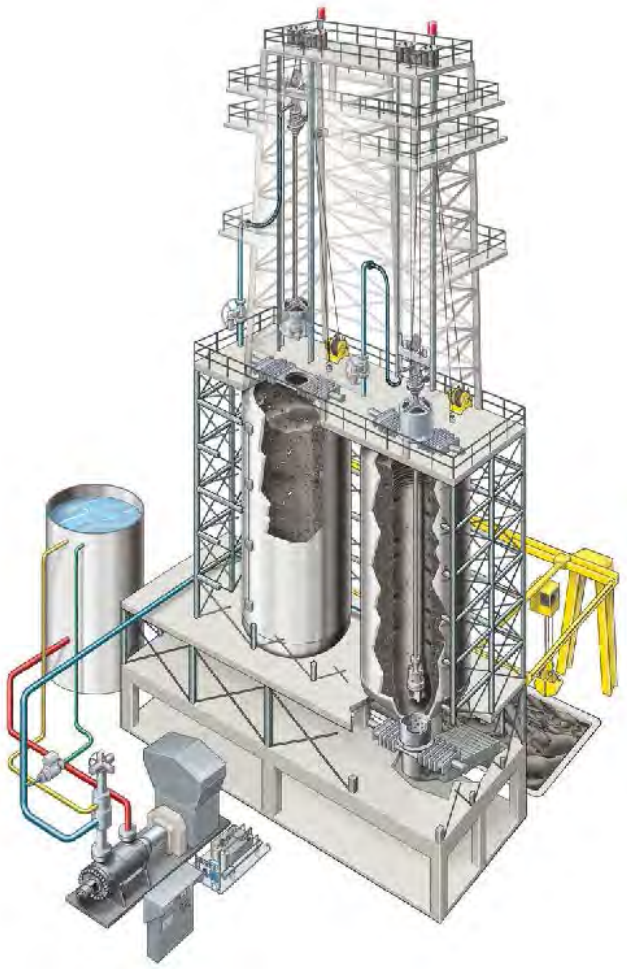
Experience In Motion

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*

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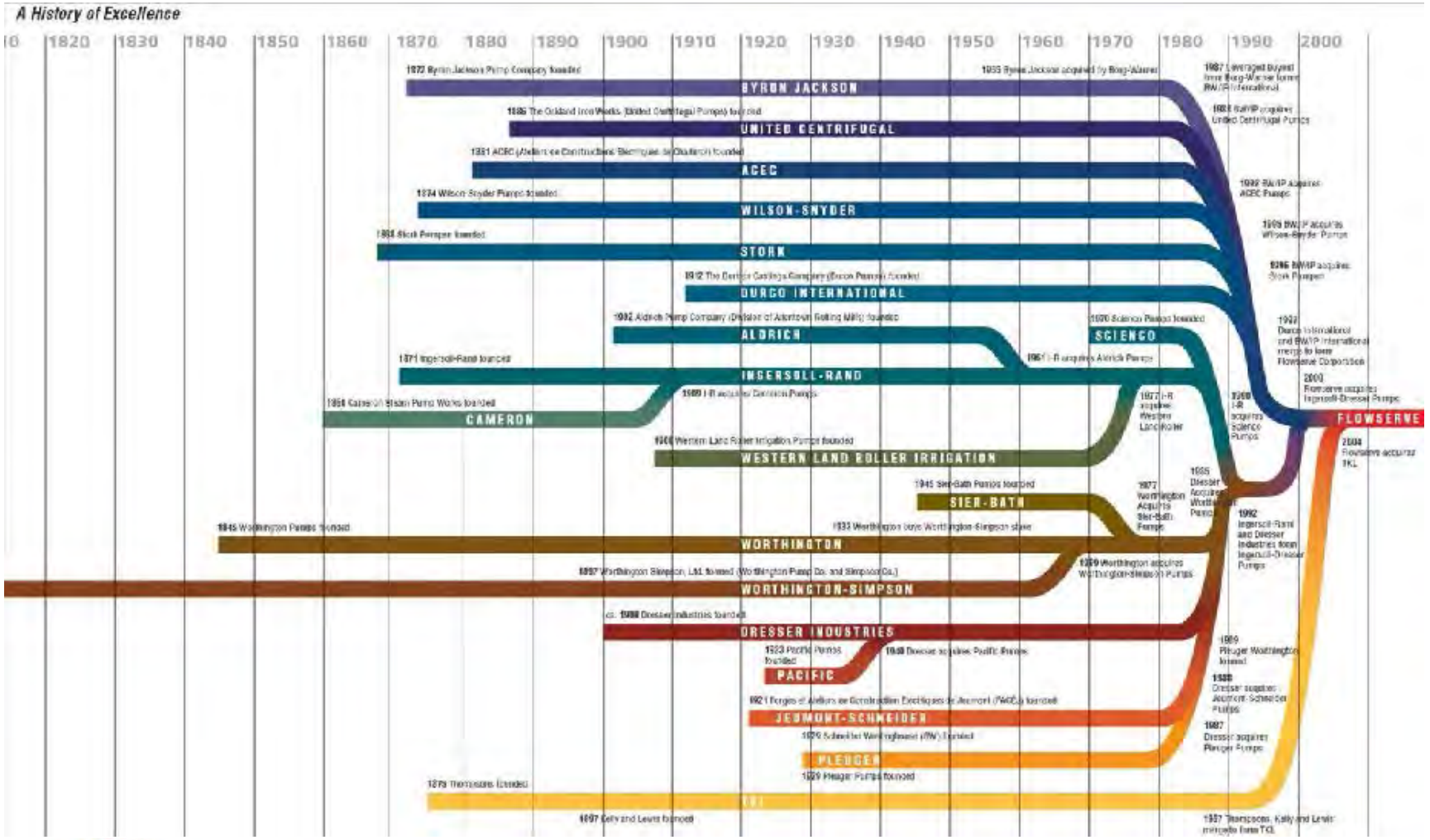
Heritage



Hydraulic Decoking Systems History

1938 Process patented by Shell

1938 Original Jet pumps & valves by WORTHINGTON

1940 PACIFIC® enters the market

1985 DRESSER PUMP / DRESSER Pacific & Worthington merge

1992 Pump Divisions of Ingersoll-Rand & Dresser form joint venture Ingersoll-Dresser Pumps

2000 FLOWSERVE acquires IDP

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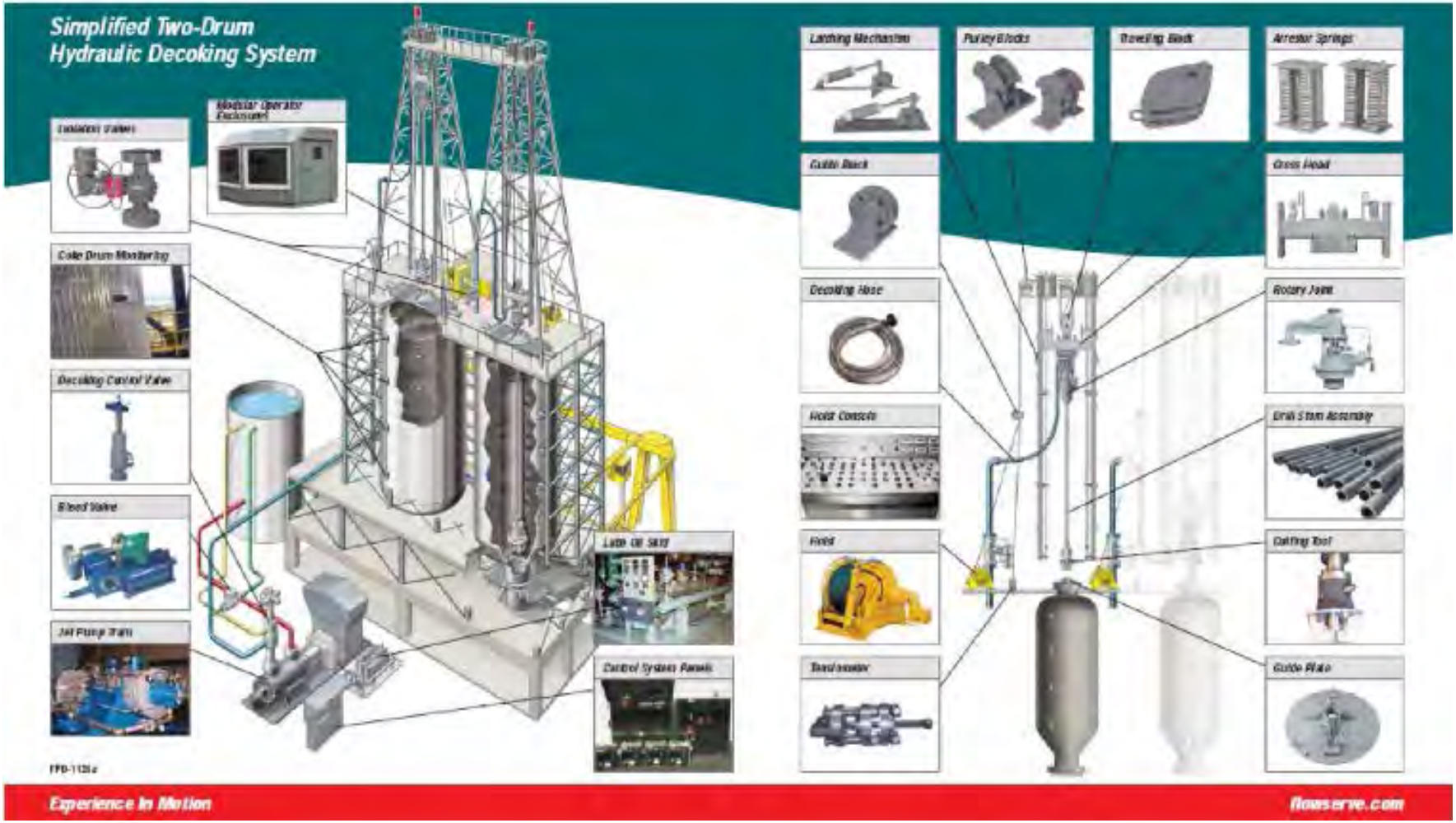
Introduction

- ***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



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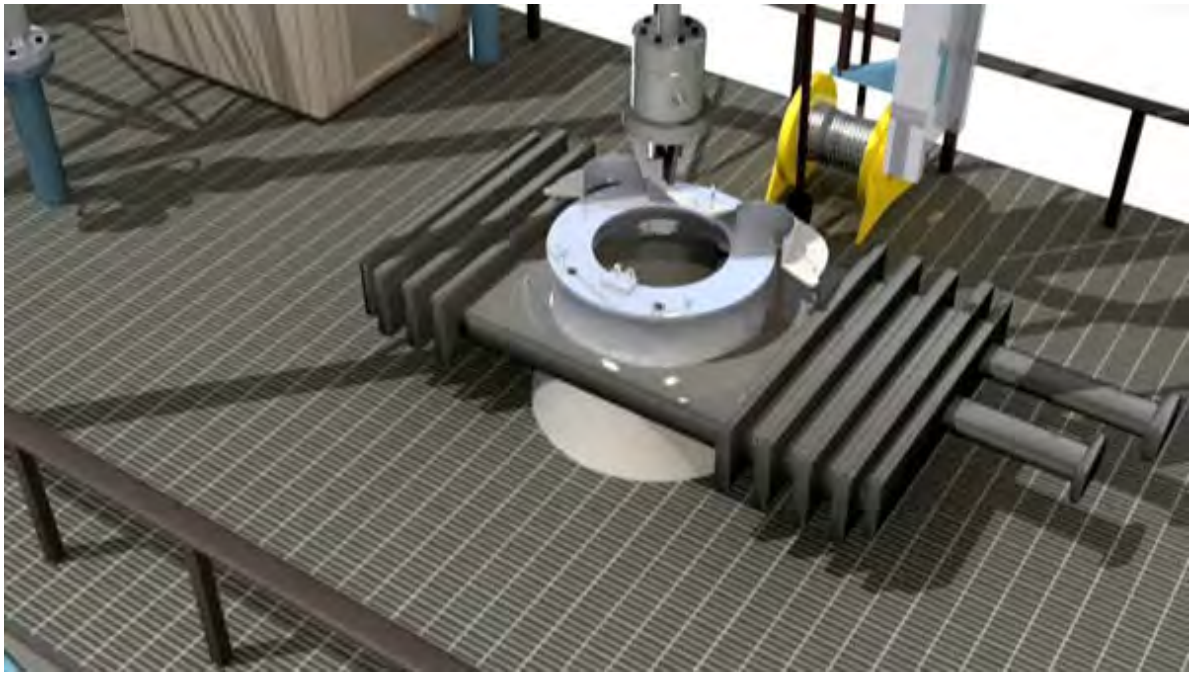
Hydraulic Decoking

Removing coke from the drum

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

2-Step process

1. Boring



Hydraulic Decoking

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2-Step process

2. Cutting

The Goal…is … transition from

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**

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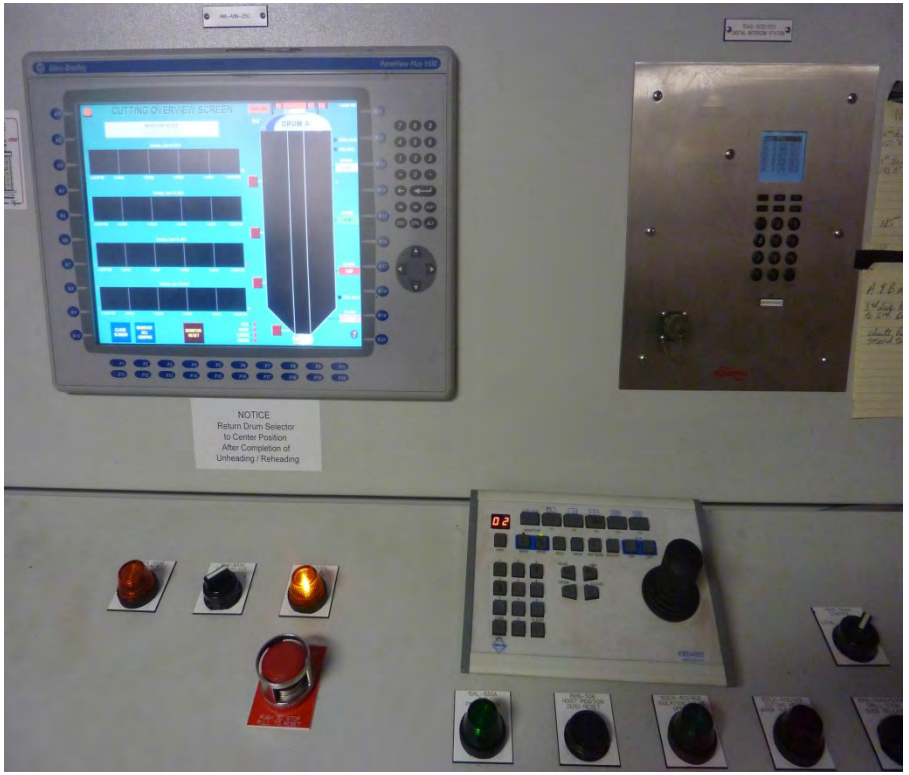
Transition to…. modern systems



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

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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***

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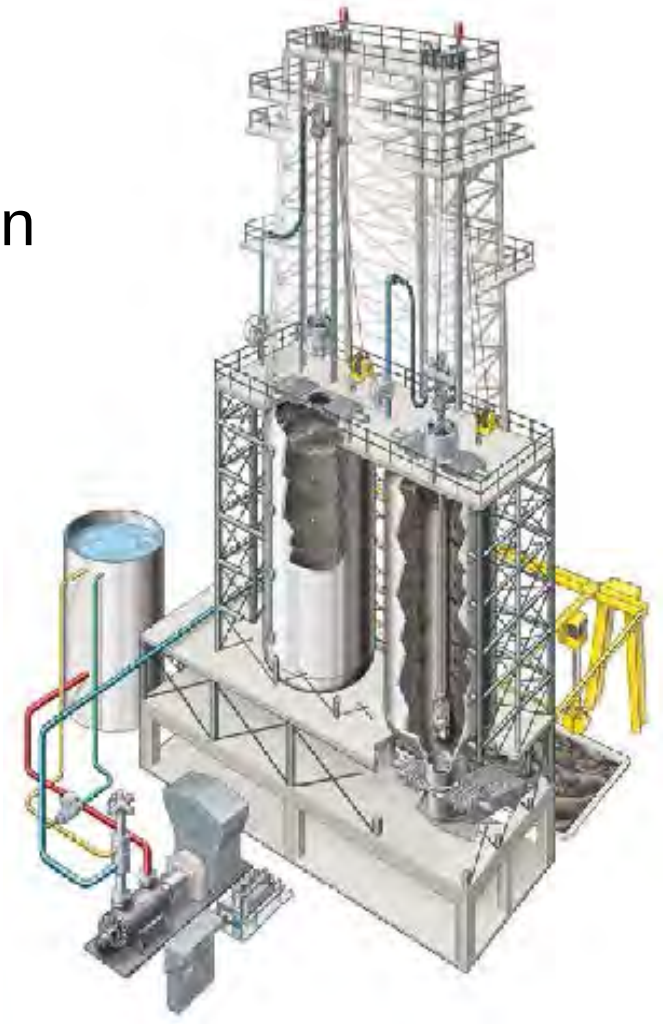
Remote Coke Cutting Requirements

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

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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

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Vibration sensors

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

Vibration sensors

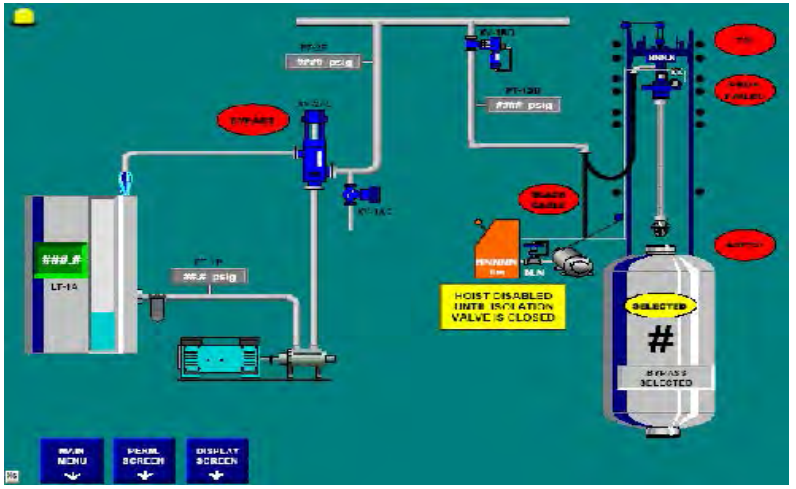
Automated decoking

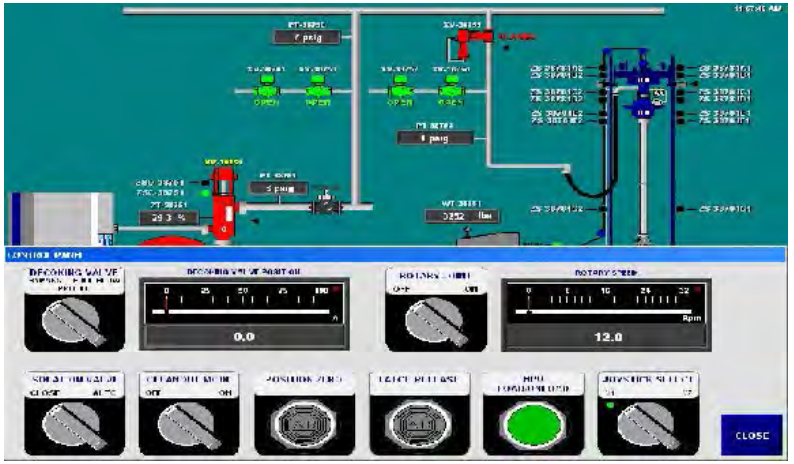
- ***Ultimate safety – complete automation of the coke removal process***
- ***Operator observes the cutting process and can intervene at any time***
- ***Automated decoking implemented as***
  - Preprogrammed cutting
  - Fully Automated cutting

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***

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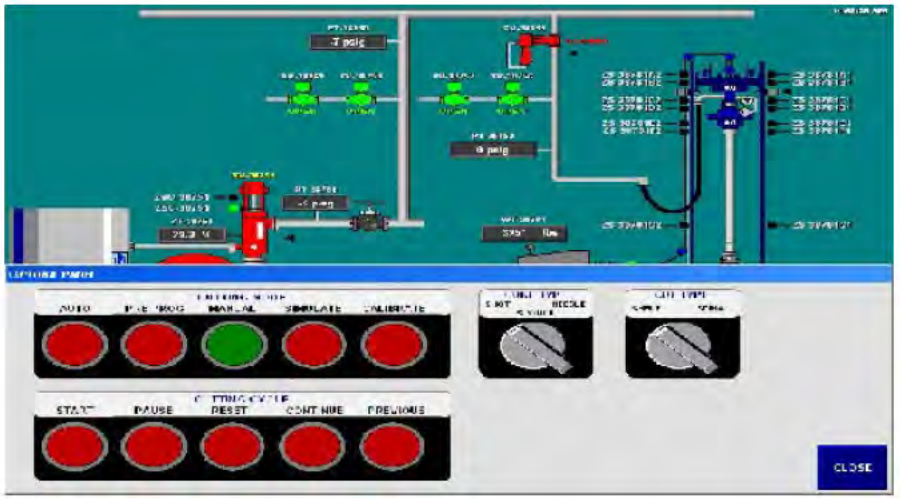
IPS APEX

- ***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



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

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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, Venezuala
  - Chevron, El Segudo, California
- ***Automated Decoking***
  - BP whiting Indiana
  - Repsol Cartegana
  - Petron , Philippines
  - Sinopec , china
- ***Audio Systems***
  - Motiva
  - Shell PSR
  - COP Wood river

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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

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Questions ?