



# *Remote & Automated Coke Cutting*

*Andrew Worley – Product Manager Coke Cutting Systems  
Flowserve FSG*

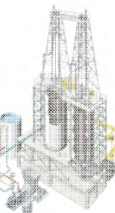
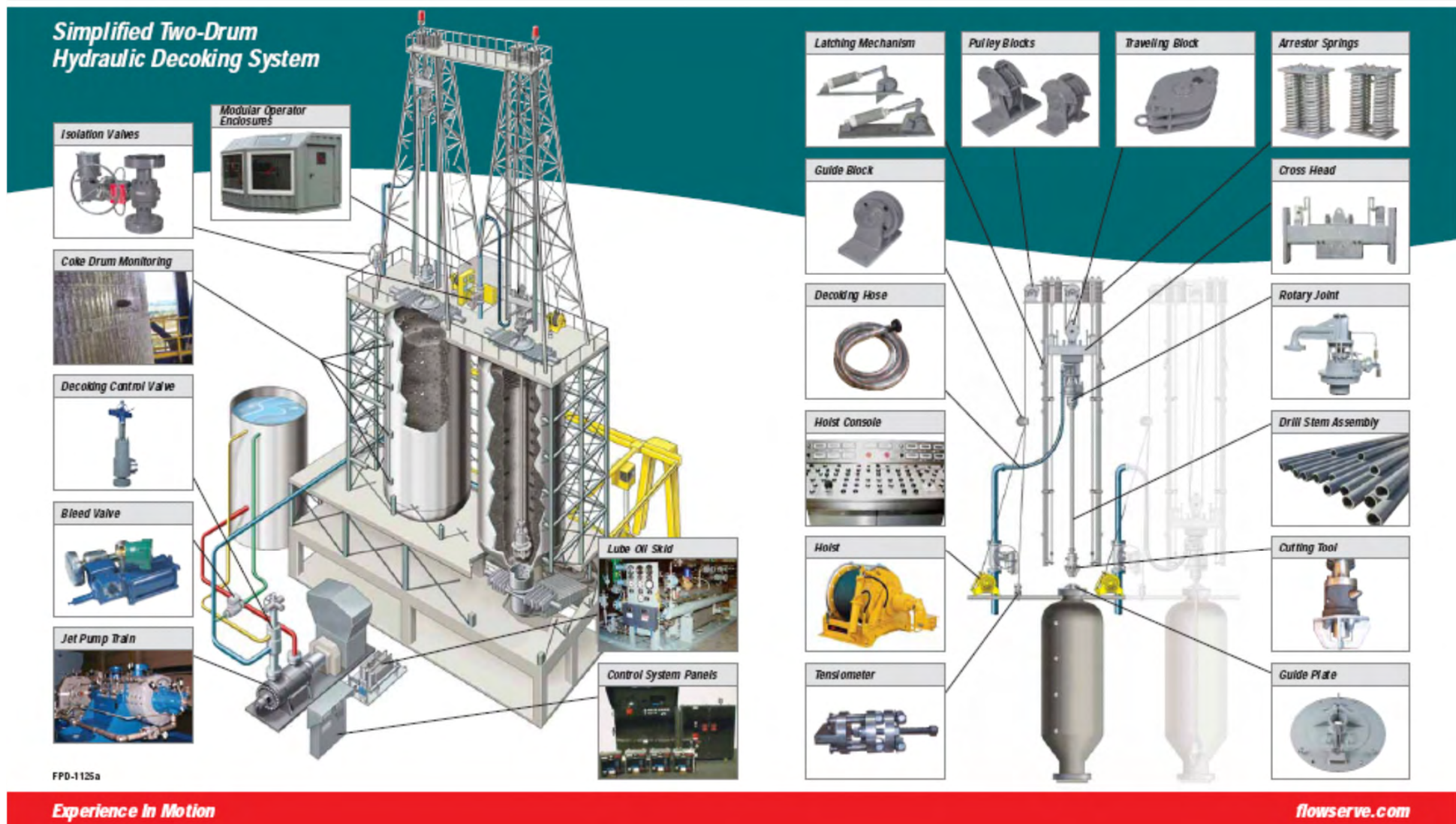


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# ***Agenda***

- ***Flowserve Overview***
- ***Decoking System Overview***
- ***Process Benefits***
- ***Remote Cutting Requirements***
- ***Automation Requirements***
- ***Required Equipment***
- ***Drum Monitoring***
- ***Automation Process***
- ***Lessons Learned***

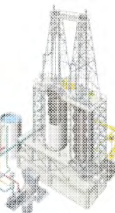
# Simplified 2 Drum Decoking System





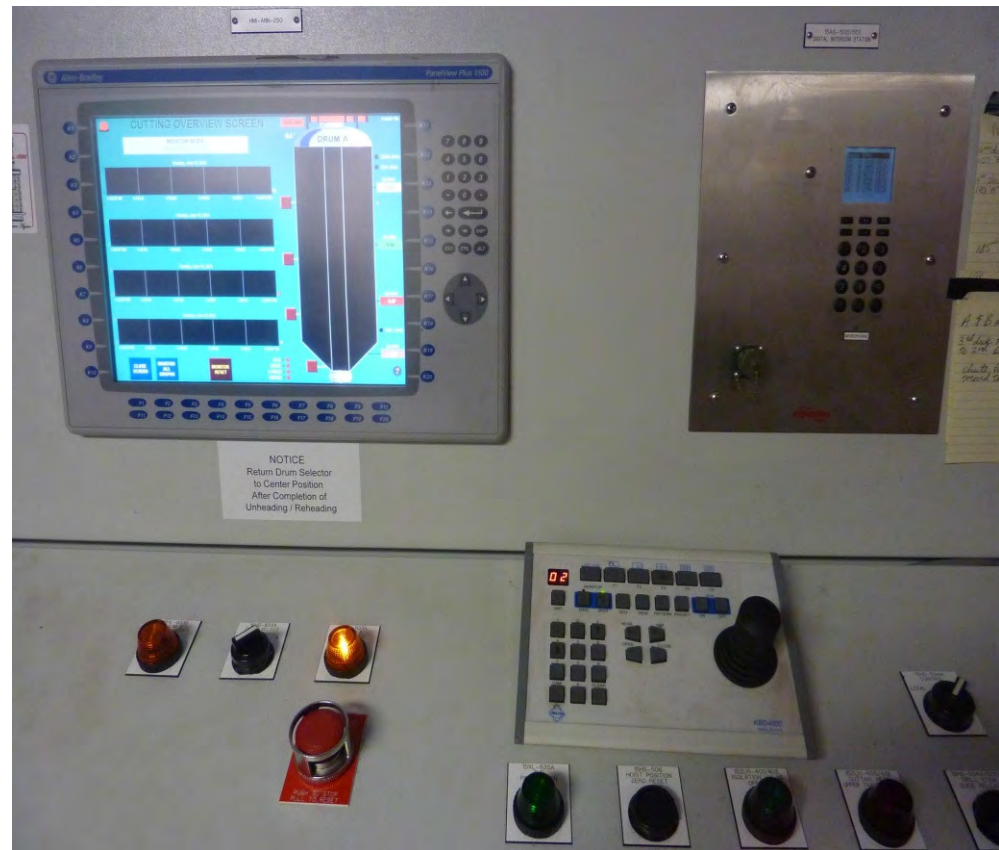
# *The Goal...is ... transition from*

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# *To.... modern systems*

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# ***Remote Coke Cutting***

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***Move operator from the cutting deck to a remote location***

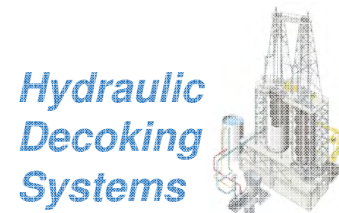
## **Benefits**

### ***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

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## 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***

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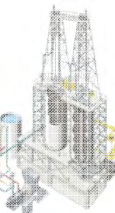
## **Information required for the Operator**

### ***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***

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## **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***



*Flowserve Innovation*

*Remote Winch & Rotary Joint Operation*

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# Drive Options

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- **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**

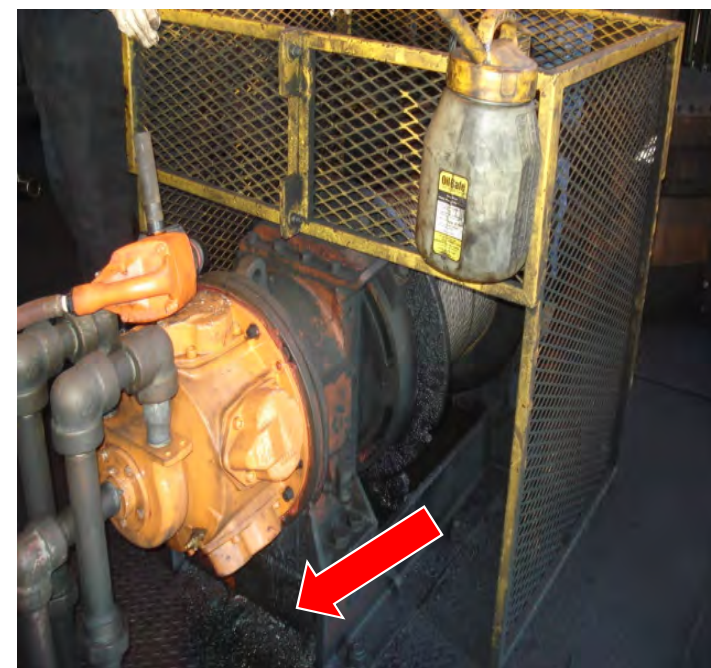
# Why Air Motors?

## 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?

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## Main technical reasons (2008):

- Proven technology is available and affordable
- Reduces installation and maintenance efforts

## Cons:

- Space for electric motors



# Electric Motor Design Features

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- 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

		AIR	HYDR.	ELECTR.
Physical Prop.	Space Requirements (Cutting Deck)	+	0	-
	Driver Weight	0	+	-
Operation	Speed Torque Characteristics	0	+	0
	Control/Response Characteristics	-	+	+
	Environmental Issues	-	0	+
	Maintainance Requirements	-	0	+
	MTBR	0	+	+
Commercial	Spare Parts Availability	-	+	+
	Initial Investment	+	0	0
	Installation Cost	+	-	0
	Maintenance Cost	-	0	+
TOTAL SCORE		- 2	+ 4	+ 4







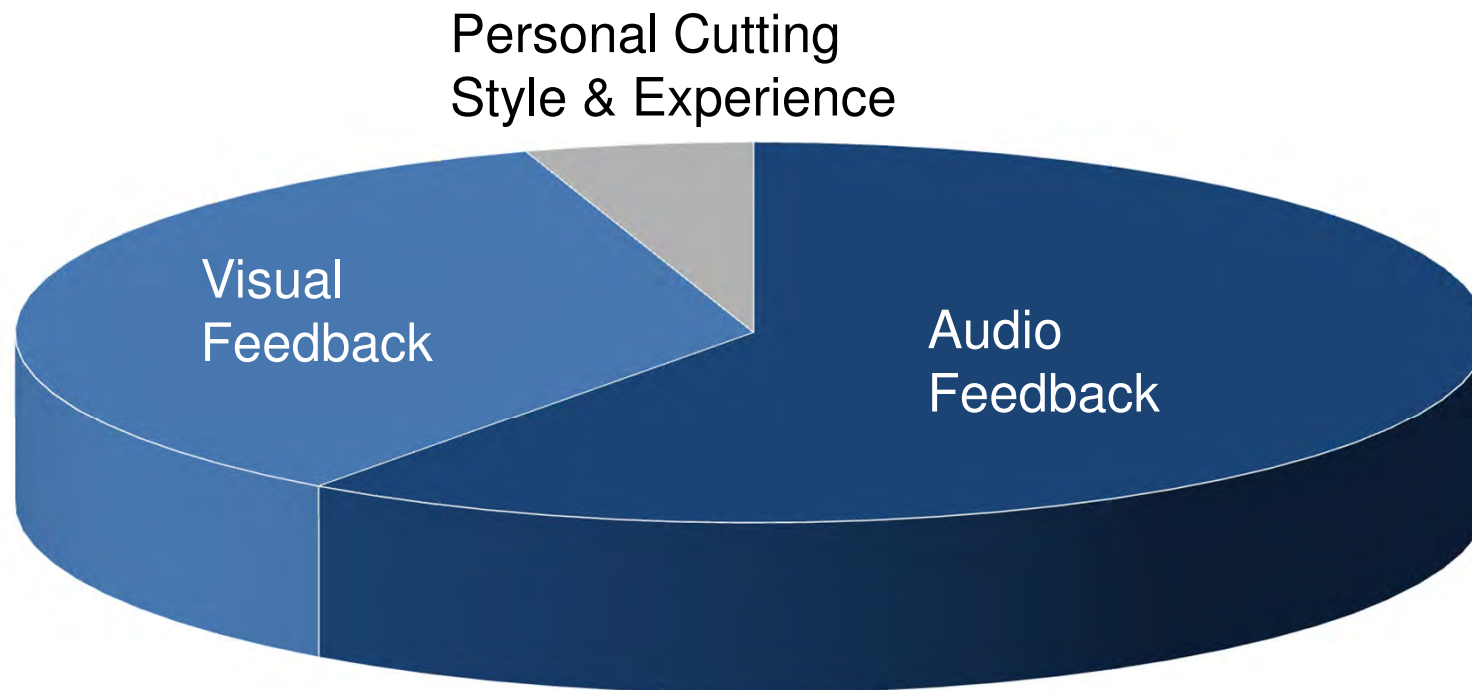
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## *Drum Monitoring – Audio, Video & Vibration*

*Experience In Motion*

# *Operator feedback for Cutting progress*

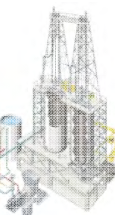
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# Confusing Environment

## ❖ 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/

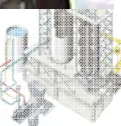
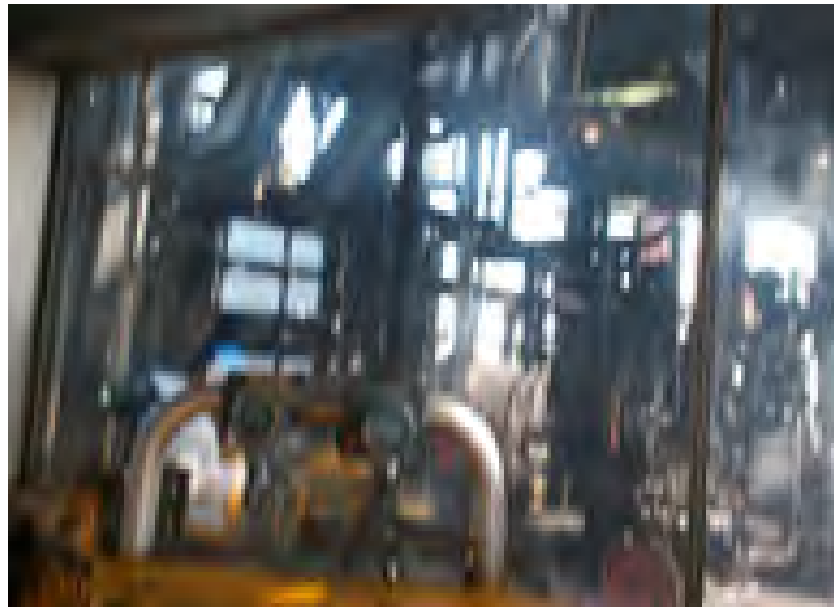
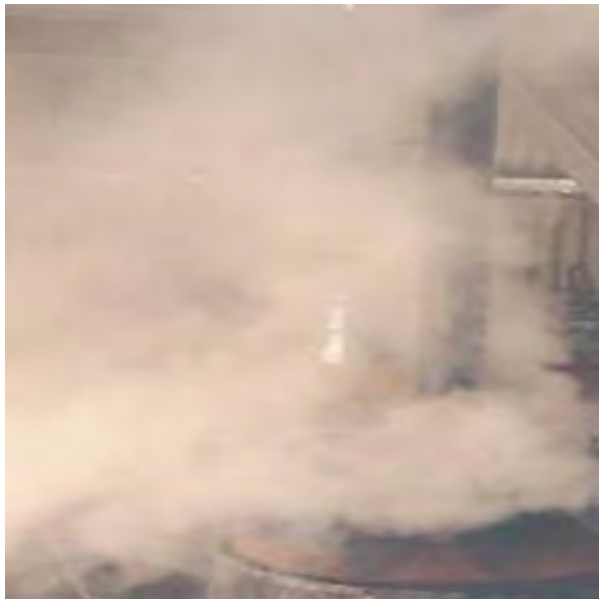


# Challenging Layouts & Situations

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❖ 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



Remote  
Cutting  
Shelter

## ***❖ Provide reasonable duplication of the Sights***

- Remote Camera Systems



Remote  
Cutting  
Shelter

## ***❖ Provide additional detailed information on the process activity to manage better decisions.***

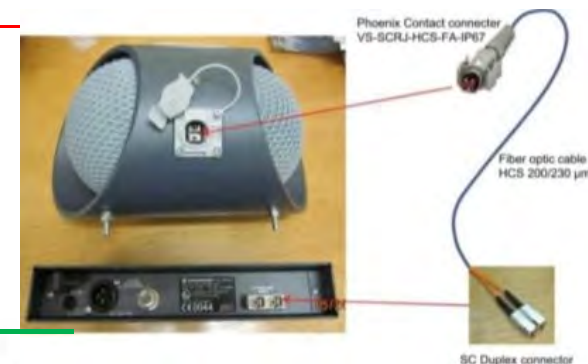
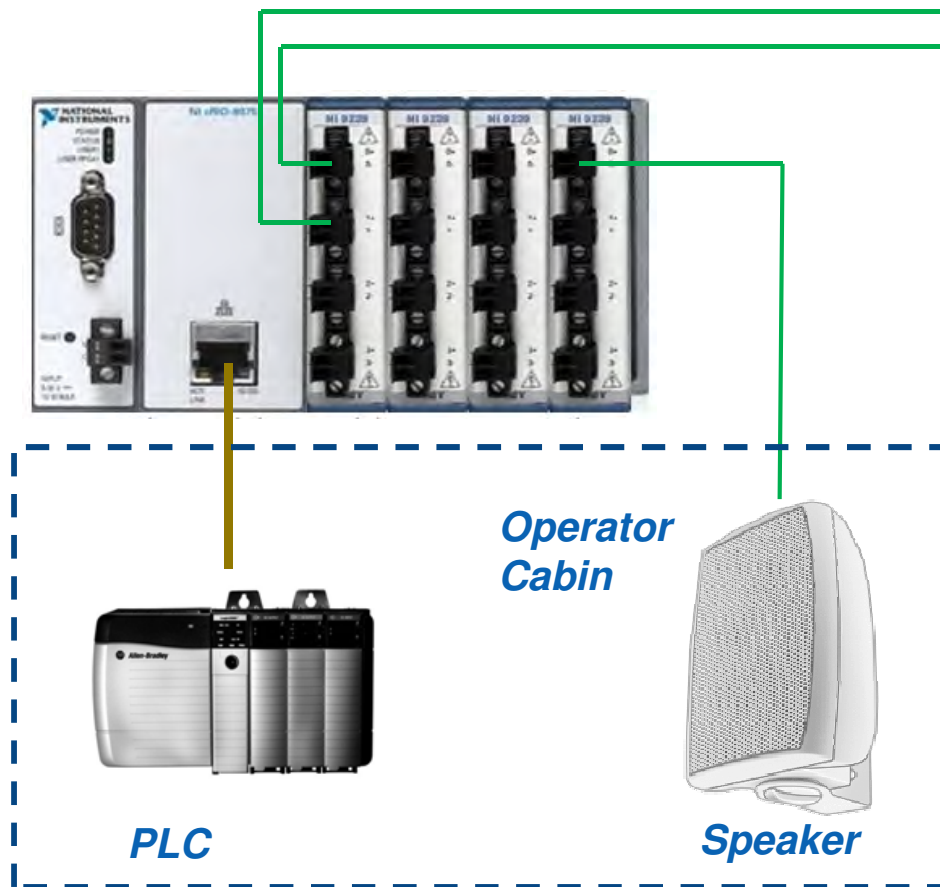
- Remote Drum monitoring information



Remote  
Cutting  
Shelter

# Updated & Simplified Audio system

- Compact/simple arrangement
- Area rated



*Mic*



Dynamic  
Decoding  
Systems



# 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



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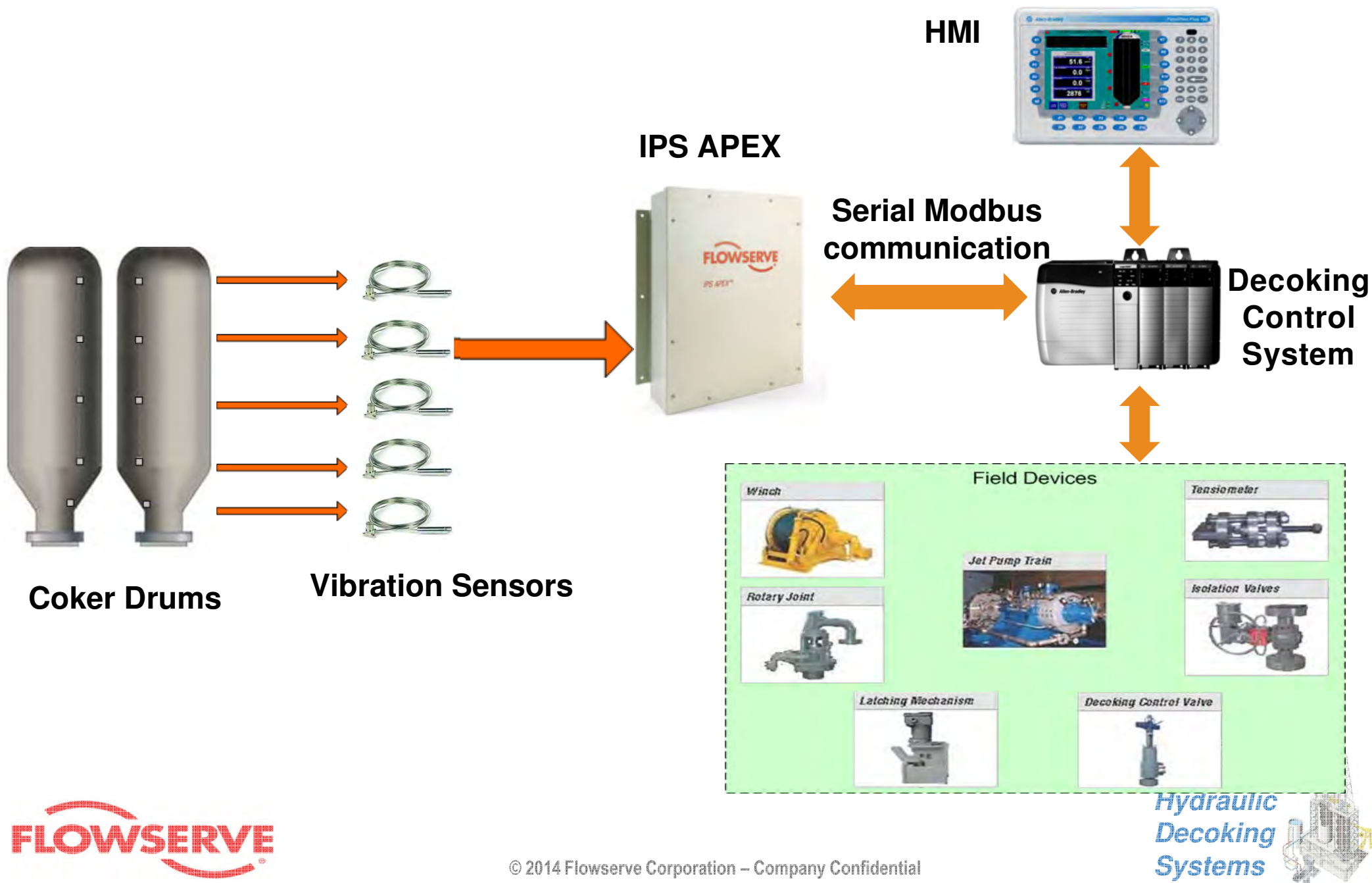
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**Hydraulic  
Decoking  
Systems**

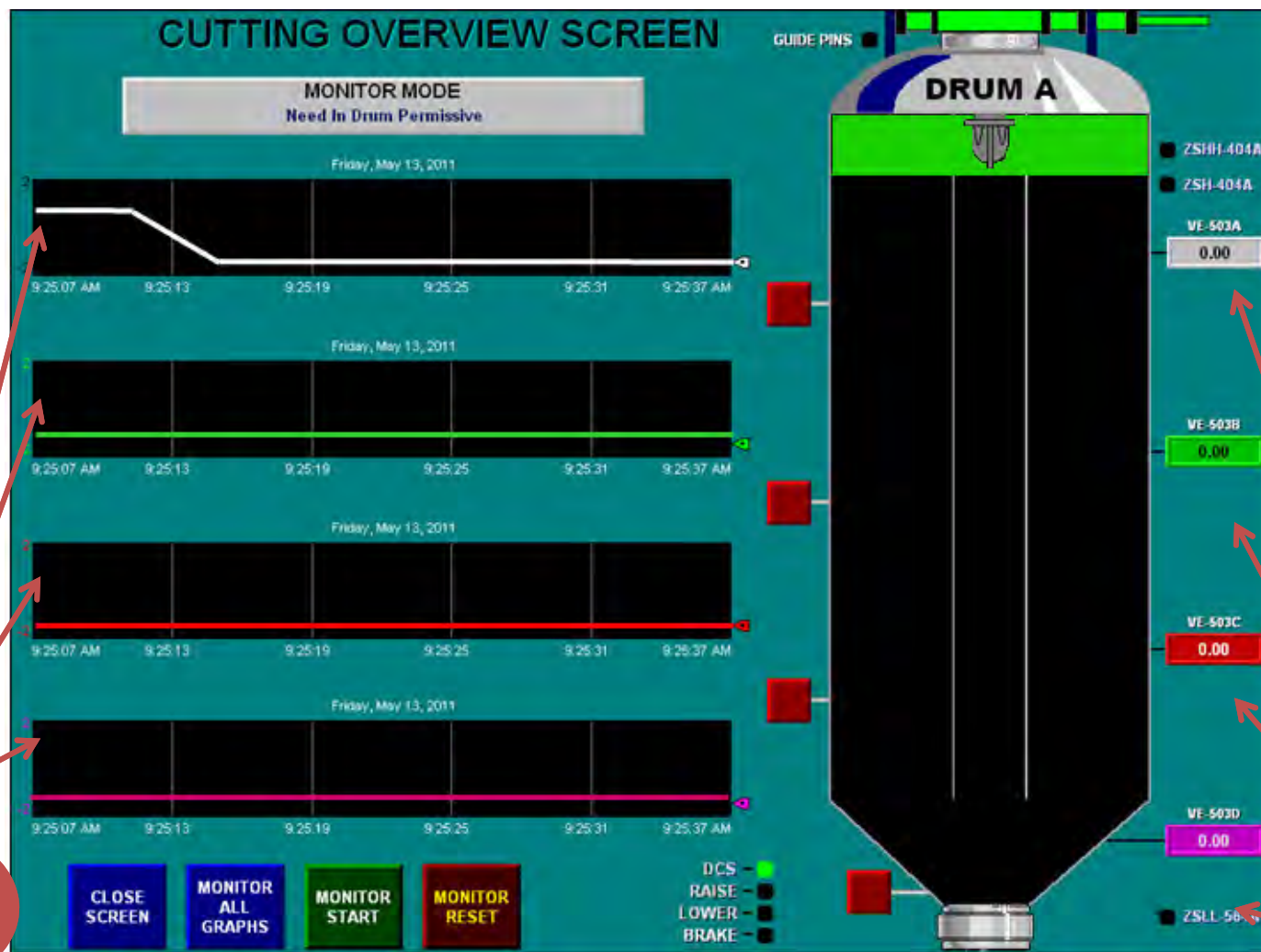


# Automation System Architecture





# Cutting Overview on HMI

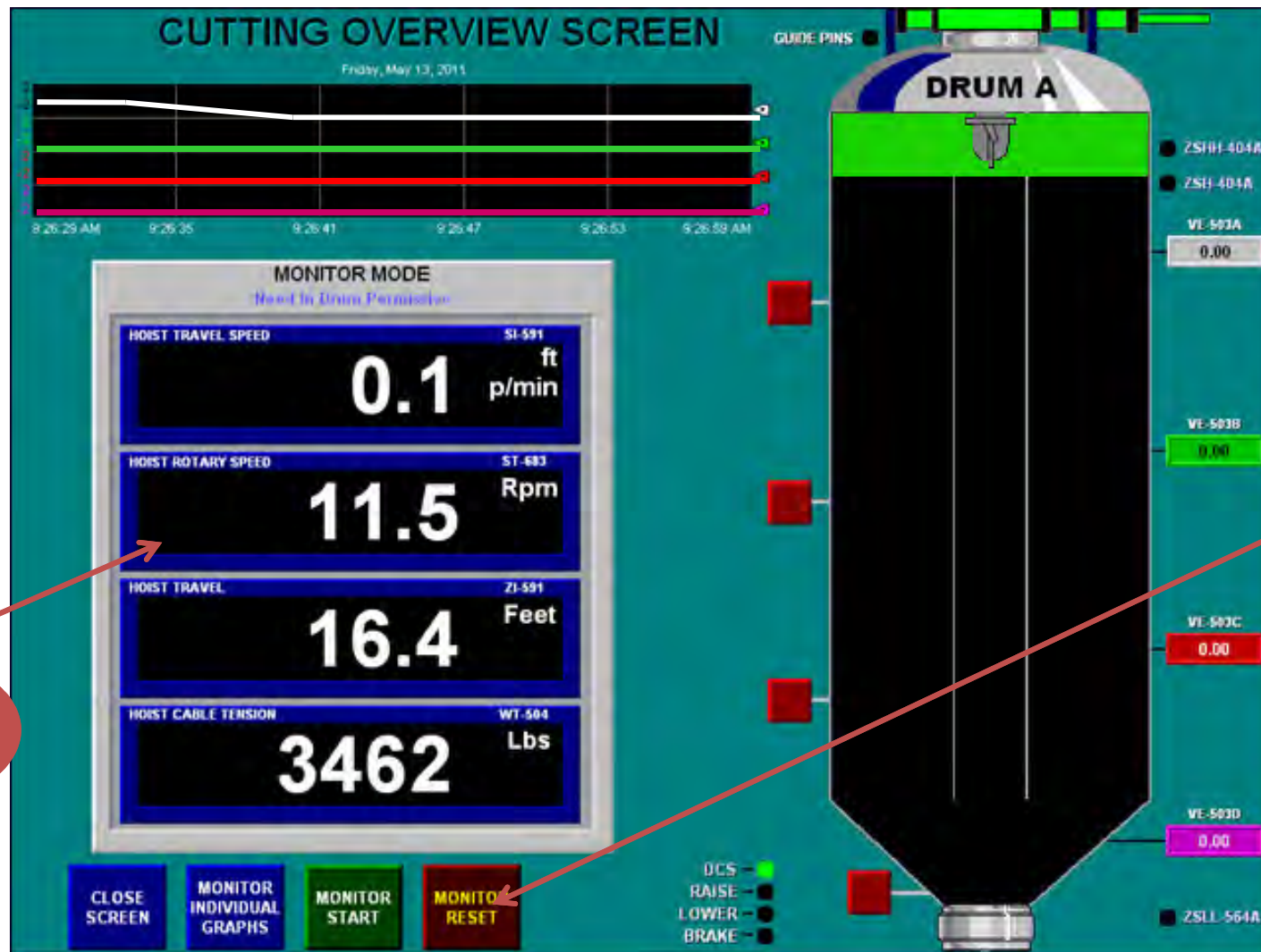


Vibration  
Strip  
Charts

Instantaneous  
Vibrations

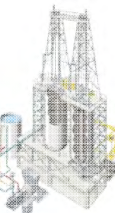


# Cutting Overview on HMI

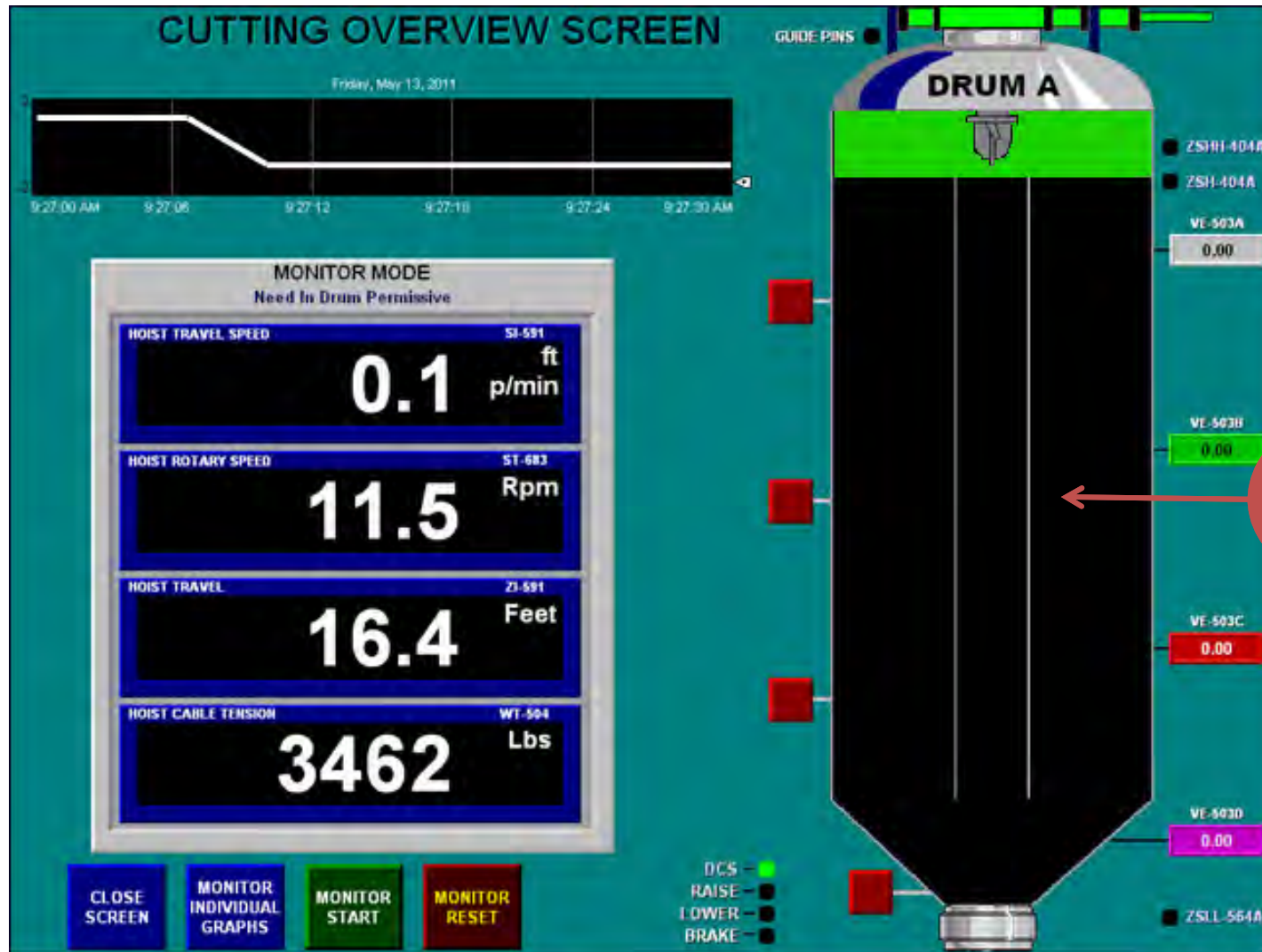


Field  
Information

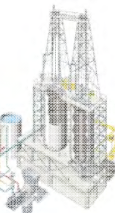
Push  
Button  
Controls



# Cutting Overview on HMI



Drum Cleanliness Will Be Indicated Here





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# ***History - Pre-programmed cutting***

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***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***

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## ***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

