# REMOTE COKE CUTTING REVIEW

REMOTE DECOKING

PROJECT DEVELOPMENT AND EXECUTION

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# REMOTE COKE CUTTING BENCHMARKING

Remote Coke Cutting –

14 Locations Benchmarked with some form of Remote Coke Cutting either in service or in Project Stage

- 8 US locations in Operation or in Project completion
  - 5 Off the Structure (4 Operating, 1 in Project)
  - 3 On Deck - Off to side or Center (all Operating)

- 6 Non-US locations in Operations or in Project Stages
  - 6 Off the Structure
  - 2 Operating, 4 in Project Stages

# TECHNOLOGY ENHANCEMENTS - RISK REDUCTION

- Risk reduction Technology improvements to Refining.
- Hazards to people and to the work place are reduced.
- Certain types of Hazards are common to all Decoking operations and should be considered:
  - Blowouts, Boil-over's, Opening Live Process, Mechanical failures, Falling equipment, Releases, Fire hazards, Hot surfaces and liquids Ergonomic hazards, etc.
- Review of data shows that approaches to removing people from the Drum Structure varies.

# TYPICAL REMOTE DECOKING PROJECT SCOPE

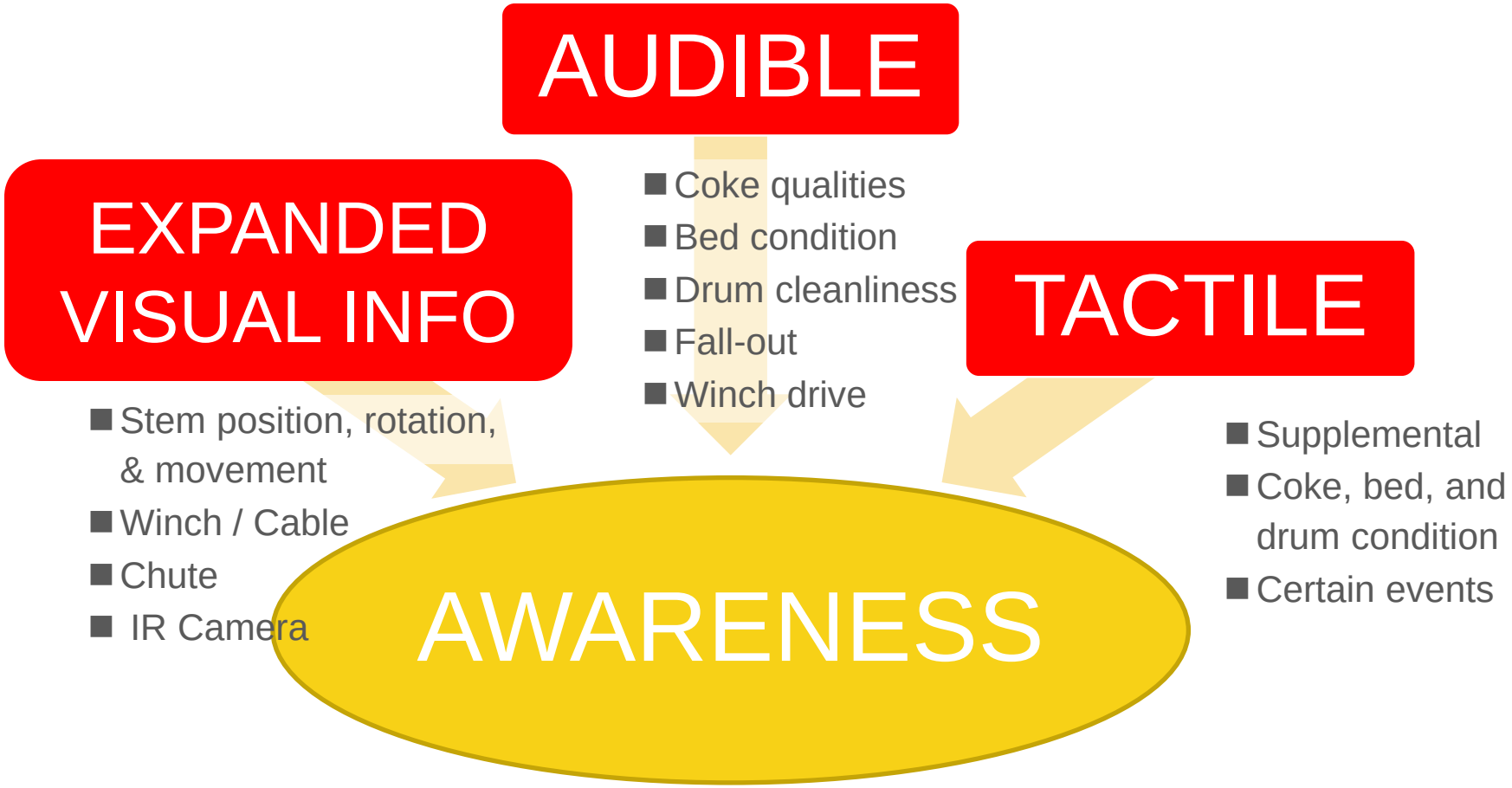
- Off-Unit or BRM, (Blast Resistant Module)
- PLC with all decoking controls integrated
- HMI – (Human Machine Interface) Jet Pump, Valve Isolation, and Vibration Monitoring for ‘clean drum’ detection
- Integrated audio and video monitoring
- New pneumatic , electric or hydraulic winches and rotary drives
- “E-to-A”, (Electric to Air), package for remote control of pneumatic equipment, or Electronic for Electric Drives


Decoking Control Panels

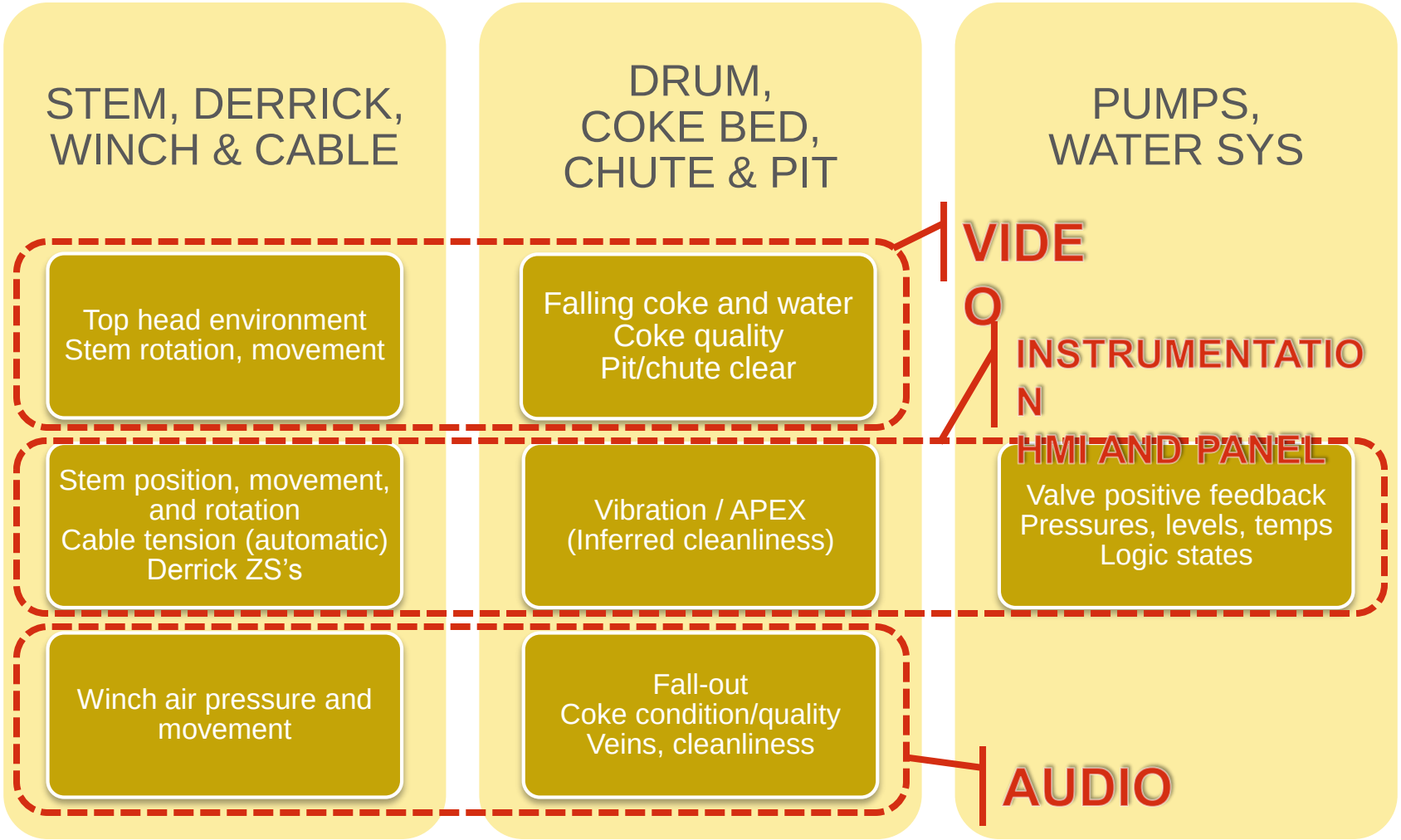
# REMOTE DECOKING PICTURE

- The system does not permit decoking from the cutting deck (this would require PLC code modification).
- Procedure dictates when personnel may be on the structure; no access during unheading or decoking.
- To be on cutting deck with jet pump in operation (in bypass) requires authorization.  Admin and Barricades?
- Multiple systems provide redundant interlocking:  Mechanical, hydraulic, and electronic.
- Bypass process is controlled and auditable.
- The DCU structure operators and coke handling operators jointly walk the structure and co-sign a permit to open every drum.
- DCS console operator must manually advance interlock system to allow unheading.
- Communications between three parties who understand each others' roles.

# IMPACT ON THE COKE CUTTING OPERATORS REPLACING PROXIMITY WITH TECHNOLOGY



# EYES AND EARS



# THE PROJECTS EXPERIENCE

- Lots of players with differing expectations of timing and mutual interactions.
- Automation intensive - detailed coordination was required during design. Resources committed in advance, which limit flexibility.
- DCU-experienced lead constructor working with local project management. A must.
- Electrical/automation contractors very experienced at site. Specialty contractors were chosen for pertinent experience.
- Project schedule slip required plant to accommodate a more intensive construction period than planned.
- Commissioning was highly coordinated, especially the last few days and hours.
- Some site resources were scheduled solid for a full year in advance of the turnaround. Implementation required “full commitment” for 10-12 weeks.

# WHAT WORKS WELL

- Pump and valve integration, logic, and controls in the decoking PLC.
- Integration with other systems – DCS, SIS, unheading and decoking systems all play nice together.
- Derrick/stem  instrumentation and components are reliable.
  Especially the running-line tensiometer position/payout/tension instrument and automation of the tension logic.
- Clean Drum indication on HMI is reasonably accurate– usually within several feet – depends on Tuning.  Cone section is the most challenging.
- Coke handler has adequate tools to cut drums in similar time to pre-project
- Coke handler is now remote and removed from the environment of the cutting deck.
- Communication between coke handlers, structure operators, and console / DCS operator is well developed and integrated with unit operating procedures.

# LOCATION-A DELAYED COKING UNIT - PRE-PROJECT

- 2-Drum,14-hr cycles, sponge coke, small pit.
- Relocated from Midwest to the West Coast and re-instrumented in 1982 - 1983. Started Up in mid1984. 1984 Decoking Technology. Spare Jet Pump installed in 1991.
- “Manual” in most respects with respect to structure operations and unheading/decoking.
- Structure operations were encoded into an automated interlock system in the DCS in 2006. No Decoking Mods
- Unheading and Decoking – managed by procedural controls
- Local Decoking Shelter on Top of Drums

# LOCATION-A VIDEO CAMERA VIEWS


4-Square View

Chutes

Top Head View

IR / Thermal Camera – Pit and Maze

# LOCATION-A - CHALLENGES

- Initial stability problems between the remote Decoking PLC and the APEX vibration processing unit.
- Audio system is somewhat complex to maintain.  Issues difficult to diagnose without experience.
- Audio quality was initially such that background noise competed with useful drum noises.  Noise-cancelling microphones made a significant difference.
- Video system (legacy) needed considerable work to make it useable.
- Coker-1 initially required a ‘training system’ – not a good use of resources.
- Graphics were a challenge.
- Hoist control logic in the PLC initially contained errors which passed

# LOCATION-A - ONGOING CHALLENGES

**Pneumatic hoist controls –**

- "E-to-A" controls work, but are limited by the limitations of pneumatic hoists. Lots of play, difficult to control precisely.
- E-to-A components are delicate.

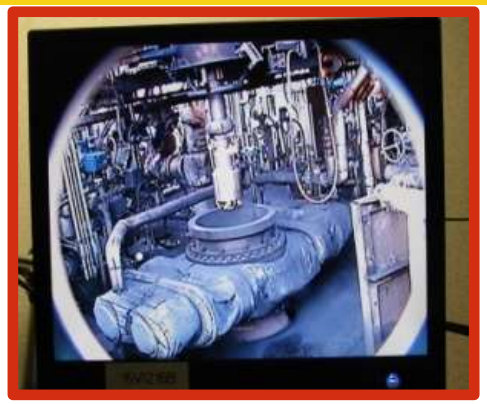
**Audio monitoring –**

- The system requires some nursing, such as an occasional power cycle.
- Parts development continues, and parts are long-lead.

**Vibration monitoring / Clean Drum indication –**

- Vibration probes are subject to mechanical damage from insulation (and Insulators). Has been difficult for us to keep functional.
  - Presently Need New Probes
- Adjustments require an on-site visit – the APEX is a specialized part, and audio model adjustment is a function Flowserve performs.

# LOCATION -A - SUCCESSFUL PRACTICES



**Video is essential 'kit' for a coke handler.** System should be designed for reliability and to provide at least four views simultaneously. (Open head, Winch Drum, Chute, and Crane location.)

The coke handling experience becomes increasingly visual because of the loss of proximity. Instrumentation provides valuable feedback but is too indirect to portray some of the nuanced events that require prompt response.

**Audio is near-essential**. System should be designed to be reliable and noise reducing. Multiple locations is helpful, particularly near the cone and mid-to-upper drum.

Audio provides information which is not offered by any other instrument, including verification of clean drum, proximity to drum wall during cut, coke bed condition, etc.

**Panel ergonomics** should be a key deliverable because of the attention and static body posture required. Consider working with a coke cutting operator to design the panel.

Avoid replacing physical controls with HMI touch screen controls.
Prevent requiring continuous pressure on a joystick, as this may invite 'creative solutions' by the user.

# LOCATION-A - SUCCESSFUL PRACTICES

**Consider “serious controls” on human presence on the cutting deck during unheading and decoking.** Routine human presence may come to be viewed as necessary, and reduce the benefit of the effort.

There are examples of sites which have installed remote decoking only to use it with people on the deck and/or not to use it at all. Its clear that making this transition requires resolve; use it.

**HMI graphics need to be simple to use, consistent, and well understood by the coke handler.**

Agree on design and dynamic behaviour well ahead of the FAT, so that FAT testing can include complete graphics.

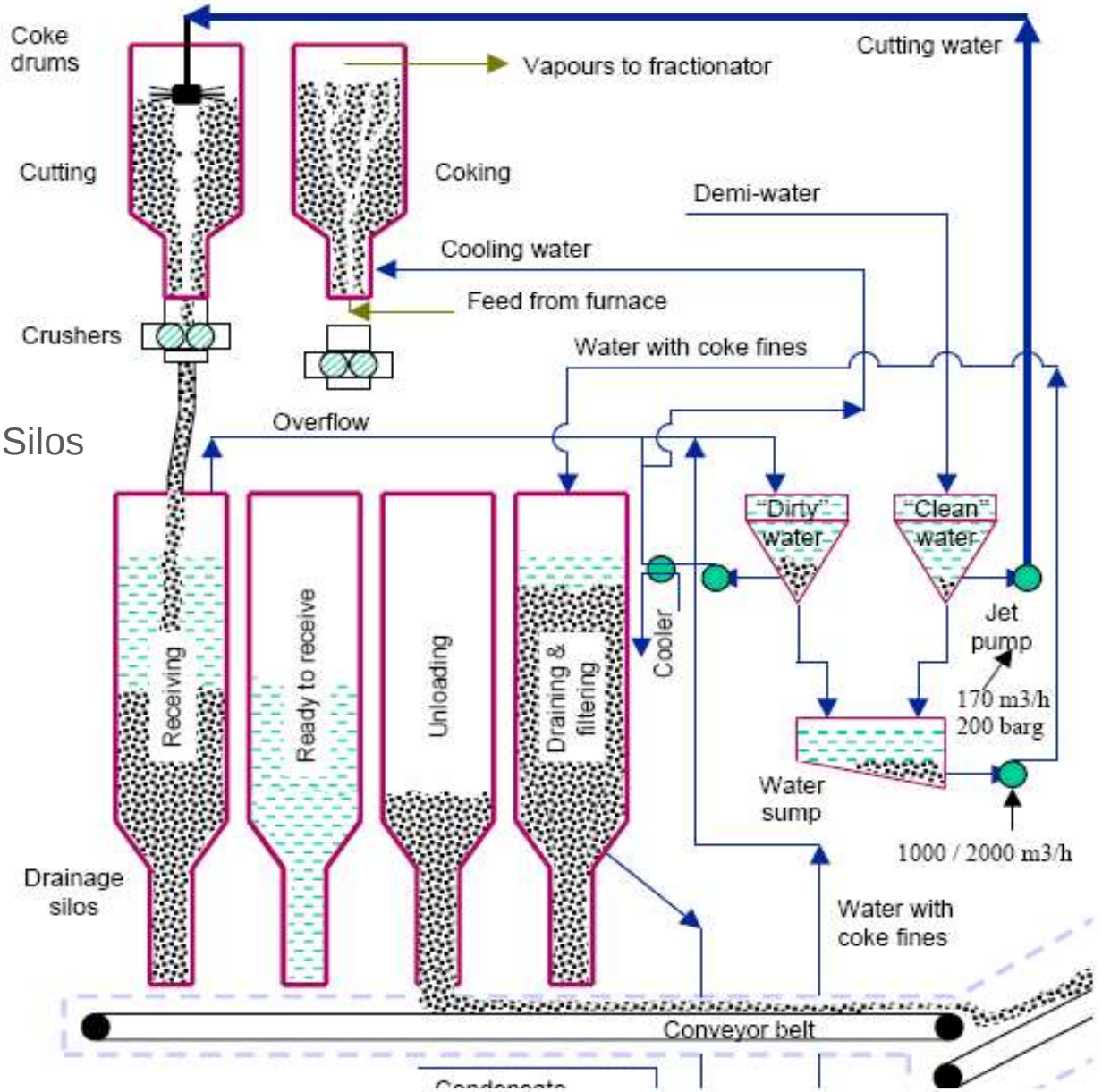
**Consider hydraulic or electric Winches and Rotators**.

Location A retained pneumatic winches and rotators due to Location past success and improved plant air quality. However other Technologies may be more suitable for remote operation such has electric or hydraulic.

# Location B - DCU Project - Remote Coke Cutting

# Location B - Remote Coke Cutting Project - Sept 2010

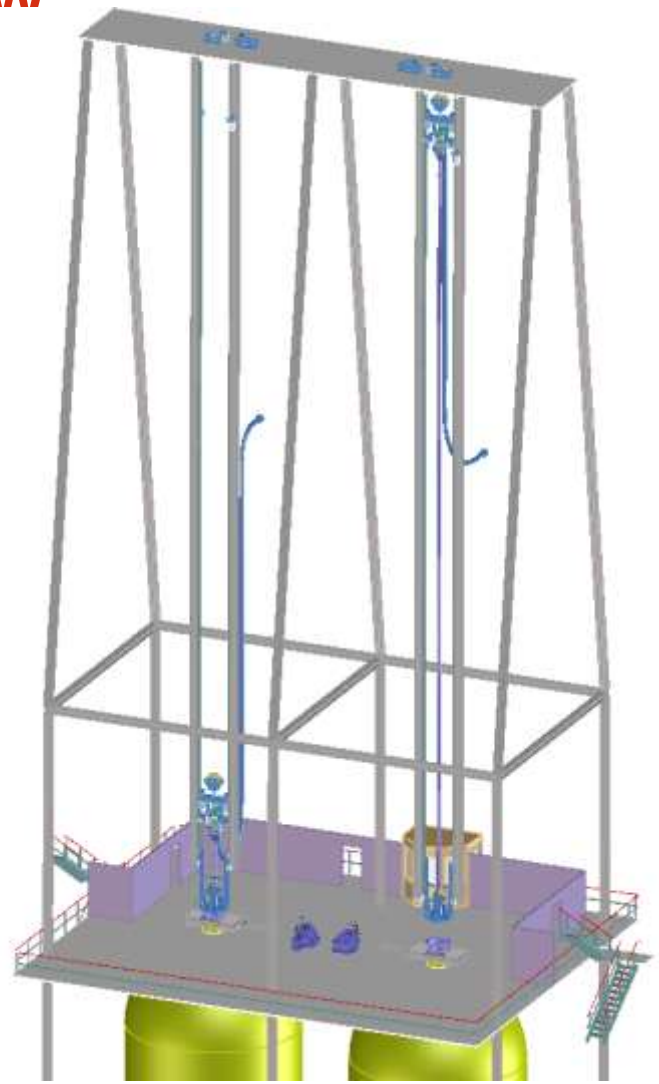
Six Drainage Silos



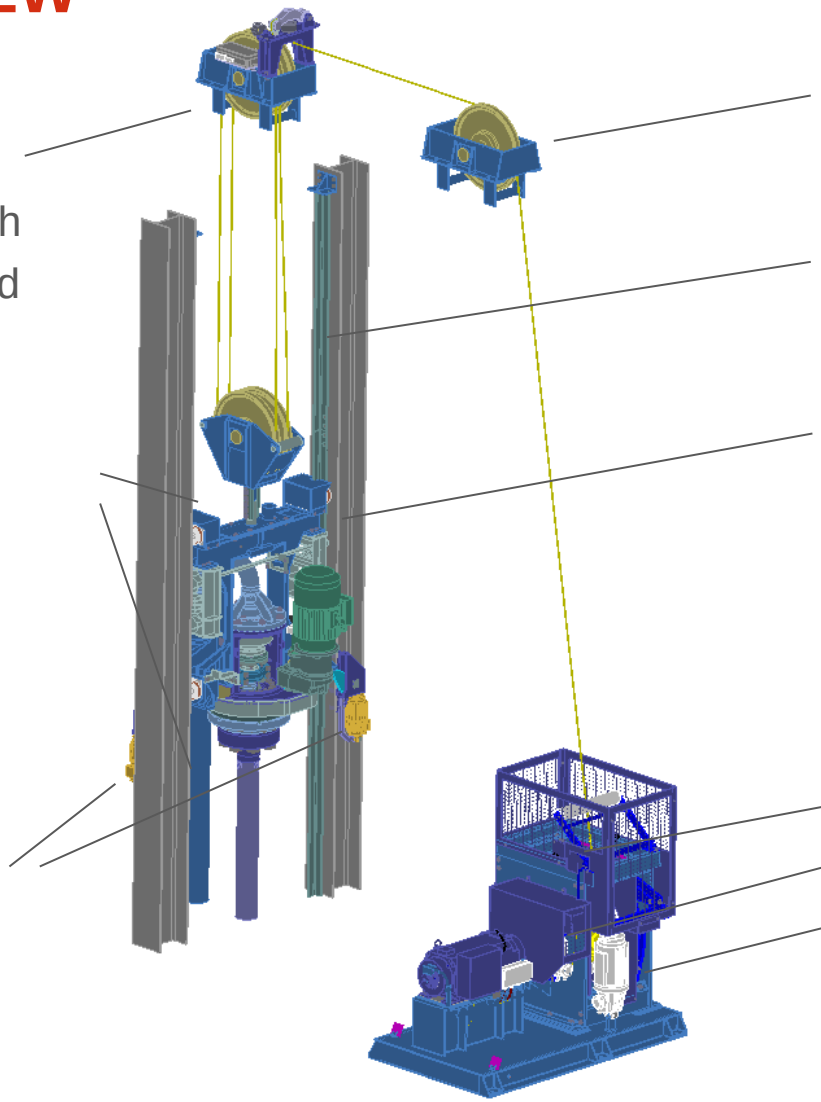

To Storage and shipping Silo

# LOCATION B - DECOKING SYSTEM: DERRICK OVERVIEW

- Double Pulley with Encoder and Load Cell
- Single Pulley
- Crosshead with Drill Stem Drive (DSD)
- Latching devices, electric
- High Pressure Hose
- Drill Stem
- Latching devices, manual
- Guide device
- Enclosure
- Tool
- Hoist



# LOCATION B - DECOKING SYSTEM: DERRICK OVERVIEW



Single Pulley

Double Pulley with Encoder and Load Cell

Guide Rails

Crosshead with Drill Stem Drive (DSD) and Free Fall Arrestor

Position switches Derrick

Hoist with

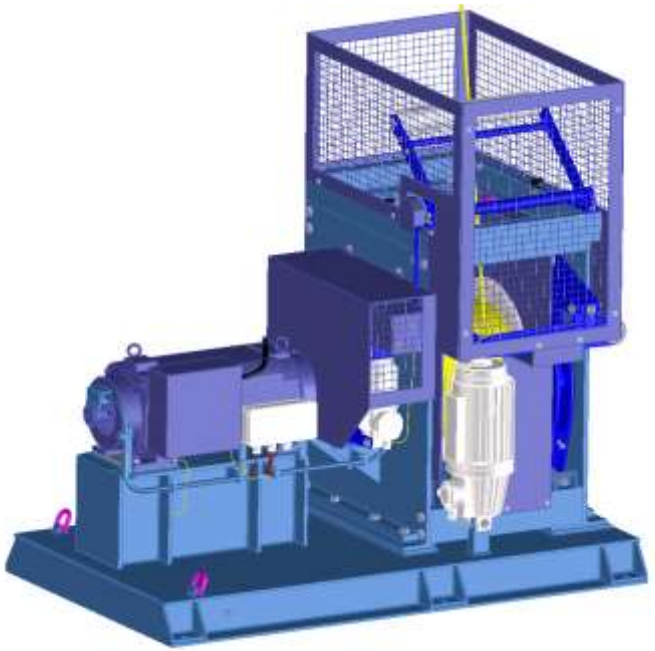
Slack Rope switch

working brake and safety brake

Latching devices, electric

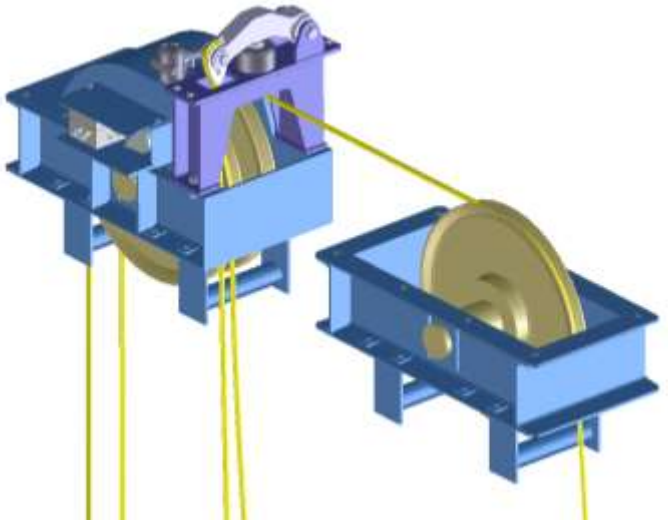
# LOCATION B - DECOKING SYSTEM: HOIST

- Hoist, electrical driven, integral cartridge gear
  - Pull force 5 t
  - Slack rope device
  - Motor with encoder
- Rope
  - measurement of tension in the rope
  - indication at the operator panel
  - avoiding of overload
  - Slack Rope Lever & switch
  - Safety Brake & switches
- Variable Frequency Converter  VFC



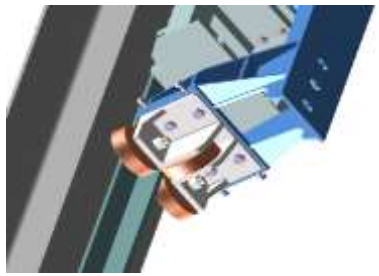
# LOCATION B DECOKING SYSTEM: PULLEY BLOCK

- Pulley Block
  - Single & Double
  - Fitted with Encoder
- Devices to measure
  - Load / Position / Speed
- Rotary Encoder
  - Tool position indication
  - Signal verification of position switches in Derrick
- Load Cell
  - Measurement of tension in the rope
  - Indication at the operator panel
  - Avoidance of Overload and Slack Cable



# LOCATION B - DECOKING SYSTEM: CROSSHEAD

- **Crosshead**
  - 4 running points on new guide rails
  - 3 wheels each
- **Drill Stem Drive**
  - electric driven
- **Free fall Arrestor – “Otis” Style with Rails rather than cables.**
  - Automatic operation on loss of pull force
- **Pulley Block**
- **Gooseneck / Swivel – Rotary**

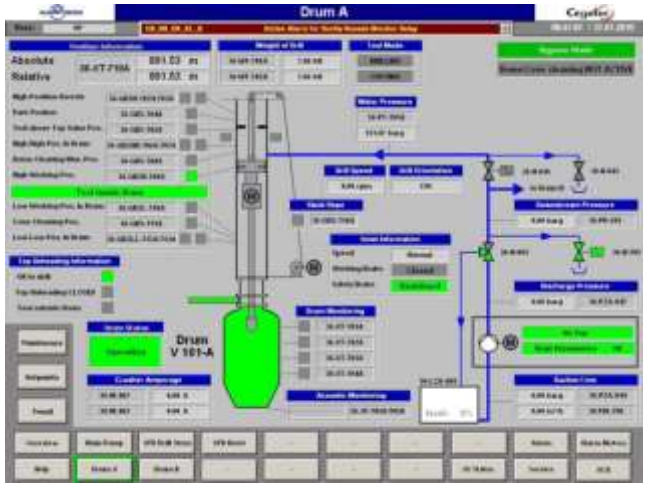


# LOCATION B - DECOKING SYSTEM: COMBINATION TOOL

- Basic design
  - Slim tool,  OD 13,7” (350mm)
  - Low lift force / Low torque
- Switching devices
  - Automated with pressure changes
- Nozzles, cutting
  - 2 opposite nozzles
  - Nozzles completely inside valve body
  - Easy cleaning & replacement (bolted)
- Nozzles, drilling
  - 1 strong centre nozzle
  - 3 periphery nozzles
  - Easy cleaning & replacement (bolted)

# LOCATION B - REMOTE DRILLING AND CUTTING

- Drilling and cutting from satellite room located 100 m from the unit at ground level
  - 4 Vibration sensors on each drum wall to help in appropriate drum wall cleaning
  - 1 mic near each bottom chute with graphic signal to detect coke falling to crushers
  - Crushers amperage indication and remote start/stop control
  - No real audio from cutting deck to hear water jet on the drum wall (as it was when cutting from top deck). Doesn't help on drum cleanliness detection
  - 4 CCTV cameras per drum to visualize hoists, top Delta Valve and crushers
  - Complete graphical interface showing all instrumentation and system/interlock status



# LOCATION B - DECOKING SYSTEM RELIABILITY

Decoking system issues: none related to Remote Cutting Operation

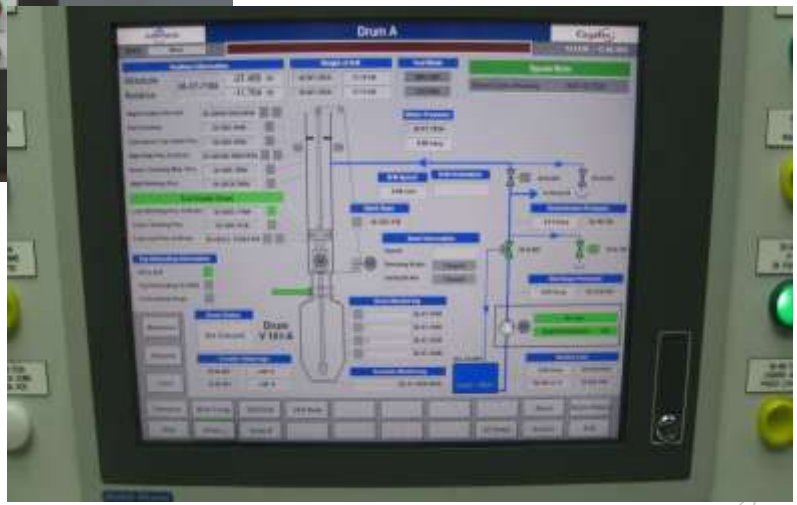
- Two system logic problems in first year of operation
  - PLC system locked after pulling the tool out of the drum with dome/cone cleaning mode still on and closing the slide valve.

    Consequence: recirculation for few hours until solved by Technical support
  - Crosshead proximity switch detection failure leading to system locking. Consequence: recirculation for few hours until resolved by Technical support
- Two hardware problems in first year of operation
  - Loading Cell failure. Consequence: recirculation for few hours.

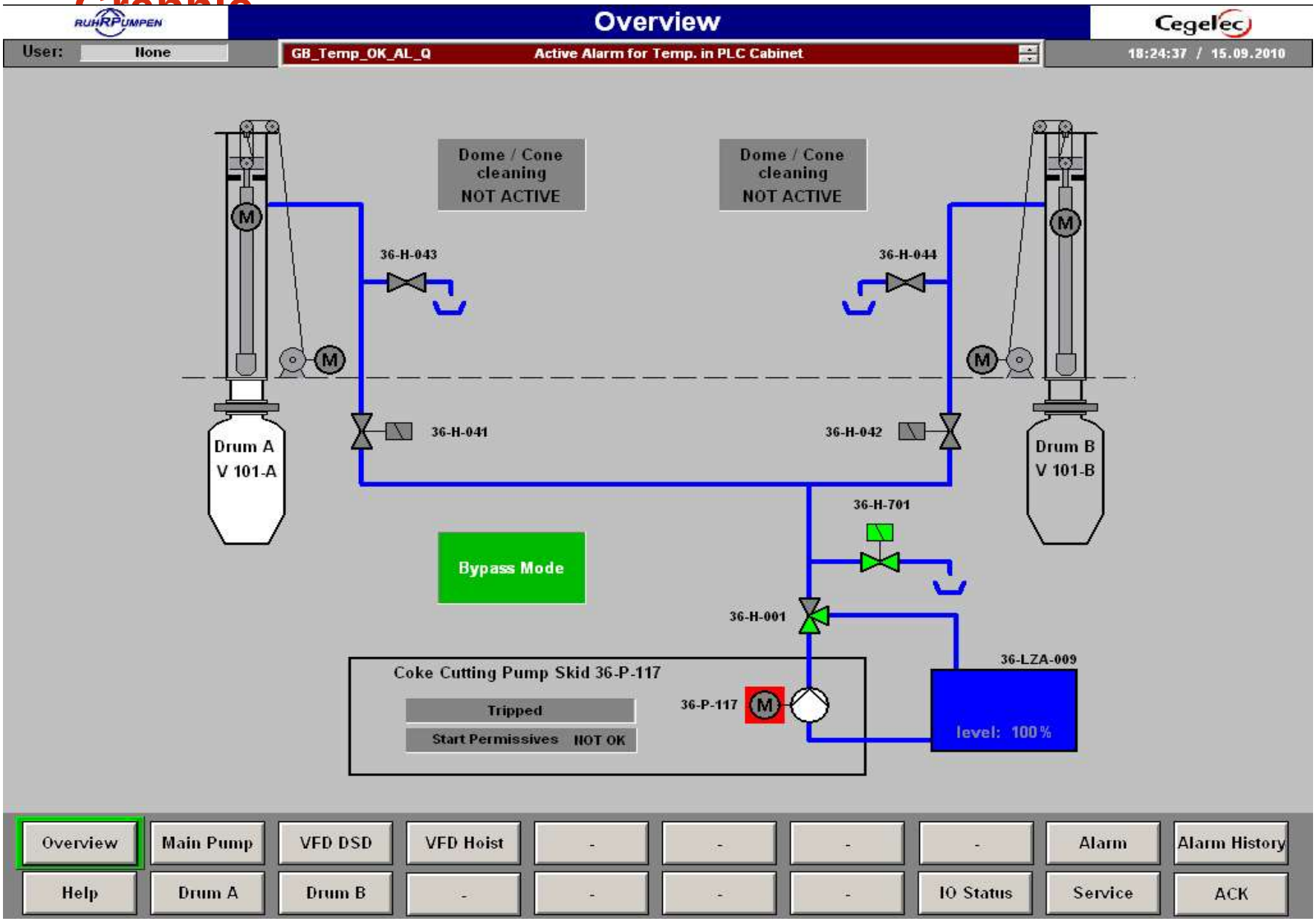
    Now operating with spare (has two operating cells per drum)
  - Combination tool internal drill/cut switching mechanism failure. Tool easily replaced by existing spare. Switching Mechanism easy to change.

# LOCATION B – Remote Unheading & Coke Cutting Controls

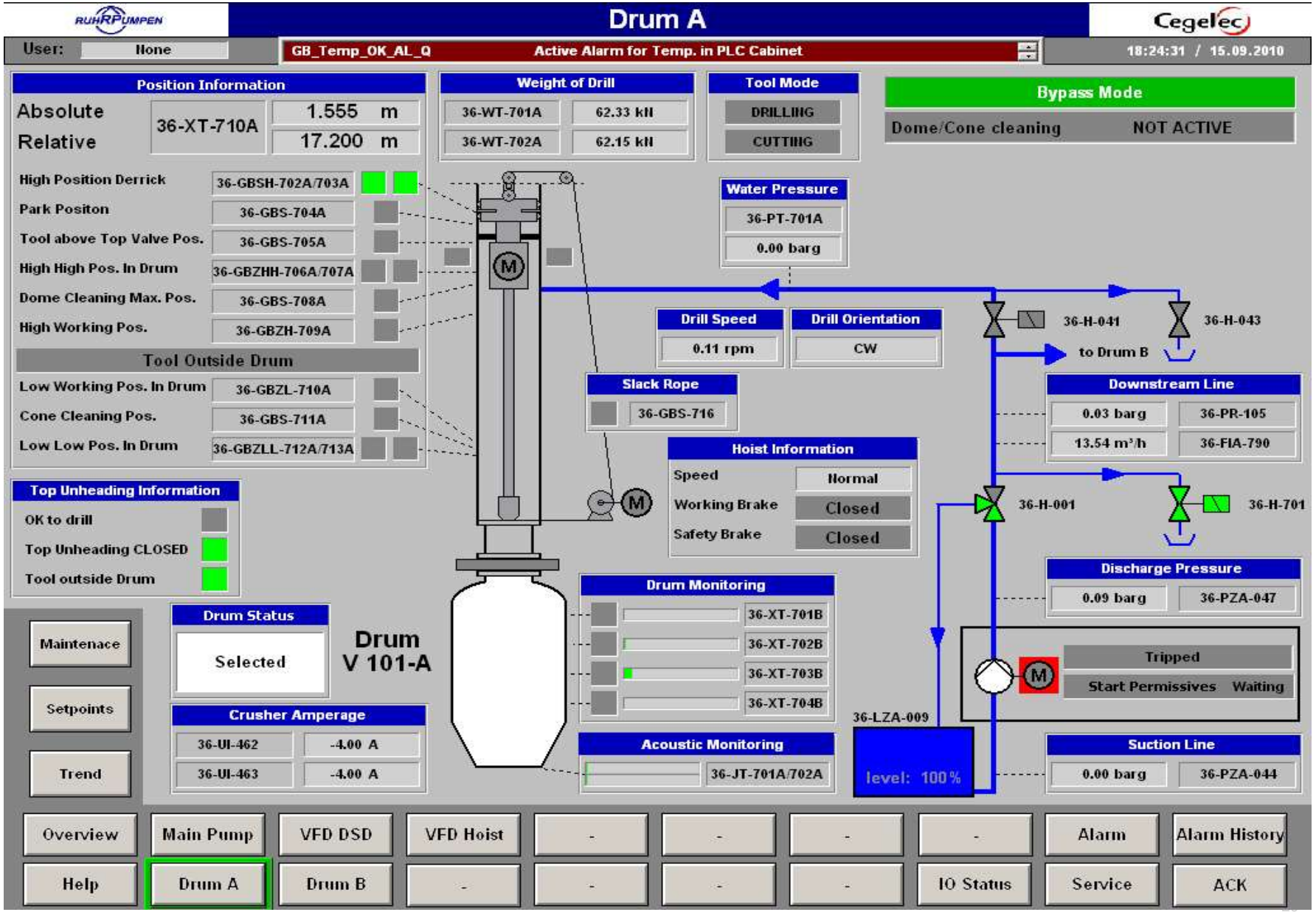




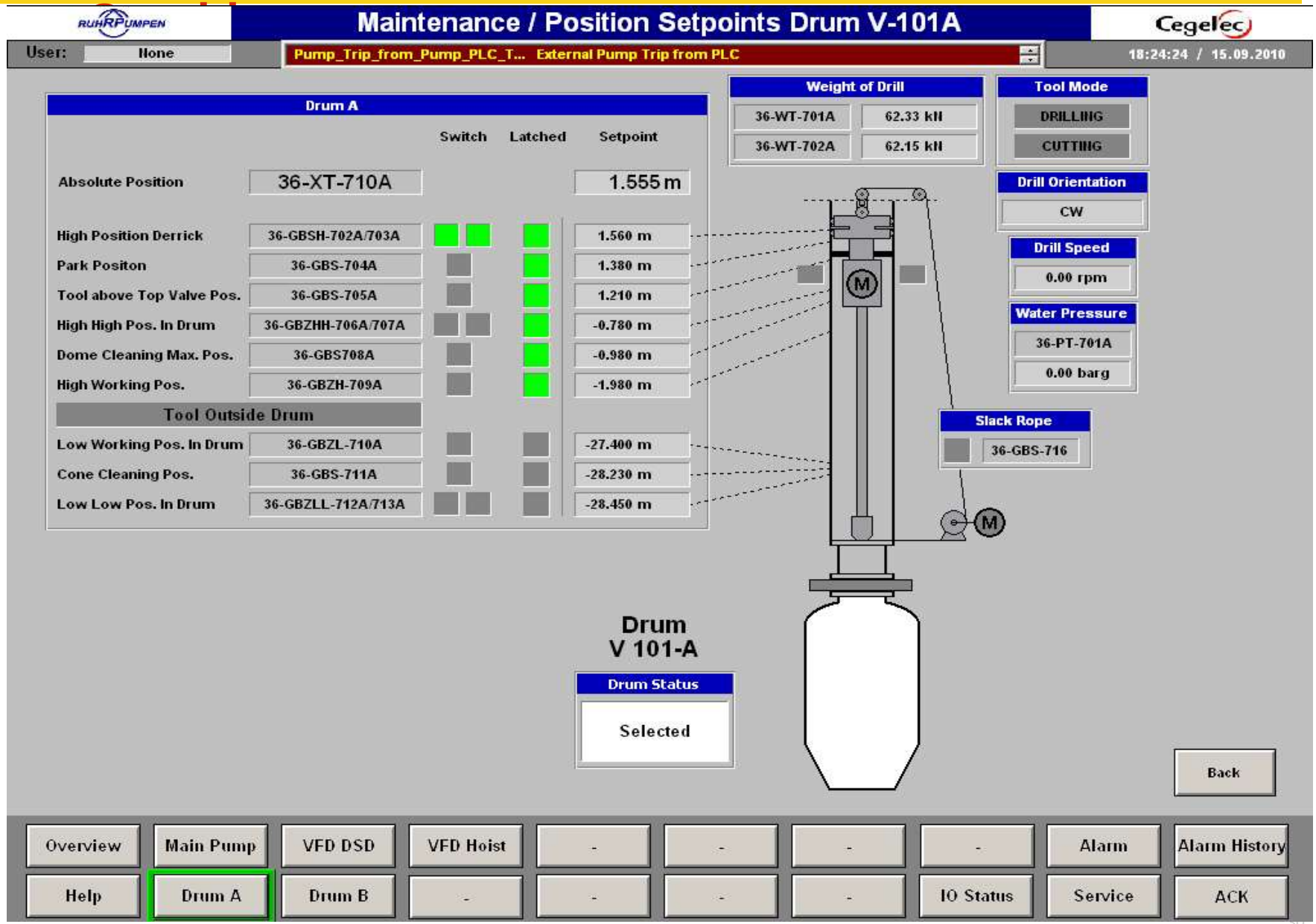
# LOCATION B - Remote Coke Cutting Overview Graphic



# LOCATION B - Remote Coke Cutting Control Graphic



# LOCATION B - Remote Coke Cutting Maintenance



# LOCATION B - Top Slide Valve and Tool Enclosure

# Q & A