

Two thin, red, wavy lines that span the width of the slide, positioned above the main title.

Improving Decoking System Reliability

*Coking.com Calgary
September 2009*

A large, solid red bar at the bottom of the slide with a wavy top edge.

Experience In Motion

Flowserve Overview



Flowserve is the recognized world leader in supplying pumps, valves, seals automation and services to the power, oil, gas, chemical and other industries.



With more than 14,000 employees in more than 56 countries, we combine our global reach with a local presence.

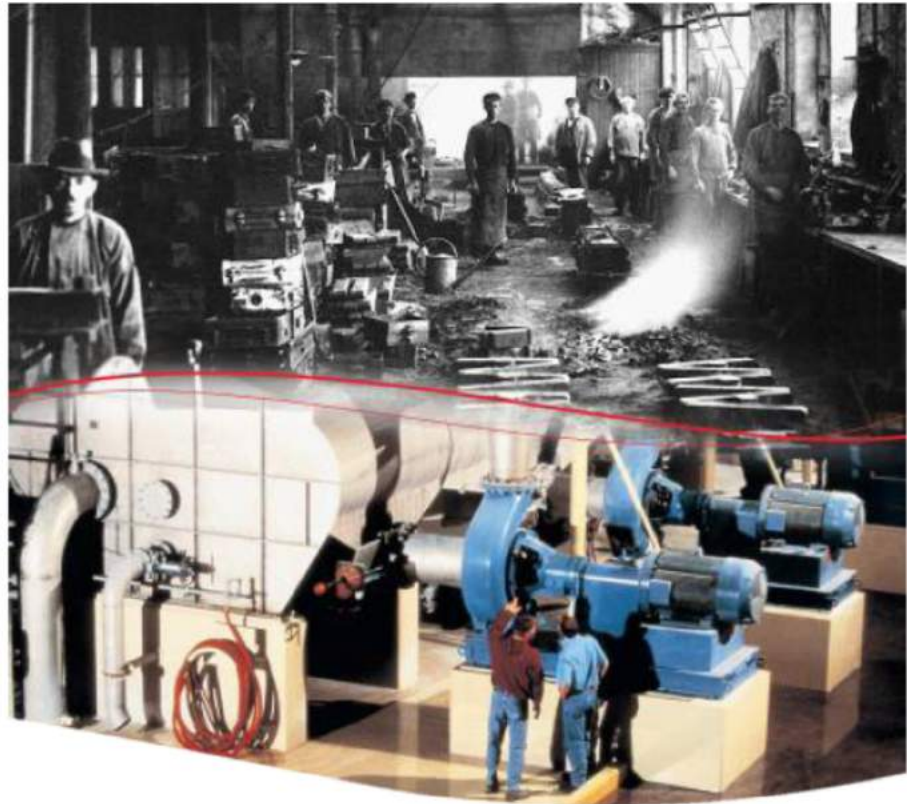


Serving the process industries with a strong history of brand names and industry experience



Flowserve History

- The Flowserve heritage dates back to the 1790 founding of Simpson & Thompson
- The company was created in 1997 with the merger of two leading fluid motion and control companies – BW/IP and Durco International
- The Flowserve Corporation includes more than 50 companies and product brands



Breadth of Flowserve Products



Valves

- ▶ Ball Valves
- ▶ Plug Valves
- ▶ Gate, Globe, Check Valves
- ▶ Globe Control Valves
- ▶ Rotary Control Valves
- ▶ Actuators
- ▶ Steam Valves and Traps
- ▶ Positioners
- ▶ Switches
- ▶ Services



Pumps

- ▶ Multi-Stage Pumps
- ▶ Vertical Pumps
- ▶ High Pressure Pumps
- ▶ Multi-Phase pumps
- ▶ ANSI/API/ISO Pumps
- ▶ Specialty Products
 - ▶ Hydraulic Decoking
 - ▶ LNG Expanders
 - ▶ Ebullators
- ▶ Services



Seals

- ▶ Mechanical Seals
 - ▶ Bellows
 - ▶ Compressors
 - ▶ Lift-Off, Dry Running
 - ▶ Mixer
 - ▶ Pusher
 - ▶ Steam
 - ▶ Standard Cartridge
 - ▶ Slurry
- ▶ Services

**Oil and Gas (Exploration, Pipeline, Refining) • Power Generation • Chemicals •
Food and Beverage Waste Water • Clean Water • Aerospace •
Pharmaceuticals • Agriculture • Navy/Marine**



Hydraulic Decoking Systems

Flowserve is the recognized world leader for decoking


- Combined technology of  and  heritage companies
- Reliable operation since 1938
- Operating in over 150 delayed coker units worldwide

Continuously developing solutions to improve safety, reliability and value to refiners



Challenges facing end users

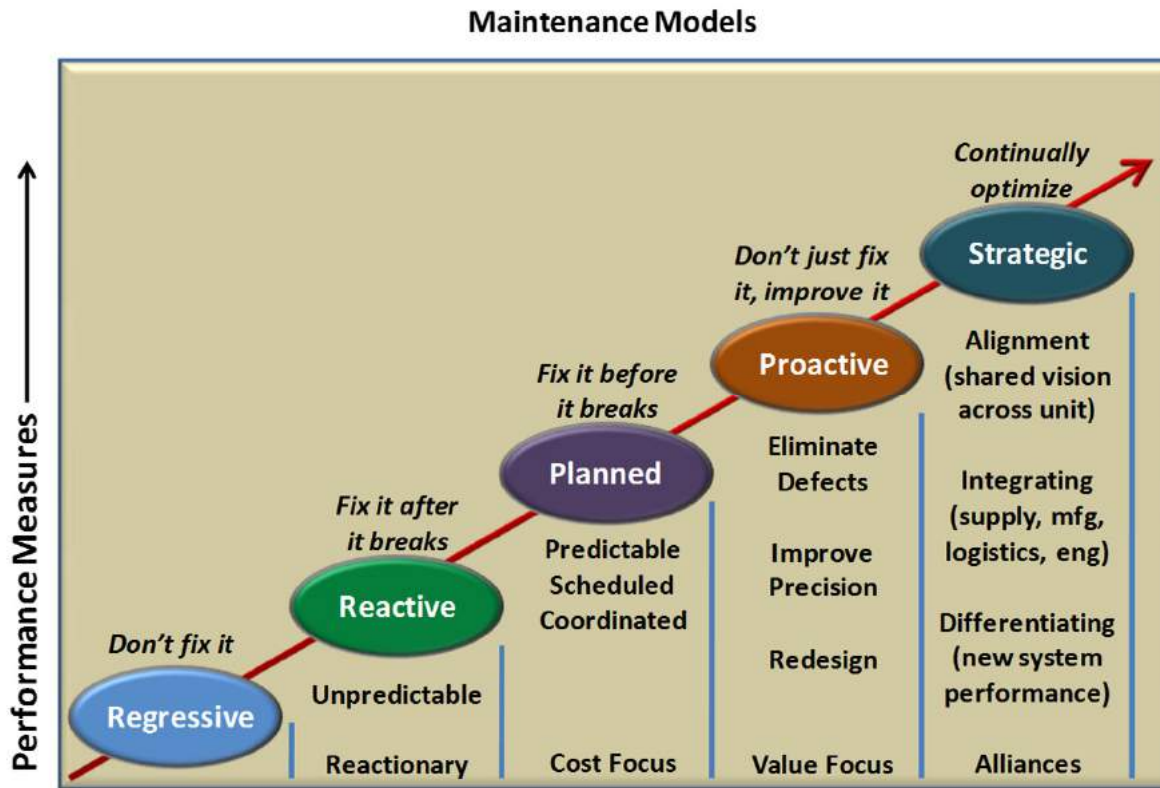
 **Operating Budgets**

 **Rising Energy Costs**

 **Rising Operational Costs**

- Reduced operating budgets flat
- Rising energy costs
- Spare parts inventory
 - Availability, carrying costs
- Unplanned or Emergency breakdowns
- Lack of useful data / too much data
 - Expertise in what it all means
- Aging workforce
 - Rotating equipment expertise retiring

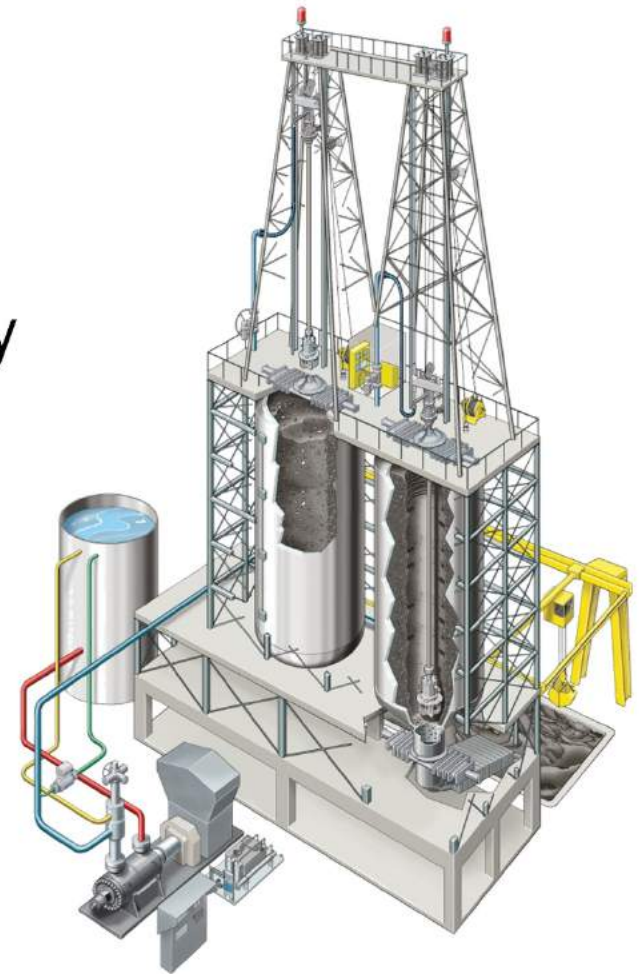
Reducing Cost & Maximizing Reliability



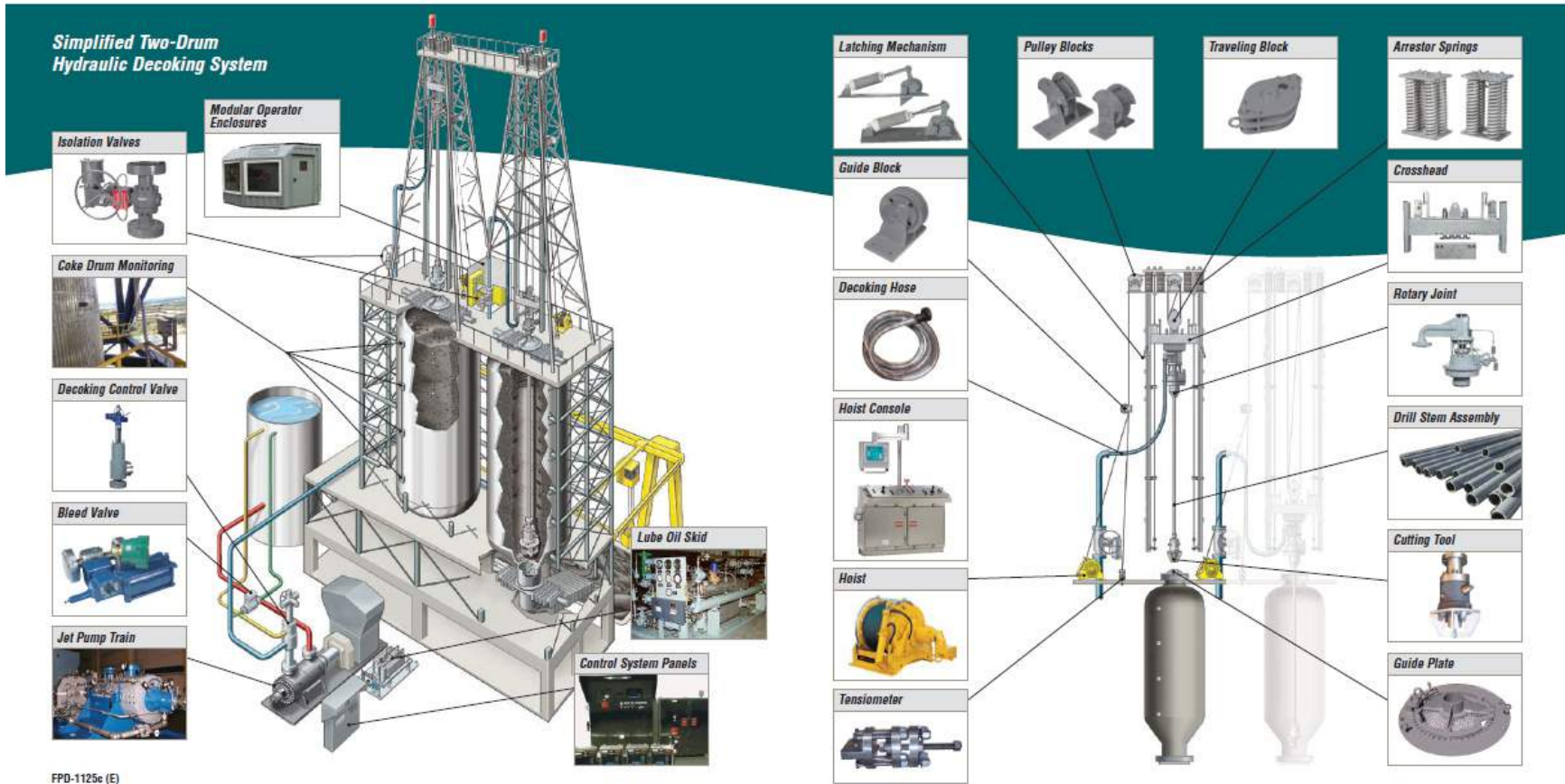
- Training
- Failure prevention technology
- Predictive maintenance
- Energy monitoring & optimization
- Additional consultative services
 - Inventory reduction management assistance
 - Outsource repair/rebuild activities
 - Engineering services

Hydraulic Decoking Systems

1. Remove coke from drum
2. Protect personnel
3. Maximize performance and reliability



Hydraulic Decoking Systems



Online Assurance™ for Hydraulic Decoking

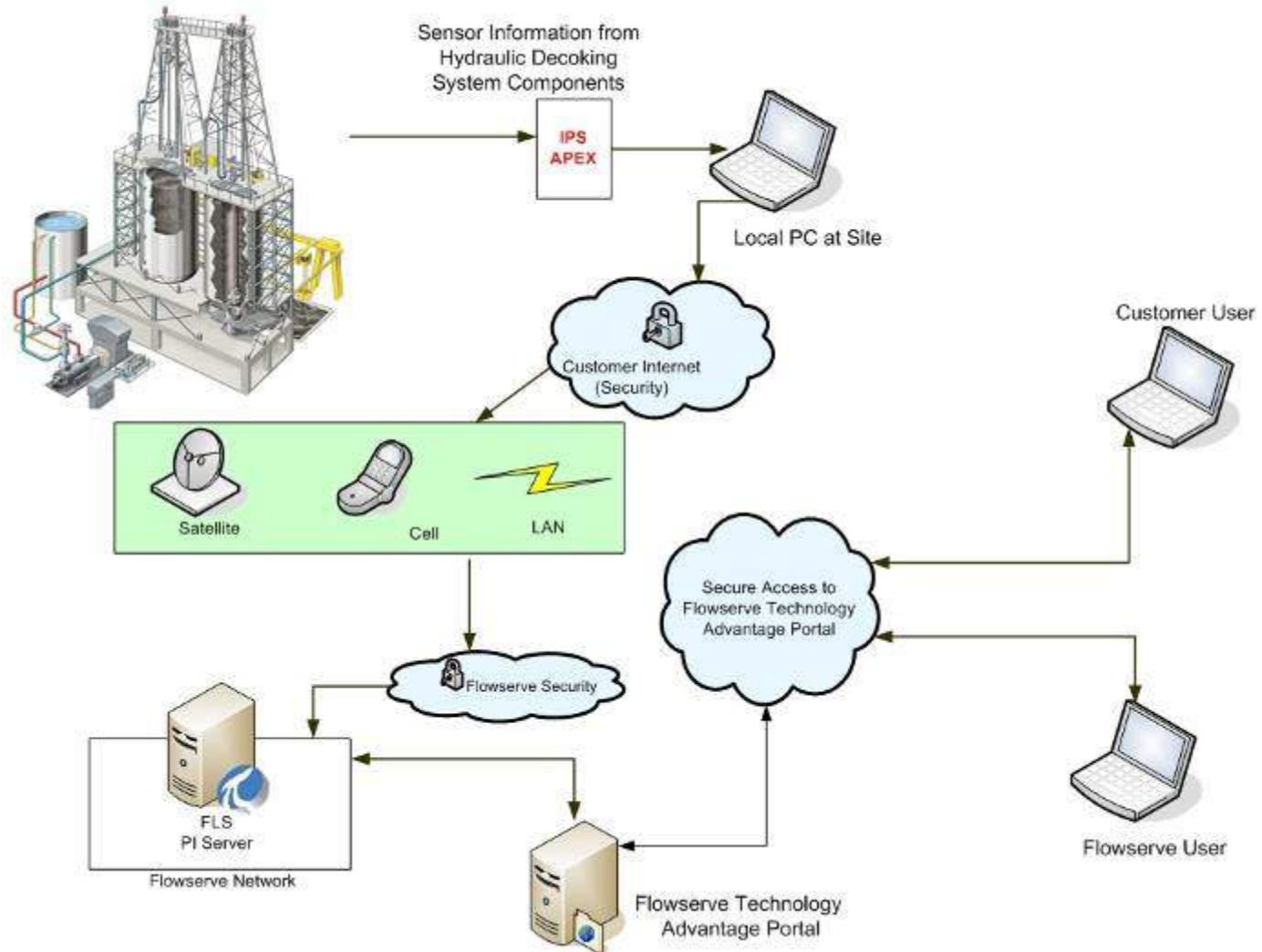
- Utilizes system operational data for conversion into actionable information
- Goal is to improve reliability, availability and efficiency of the decoking system



Online Assurance for Hydraulic Decoking

- Real-time equipment monitoring and control systems
- Advanced diagnostics algorithms which predict equipment behavior and provide information to help prevent unplanned or emergency breakdowns
- Intelligent algorithms for automated control of the decoking process
- Customized data viewing portals for global access to actionable information

Real-time equipment monitoring



Decoking System Diagnostics

- Jet pump performance, pressures and cutting times to assess cutting nozzle wear
- Decoking valve differential pressures and flows for proactive maintenance
- Rotary joint bearing vibration, gear box oil condition and seal leakage for proactive maintenance
- Equipment in-service counters for preventive maintenance reminders



Automated Decoking

Fully automated systems

- Embedded intelligence and advanced algorithms to process signals and control the cutting process
- Automatic coke cutting with continuous feedback
- Operator consulting only required for exceptions

Automated Decoking

Benefits

- Improved cutting personnel safety
- Process efficiency and consistency
- Improved equipment reliability
- Data recording for process optimization or troubleshooting

Automated Decoking

Basic operation

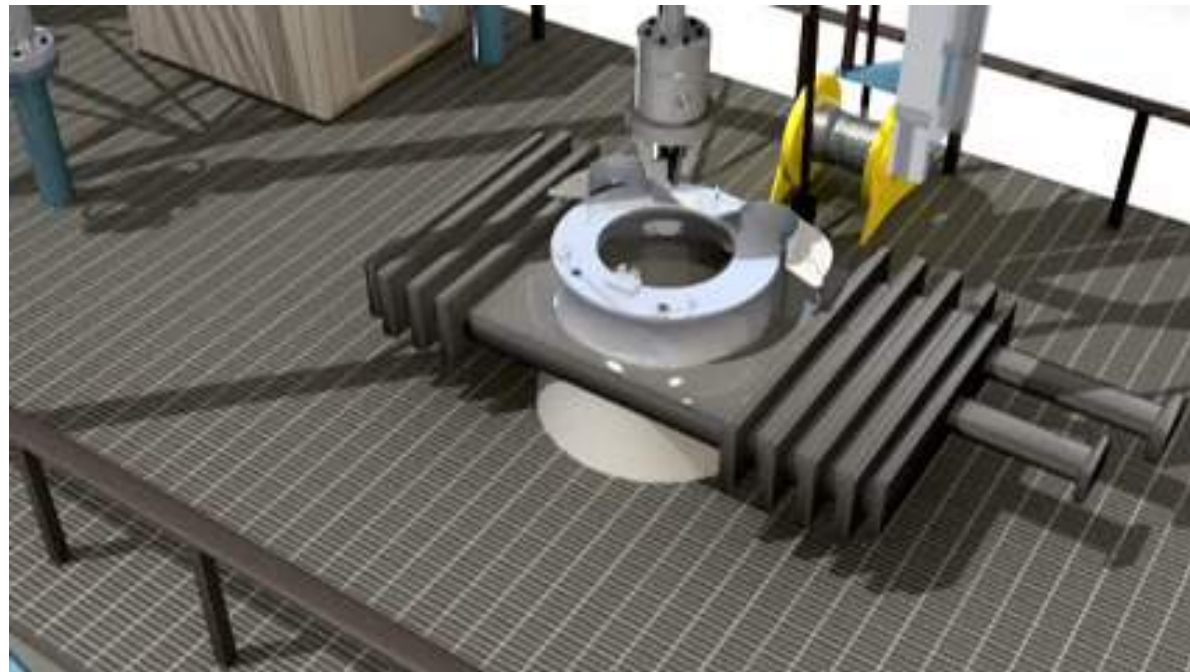
- Use vibration sensors mounted on the coke drum to provide feedback on the state of cleanliness of the drum wall
- Sensors provide interactive feedback on the cutting status that can optimize the cutting time
- Program is customized based on site-specific cutting practices and configured with end user



Hydraulic Decoking Procedure

Removing coke from the drum

- Fracture coke bed hydraulically using high-pressure water
- Cutting water is recycled
- 2-Step process
 1. Boring



Hydraulic Decoking Procedure

Removing coke from the drum

- Fracture coke bed hydraulically using high-pressure water
- Cutting water is recycled
- 2-Step process
 1. Boring
 2. Cutting



AutoShift Installations

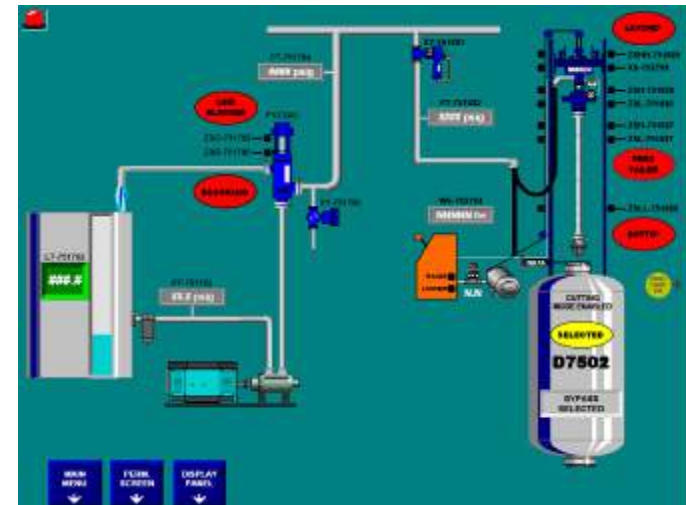
- Flowserve has AutoShift tools in-service since January 2004
- Currently have 98 AutoShift tools in operation at 32 refineries
- More than 70 additional tools/conversions are pending delivery or commissioning



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 via drum monitoring system

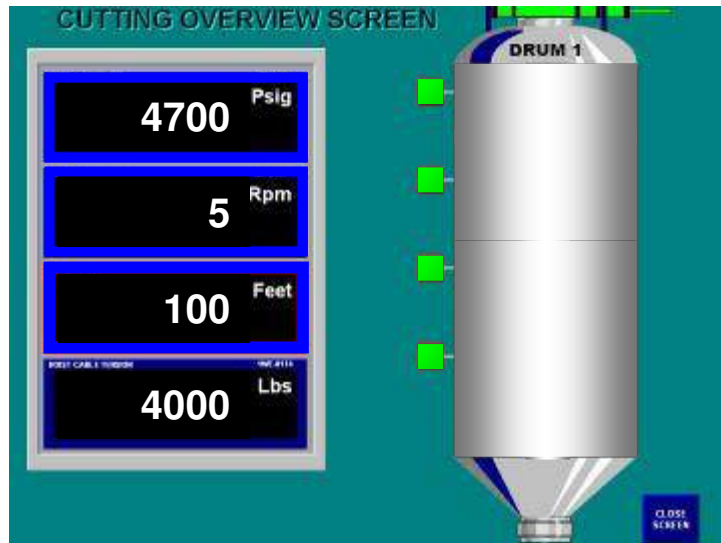


Coke Drum Monitoring

Vibration systems

- Progress monitored on customizable display screens

CUTTING



Online Assurance for Hydraulic Decoking

- Customized data viewing portals for global access to actionable information




Unit / Equipment Level

Homeplate

Customer Site	Customer1 Plant1	Unit Equipment	LC Finer ED001 - Type FR	Country	Canada
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Ebullator



Live Data

Voltage	446.50 V	3/10/2009 2:38:05 PM
Current	161.38 A	3/10/2009 2:38:05 PM
Frequency	60.00 Hz	3/10/2009 2:38:05 PM
Power	1.00 kW	3/10/2009 2:38:05 PM
Cooling Water Flow	1.00 gpm	3/10/2009 2:38:05 PM
Injection Oil Temperature	1.00 degC	3/10/2009 2:38:05 PM
Injection Oil Flow	1.00 gpm	3/10/2009 2:38:05 PM
Speed	885.00 rpm	3/11/2009 2:34:25 PM
Motor Oil Temperature	1.00 degC	3/10/2009 2:38:05 PM
Reactor Temperature	1.00 degC	3/10/2009 2:38:05 PM
Cooling Water Temperature	1.00 degC	3/10/2009 2:38:05 PM
Oil Thickness	1.00 mm	3/10/2009 2:38:05 PM

Analysis Results

Thrust Bearing Safety Factor	0.50	3/11/2009 2:40:39 PM
Thrust Bearing Oil Film Thickness	0.20 mm	3/11/2009 2:40:39 PM
Mixing Temperature	100.00 degC	3/11/2009 12:18:09 PM
Apparent Specific Gravity	1.00	3/11/2009 2:24:00 PM
Motor Slip	0.25 %	3/11/2009 1:38:27 PM

Active Alerts

Descriptor	State	Time of Alert	Value	Unit
No Data				

Alert History

Alert Type	State	Time of Alert	Value	Unit
Ebullator - Thrust Bearing Safety Factor - Out of Range Alert	LOW	3/10/2009 2:33:38 PM	0.50	
Ebullator - Thrust Bearing Safety Factor - Out of Range Alert	LOW	3/10/2009 2:15:35 PM	0.50	
Ebullator - Thrust Bearing Safety Factor - Out of Range Alert	LOW	3/10/2009 2:15:28 PM		
Ebullator - Thrust Bearing Safety Factor - Out of Range Alert	LOW	3/10/2009 2:14:28 PM		
Ebullator - Thrust Bearing Safety Factor - Out of Range Alert	LOW	3/10/2009 2:13:01 PM		

Asset Experts

Name	Title
Dennis Rusnak	Lead Product Engineer
Subramanya Prasad	Sr. Engineer

Tables

Descriptor	Value	Engineering Units	Time
Ebullator - Hydraulic Components % Remaining Lifetime	96.77 %		3/12/2009 8:01:00 AM
Ebullator - Mechanical Seal % Remaining Lifetime	96.32 %		3/12/2009 8:01:00 AM
Ebullator - Motor Bearings % Remaining Lifetime	96.32 %		3/12/2009 8:01:00 AM
Ebullator - Motor Windings % Remaining Lifetime	96.32 %		3/12/2009 8:01:00 AM
Ebullator - RPM	885.00 RPM		3/11/2009 2:34:25 PM

- Alarms / Notifications
- KPIs
- Schematics
- Data Views:
 - Tables
 - Gauges
 - Trends
- Contact: Asset Experts



Alarms / Notifications

- Setup based on sensory data, KPIs, or custom formulas
- Notifications can be sent via e-mail or SMS
- Alarms can be color coded

Event/Alarm Summary

Descriptor	State	Time
AP001 - Axial Vibration - Trend Change Alarm	HIGH	10/17/2008 2:00:30 PM
AP001 - Flow - Instability Alarm		10/17/2008 7:59:04 AM
AP001 - Fluid Temperature - Out of Range Alarm		10/16/2008 7:18:51 AM
AP001 - Radial Vibration - Trend Change Alarm	HIGH	10/17/2008 1:57:30 PM
AP001 - Power - Change of Status Alarm		10/16/2008 7:18:51 AM
AP001 - Discharge Pressure - Instability Alarm		10/16/2008 7:18:46 AM
AP001 - Discharge Pressure - Out of Range Alarm		10/16/2008 7:18:39 AM
AP001 - Seal Temperature - Out of Range Alarm		10/16/2008 7:18:51 AM

Event/Alarm History Time Range

Start Time: *-2h End Time: *

Apply [Refresh] [Previous] [Next]

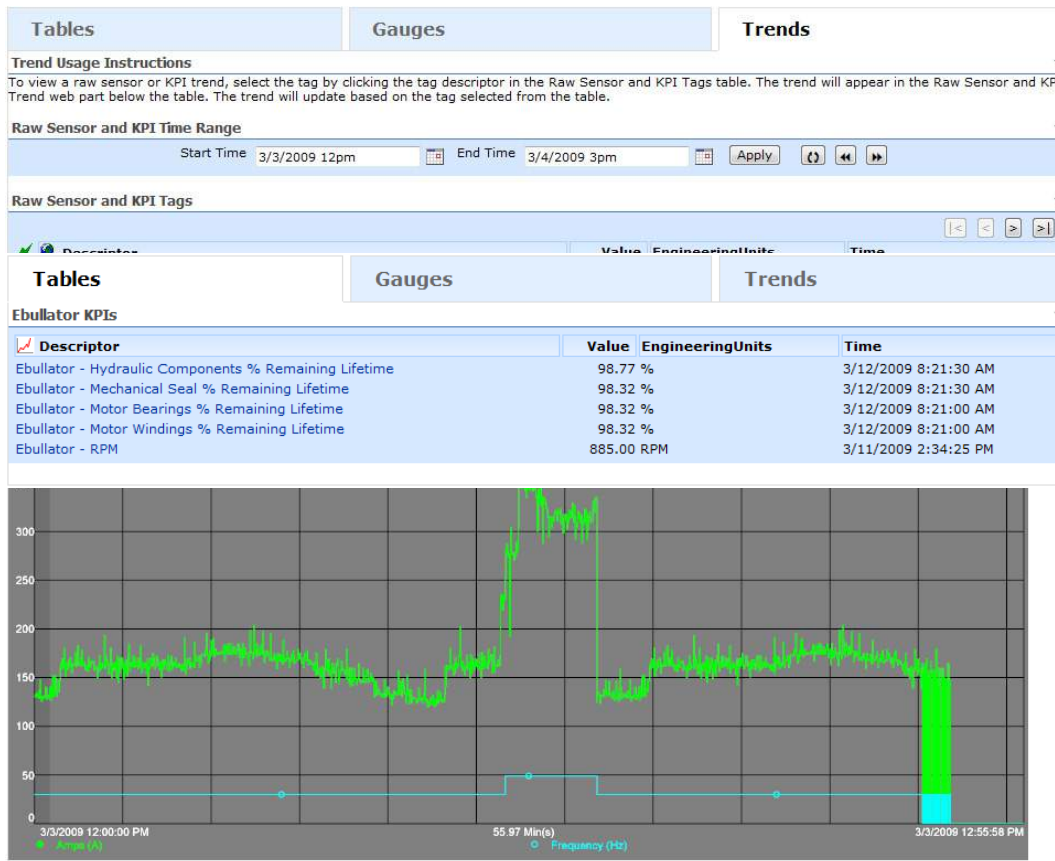
Event/Alarm History

Alert Type	State	Time Triggered	Value	Units
AP001 - Axial Vibration - Trend Change Alarm	HIGH	10/17/2008 2:00:30 PM	0.05	in/sec pk
AP001 - Axial Vibration - Trend Change Alarm	HIGH	10/17/2008 1:59:30 PM	0.04	in/sec pk
AP001 - Axial Vibration - Trend Change Alarm	HIGH	10/17/2008 1:58:00 PM	0.04	in/sec pk
AP001 - Radial Vibration - Trend Change Alarm	HIGH	10/17/2008 1:57:30 PM	0.10	in/sec pk
AP001 - Axial Vibration - Trend Change Alarm	HIGH	10/17/2008 1:56:31 PM	0.04	in/sec pk

Showing 1 to 5 of 52



KPIs – Tables / Gauges / Trends



- Key Performance or Process Indicators
- Can be based on sensory data, equations, life cycle data, etc
- Multiple visualizations:
 - Tables, Gauges, Trends

Asset Info - Enterprise Data

The screenshot displays the FLOWSERVE Customer software interface for a 'Standard Pump System'. The interface is divided into several panes:

- Bill of Materials (BOM):** Located at the top right, it shows a list of materials with columns for 'Std Item', 'Qty/Std Unit', 'Type', 'Unit', 'Std Unit', 'Std Unit', 'Std Unit', and 'Std Unit'. The 'Std Unit' column is highlighted in yellow.
- Maintenance Data:** Located in the middle left, it shows a table with columns for 'Date', 'Type', and 'Comments'. The 'Date' column is highlighted in yellow.
- Standard Pump Drawings:** Located in the bottom right, it shows a technical drawing of a pump system with various components labeled. Below the drawing is a table with columns for 'Std Item', 'Qty/Std Unit', 'Type', 'Unit', 'Std Unit', 'Std Unit', 'Std Unit', and 'Std Unit'. The 'Std Unit' column is highlighted in yellow.
- People Table:** Located in the bottom left, it shows a table with columns for 'Name', 'Role', and 'Status'. The 'Name' column is highlighted in yellow.

- Maintenance Data
- Installation Information
- Drawings
- Bill of Materials



Reports

The screenshot displays the FLOWSERVE Standard Pump System software interface. It features a navigation pane on the left with a tree view showing the system hierarchy. The main window is divided into two report sections:

- Alarm History Report - Time Range:** This section shows a table of alarm events with columns for time range and status.
- Performance Report:** This section displays a detailed performance analysis. It includes a table with columns for Tap Names, Description, Average Value, Max Value, Min Value, and Sum. The table lists various taps such as 'R5-DRAW-LOG-AP001-Dr', 'R5-DRAW-LOG-AP001-Ps-Dr', and 'R5-DRAW-LOG-AP001-Dp-Dr'. Below this, there is a summary table for various performance metrics like 'Availability_Monthly', 'Efficiency', and 'Runtime'.

At the bottom of the interface, there are sections for 'Documents' and 'OEM Knowledge', providing additional context and resources for the user.

- Reports are built using Excel and shared via the web
- Custom layouts
- Can pull sensory data live and/or historically
- Can embed trends, graphics, etc.



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