

CRUDE UNIT

Application Solutions Guide

THE CHALLENGE

Refiners are faced with an increasingly connected global market. These market dynamics lead to a competitive environment that is unprecedented in the history of the industry. Most refineries operating today were designed with the minimum degree of process automation to run the plant in a basic fashion. Today's operational demands require breakthrough performance, and Emerson Process Management can enable refiners to achieve new levels of safe performance in key operational areas.

Improving Crude Unit Operations with the Smart Refinery

The Crude Unit is the gateway to all other process units in a typical refinery, yielding intermediates and finished products that drive bottom line refinery business results. It can also be the bottleneck, if not operated safely and in optimum balance with refinery and market demands. The keys to profitability in crude unit operations often depend on operational excellence in the areas of safety, energy efficiency, optimal process unit utilization, and consistent and reliable unit operations, day after day. Emerson Process Management has a long history of providing total automation solutions that improve performance in these key operating areas. The result is a competitive advantage that puts you ahead of other refiners in today's changing refining marketplace. Read on to see how we can work with you to move your refinery toward top quartile performance.

Performance Challenges	Business Consequence	Improvement Opportunities
Energy Efficiency impacted by: <ul style="list-style-type: none"> • Tube fouling leading to inefficient heat transfer • Poor combustion air control • Burner tip plugging leading to poor heat distribution 	Increased Energy Costs	Reduce energy costs through improved measurement of fuel gas flow, heater pass flow, flue gas O ₂ , CO, and combustibles content and tighter control of combustion air.
Crude Unit Utilization impacted by: <ul style="list-style-type: none"> • Frequent crude switching leading to suboptimal product draw rates • Poor desalter operation leading to downstream corrosion and fouling 	Reduced Utilization Reduced Product Quality	Increase quality and yields with better regulatory controls that improve temperature control, separation efficiency and desalter operations.
Field Asset Reliability impacted by: <ul style="list-style-type: none"> • Lack of visibility to rotating and fixed equipment health • Unplanned slowdowns and shutdowns 	Reduced Production Increased Maintenance Costs	Maximize reliability with device diagnostics to predict field asset failures and enhance visibility into the health of rotating and fixed equipment.
Safety, Health, & Environment impacted by: <ul style="list-style-type: none"> • Regulatory agency codes and standards • Operator and maintenance training • Inconsistent startup and shutdown practices • Unreliable emissions monitoring 	Increased SH&E Risks	Improve plant and community safety and operate within increasingly stringent environmental regulations with automation solutions that deliver better measurement, control, and diagnostic information.

Refining Application Solutions Guides are available on the following applications:

Crude Unit Fired Heater Hydrocracker



PLANTWEB® – DIFFERENT, BETTER, AND WHY

PlantWeb digital plant architecture offers leading edge technology giving you a greater view to your process operations and equipment health. The crude unit is at the beginning of the refining process, and is the gateway (or bottleneck) to all other process units. The key process challenges in a crude unit, which can drive down total refinery performance, are optimizing unit utilization, improving overall process unit reliability, and increasing energy efficiency, all with safety as a first concern.

Emerson Process Management provides best-in-class field devices, final control elements, analytical products, safety solutions, asset management, and control platforms to address your key operating challenges. These elements, integrated together in PlantWeb, enable you to achieve **breakthrough** performance. DeltaV™ provides one platform for control, APC and asset management, and provides best control loop response for tighter, robust control. Breakthrough performance is also achieved through APC applications embedded into DeltaV, seamlessly integrated predictive diagnostic from critical production assets, one common database, operator display, and an engineering toolset for basic process control to safety systems, including training simulator.

Utilization

SmartProcess® fractionator optimization applications improve crude unit operation efficiency with greater yield flexibility. These applications are pre-engineered, embedded multi-variable control that allows the unit to safely operate closer to constraints without violating them. Although the applications are pre-engineered for faster implementation and lower cost, trained refinery staff is still able to customize, implement, and maintain the configurable applications ensuring long-term use. One key benefit with these multi-variable control applications is the ability to minimize transition time and disruption during crude switching.



Energy Efficiency

Inefficiency in energy management is one of the greatest contributors of high operating costs. Crude oil heating costs are among the highest of any operating unit. SmartProcess heater optimization combines advanced regulatory and combustion control modules to operate at maximum efficiency while maintaining safe operations. PlantWeb allows you to get the most efficient use of energy by improving heater combustion, managing energy efficiency of process equipment, and operating with tight and robust temperature control.



Reliability

Crude unit reliability is essential to ensure end to end refinery reliability. Rotating equipment (pumps, compressors, motors, air fans, etc.) assets fail with greatest statistical severity, causing refinery-wide slowdowns and shutdowns. Poorly performing control valves negatively impact process unit operations and reduce the benefits of APC.

AMS® Suite applications allow for real-time information from critical rotating assets, providing quick access to information on active alerts and events. These applications are tightly integrated with DeltaV, enabling effective decision support to diagnostic viewing for operations and maintenance. Emerson's PlantWeb offerings simplify implementation of predictive maintenance with actionable information required to maintain safe and optimized performance.



Customer Proven

“We converted two crude units from pneumatics to PlantWeb and added a third unit to our refining process. We increased capacity by 30% without additional personnel. We saved four jobs with the new system. Our production is now limited only by our permit.”

Jody Verrett
Operations Manager
Calcasieu Refining Company

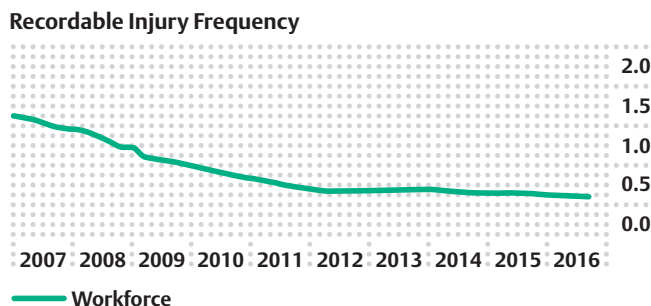
“The technology around instrumentation wasn't up to the challenge of the 21st century. So the path was set to achieve what we needed to achieve from a business standpoint. We needed to focus hard on enabling future operators to run the plant in a way that is required to deliver the products to the marketplace, to meet specs and to do it in a competitive way.”

Jeff Funkhouser
Operations Manager
Motiva Norco

Safety

Safety, health, and protecting the environment are top priorities in every operation. There are two reasons that a strong safety, health, and environment program is “Job One” in virtually every refinery: The risks are real, and the consequences serious.

Emerson provides SIL-rated transmitters, final control elements, and logic solers, as well as the engineering expertise to deliver an integrated safety instrumented system in accordance with your safety requirement specifications.



CRUDE UNIT CHALLENGES

Poor desalter operation leads to exchanger and fractionator tray fouling and overhead system corrosion

Safe and effective start-up, operation, and shutdown are critical

Environmental impact and energy efficiency depend on good combustion control

Fractionator flooding disrupts operations

Fluctuating fuel gas composition causes operational disturbances

Measurements are missing that enable me to fully optimize the plant

Spurious trips caused by malfunctioning instruments and control upsets

Crude switching is a challenge for optimal operation

Variability in heater outlet temperature causes process disturbances

Low NOx burners are a maintenance challenge

Pump seal failure can cause a release of hazardous material and possibly fires

You can achieve a safely optimized crude unit that is reliable and energy efficient.

Emerson Process Management has the technology and expertise to make it happen.

STRATEGY FOR A SMART REFINERY



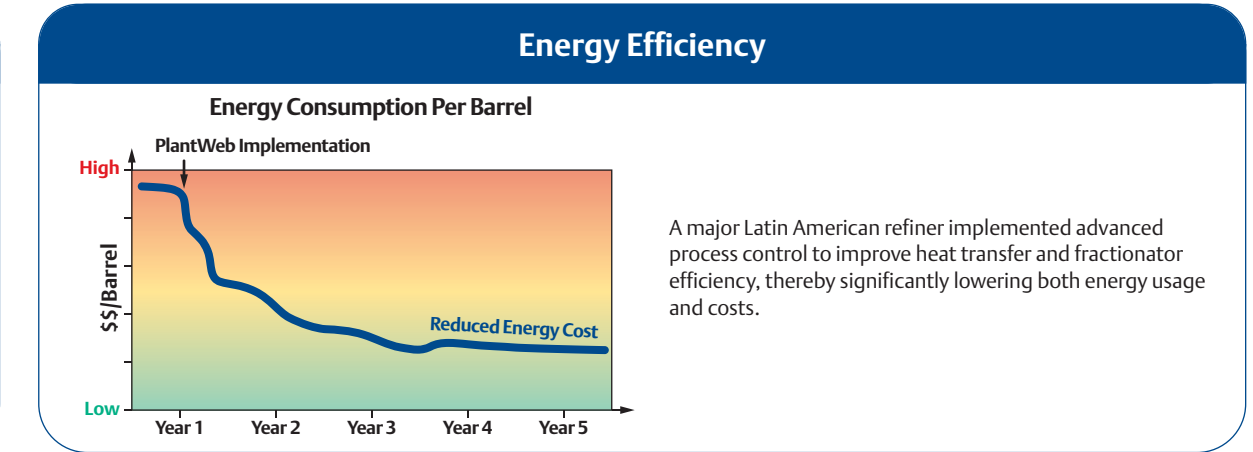
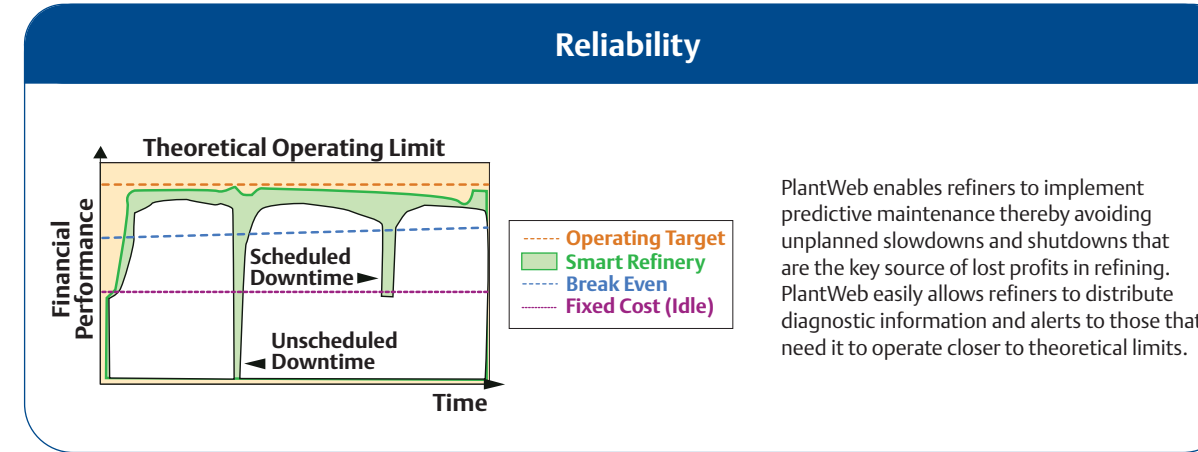
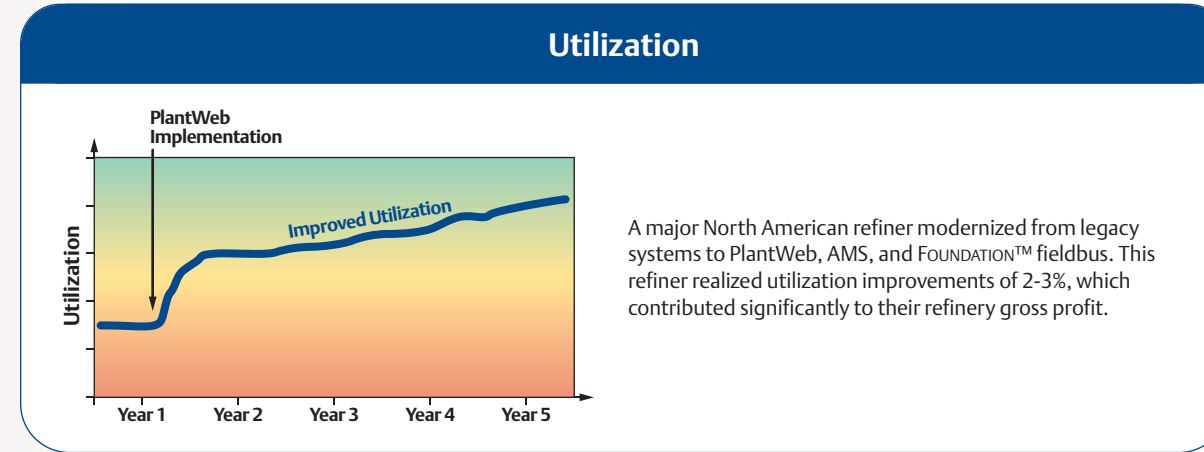
Predictive Intelligence and the Power to Use It

Emerson's PlantWeb digital Smart Refinery architecture enables you to harness the power of predictive intelligence to operate more efficiently, safely, and effectively.

With PlantWeb you gain unmatched capabilities to improve profitability through reduced cost and improved output.



PLANTWEB IN ACTION



Control, Protection, and Asset Optimization



The PlantWeb smart digital control, smart safety, and smart asset management systems power PlantWeb by enabling safe, reliable and optimized operations.

Only PlantWeb provides breakthrough performance in refining through:

- Best control loop speed of response, resulting in tighter control, providing operational excellence and increasing profitability.
- Continuously running diagnostics to readily distinguish an instrument problem from a process problem.
- Clear direction on which assets – including automation, electrical, process, and rotating equipment – are in need of attention, avoiding upsets, slowdowns, and shutdowns.

SMART DIGITAL CONTROL

PlantWeb, with DeltaV, offers better basic process control by providing best loop speed of response and ensuring health of process assets.

- DeltaV has a broad portfolio of easily configured embedded advanced control applications, including multi-variable model based predictive controllers, neural networks, fuzzy logic, and adaptive control.
- DeltaV continuously identifies and accurately diagnoses the root causes of any poorly performing control loop.
- DeltaV uses the same database for regulatory and advanced controls, simplifying configuration, setup, and long-term use – eliminating all problems/costs associated with connectivity to third party systems.

www.EasyDeltaV.com

SMART SAFETY

The key to safe crude unit operations is early visibility to deteriorating conditions – backed by a reliable, integrated safety loop if the situation becomes critical.

- DeltaV SIS uses the power of device diagnostics to improve the availability and reliability of your safety instrumented system.
- PlantWeb uses engineering tools common to both DeltaV and DeltaV SIS graphics, configuration and process simulation, increasing operator effectiveness and lowering total cost of ownership.
- DeltaV SIS provides automated testing of elements in the safety loop, including online partial stroke testing of the safety valve which prevents costly unscheduled interruptions and provides automated historization.

www.EasyDeltaV.com

SMART ASSET OPTIMIZATION

Only PlantWeb's native device intelligence delivers the foundation for predictive maintenance strategies and comprehensive turnaround planning to optimize asset reliability.

- Instrumentation – Understand the situation(s) prior to going into the field by detecting and diagnosing field device problems.
- Control valve – Catch problems before they escalate using extensive valve diagnostics.
- Rotating assets – Collect and display the condition of pumps, motors, fans, compressors, and other rotating equipment to proactively maintain these assets for optimum unit operations.
- Asset health information is accessible to reliability personnel and operators through DeltaV and AMS Suite, thereby increasing their effectiveness.

www.EmersonProcess.com/Optimize

Field Intelligence

With the right intelligence, your field assets not only provide more precise and reliable information on the process, but they also self-diagnose their health and alert you to potential problems.

PlantWeb seamlessly integrates inputs from FOUNDATION™ fieldbus, AS-i, DeviceNet, ProfibusDP, and HART® devices, providing flexibility and enhanced control strategies while saving money, time, and resources.



Devices, instruments, and software designed with best-in-class intelligence power PlantWeb by enabling you to extract rich and reliable data from your process to optimize control.

SMART FINAL CONTROL

Fisher® final control elements lead the world in refining, delivering:

- Superior safety loop performance with SIL-rated final control elements featuring health monitoring and partial stroke testing
- Superior control performance providing more stable process control during difficult conditions such as frequent crude switches
- Automated documentation and historical reliability records of advanced process diagnostics, including valve signature tests and partial stroke testing
- Greatest breadth of supply from basic to engineered products, providing solutions for most refining applications
- High reliability in the harshest of process environments such as the desalter mixing valve

Featured Technologies:
Fisher Digital Control Valve and FIELDVUE® Digital Controller

www.EmersonProcess.com/Fisher

SMART MACHINERY HEALTH

Rotating equipment failure is the leading cause of plant slowdowns and shutdowns. Vibration across unit assets causes a high percentage of asset degradation and failure.

While highly critical assets are often monitored by other plant systems, the balance of process pumps and assets are not continuously monitored. Emerson's effective, economically viable solutions for vibration detection help extend this capability to all unit assets.

Monitoring rotating equipment vibration gives valuable insight into predicting:

- Pump mechanical seal or bearing failure
- Overhead receiver off gas compressor seal or bearing failure
- Air-cooled exchanger loss of heat removal capacity due to fan or motor failure

Featured Technologies:
CSI® Machinery Health Monitors

www.AssetWeb.com/MHM

SMART ANALYTICAL

Reliable process heater flue gas oxygen and CO/combustibles measurements are key to optimizing heater efficiency and improving operator confidence in the measured values to ensure safe operation.

- Advanced features measure the extent of oxygen deficiency in the event of substoichiometric combustion, assisting the operator to recover from unsafe conditions
- Combined O₂ and CO/combustibles analysis enable increases in efficiency while maintaining safe operations

Reliable Continuous Emissions Monitoring Systems (CEMS) for environmental compliance.

pH measurements of the crude column overhead water provide valuable insight into corrosion prevention within the overhead condenser, piping and top trays of the crude column.

Featured Technologies:
Rosemount® Analytical Oxygen, CO/Combustibles Analyzers and pH sensors

www.EmersonProcess.com/railhome

SMART MEASUREMENT

A complete line of technically advanced pressure, temperature, flow, level, and safety measurement instrumentation to fill almost every one of your process and asset health measurement needs.

- Redundant temperature element capability provides for consistent yield and quality
- Extensive diagnostics proven to avoid process upsets, such as plugged impulse line detection and fractionator flooding
- Industry-leading long term stability, lowering total cost of ownership
- Proven, reliable vortex, DP, and Coriolis flow technology to fully optimize the plant
- High temperature, non-fouling designs with advanced diagnostics for precise measurement in adverse process conditions
- Accurate direct mass flow fuel measurement to improve energy efficiency and reduce operational disturbances

Featured Technologies:
Rosemount® and Micro Motion® Measurement Technologies

www.EmersonProcess.com/Rosemount
www.EmersonProcess.com/MicroMotion

SMART WIRELESS

Most refineries were built with the minimum amount of instrumentation to operate the unit. However, operating with improved utilization, reliability, and efficiency often require additional information. Emerson's wireless technologies lower the barrier to acquire the information needed to attain operational excellence.

- Add key process measurements to help optimize operations and determine automation asset health, including trending
- Economically monitor rotating equipment health
- Cost-effectively apply wireless solutions for remote operations, worker safety, and mobile asset tracking
- Reliably and continuously monitor devices and minimize energy consumption through self-organizing mesh technology

Featured Technologies:
Emerson's Smart Wireless Solutions

www.EmersonProcess.com/SmartWireless

SERVICES & SUPPORT

Emerson's extensive global experience in petroleum refineries helps customers create sustained operational improvements worldwide.

Consulting Services

Emerson's consulting expertise covers the full life of an automation investment from conceptual design and justification to on-going control performance audits, including:

- Master Plan Consulting – Multi-year automation investment analysis
- Pre-FEED Consulting – Conceptual design, benefit, and cost estimates
- Advanced Process Control Consulting – Design, justification studies, and implementation services for APC projects
- Control Performance Audits – Expert control loop testing, troubleshooting, and tuning
- Smart Turnaround – Instrumentation and asset reliability audit, turnaround planning, and realization
- Safety – Largest staff of certified functional safety experts and professionals, following IEC 61511 certified procedures



Education and Training Services

Emerson's 65 years of training experience result, delivered through a global network of certified training centers, result in effective learning that provides a framework for maximum availability, sustainability, and operational excellence.

- Specialized training in Maintenance, Safety, Engineering, and Operator Training Solutions
- Award winning services and training
- Customize training to meet site specific needs
- Flexible delivery options – Instructor-led courses either on-site or off-site, virtual-Learning and eLearning

Modernization and Migration Services

Emerson helps maximize return on automation investments by providing Total Migration Solutions – combining best-in-class technology, systems expertise, consulting, and project services.

- Flexible Approach – Migration solutions and capabilities to work within your operating and budget constraints
- Platform Expertise – Extensive knowledge of Emerson and non-Emerson control systems
- Migration Experience – Proven migration solution from planning to implementation
- Automated Conversion Tools – Reduces the risk of improperly converting your existing system data
- Business Case – Assist in developing the justification for migration/modernization projects based on site specific needs

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Emerson Process Management

12301 Research Blvd.
Research Park Plaza, Building 3
Austin, Texas 78759
www.EmersonProcess.com

