THE CHALLENGE
The refining industry market dynamics are global with refined products being shipped around the world creating a competitive environment that is unprecedented in the history of the industry. The hydrocracker unit within a refinery is important to meet low sulfur diesel while taking advantage of opportunistic market conditions between gasoline and diesel, thus this unit needs to operate reliably and effectively. In addition to reliable performance, safety is always a challenge with this unit with high pressures, hydrogen, hydrogen sulfide, fired heaters, and potential reactor temperature excursion.

Today’s operational demands require breakthrough performance, and Emerson Process Management can enable refiners to achieve new levels of safe, reliable performance in key operational areas of the hydrocracker units. The same breakthrough performance can also be applied to other refinery units.

Improving Hydrocracker Unit Operations with the Smart Refinery
The Hydrocracker Unit is an essential process for the overall refinery profitability in converting low value heavy feedstock into higher value fuels such as diesel and gasoline. Improved unit operations allows flexibility between gasoline and diesel production by maximizing yield cuts depending on favorable market conditions.

The keys to profitability in Hydrocracker unit operations depend on operational excellence in the areas of safety, energy efficiency, optimal reactor temperature (yield) control, and consistent and reliable unit operations, every day. Emerson 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 global refining marketplace. Read on to see how Emerson can work with you to move your refinery toward top quartile performance with higher reliability, lower maintenance cost, and lower energy consumption per barrel processed.

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<th>Performance Challenges</th>
<th>Business Consequence</th>
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<td><strong>Energy Efficiency</strong> impacted by:</td>
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<td>• Tube fouling leading to inefficient heat transfer</td>
<td><strong>Increased Energy Costs</strong></td>
<td>Reduce energy costs through improved measurement of fuel gas flow, heater pass flow, flue gas O₂, CO/combustibles content and tighter control of combustion air.</td>
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<td>• Poor combustion air control</td>
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<td>• Burner tip plugging leading to poor heat distribution</td>
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<td><strong>Hydrocracker Unit Reactor Performance</strong> impacted by:</td>
<td><strong>Shorter Catalyst Life</strong></td>
<td>Increase quality and yields with better regulatory controls that improve temperature control of the fired heater and hydrogen quench controls</td>
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<td>• Poor fired heater temperature control for the reactor inlet</td>
<td><strong>Reduced Yield</strong></td>
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<td>• Poor hydrogen quench on reactor temperature control</td>
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<td><strong>Field Asset Reliability</strong> impacted by:</td>
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<td>• Lack of visibility to rotating and fixed equipment health</td>
<td><strong>Reduced Production</strong></td>
<td>Maximize reliability with device diagnostics to predict field asset failures and enhance visibility into the health of rotating and fixed equipment.</td>
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<td>• Unplanned slowdowns and shutdowns</td>
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<td>• Reactor excursion with emergency depressuring if asset fails that controls reactor temperature (such as hydrogen quench valve)</td>
<td><strong>Earlier Catalyst Replacement</strong></td>
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<tr>
<td>• Increased Maintenance Costs</td>
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<tr>
<td><strong>Safety, Health, &amp; Environment</strong> impacted by:</td>
<td><strong>Increased SH&amp;E Risks</strong></td>
<td>Improve plant and community safety and operate within increasingly stringent environmental regulations with automation solutions that deliver better measurement, control, and diagnostic information.</td>
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<td>• Regulatory agency codes and standards</td>
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<td>• Operator and maintenance training</td>
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<td>• Inconsistent startup and shutdown practices</td>
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<td>• Unreliable emissions monitoring</td>
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Refining Application Solutions Guides are available on the following applications:

- Crude Unit
- Fired Heater
- Hydrocracker
PlantWeb digital plant architecture offers leading edge technology giving you a greater view to your process operations and equipment health. The Hydrocracker unit is the popular choice for a heavy oil conversion unit, upgrading low value oil into cleaner, high value fuel products. Many refineries around the world are adding hydrocrackers to address low and ultra low sulfur diesel requirements while providing some flexibility in product yields between gasoline and diesel.

The key process challenges in a Hydrocracker unit, which can drive down overall refinery performance, are optimizing unit reactor yield (performance), improving overall unit reliability, and increasing energy efficiency, all with safety as a first concern.

Emerson provides best-in-class measurement devices, final control elements, analytical products, safety solutions, asset management, and control systems to address your key operating challenges. The DeltaV™ control system provides regulatory control, APC, and asset management within one platform with a common database, for ease of information distribution, process data correlation, and maintenance. The embedded APC applications, best-in-class regulatory control dynamic performance, seamlessly integrated diagnostics from instrumentation and critical production assets, human centered design of the operator interface, detailed operator training simulators, with a common engineering toolset from basic process control to safety systems, integrated together within PlantWeb, enables you to achieve breakthrough process performance.

Performance

SmartProcess® fractionator optimization applications improve Hydrocracker unit separation 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 and recognized benefits.

Energy Efficiency

Inefficiency in energy management is one of the greatest contributors of high operating costs. 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.
**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, the consequences are serious, and incidents can affect the surrounding community directly.

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.

**Reliability**

Hydrocracker unit reliability is essential to ensure refinery production. 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 also 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.

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**Customer Proven**

“Looking at the results in terms of smooth plant start up and continuous uninterrupted operations, the plant has simply exceeded our expectations. It is operating to our satisfaction and we are happy that we made the right selection of Emerson’s PlantWeb architecture with FOUNDATION Fieldbus technology.”

Zhang HuaPing
Manager, Instrument Team
**Fujian Refining and Petrochemical Company Limited (J.V. between ExxonMobil, Sinopec, Saudi Aramco and Fujian Government)**

“Emerson’s SmartProcess, which includes DeltaV advanced control technology, PredictPro has given us a significant improvement in the Crude Unit operations, both in terms of improved product value and plant operability.”

Gheorghe Oprea
Senior Process Control Engineer
**Rompetrol Refining**
HYDROCRACKER UNIT CHALLENGES

- Poor reactor quench temperature control has higher variability resulting in lower yield and shorter catalyst life, reduced feed rate, and higher probability of a temperature excursion requiring an emergency depressuring.
- Fractionator flooding disrupts operations.
- Variability in heater outlet temperature causes process disturbances in the hydrotreating section of the reactor, resulting in shortened catalyst life due to poisoning.
- Spurious trips caused by malfunctioning instruments and control upsets.
- Fluctuating fuel gas composition causes operational disturbances.
- Environmental impact and energy efficiency depend on good combustion control.
- Operating flexibility to shift between maximizing diesel versus gasoline production is challenging to take advantage of opportunity market demands.
- Measurements are missing that enable the ability to fully optimize the plant.
- 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 Hydrocracker unit that is reliable and energy efficient.

Emerson Process Management has the technology and expertise to make it happen.
From Fishers’ digital drive line, Emersons Field Intelligence provides breakthrough performance in refining through:

- Smart digital control
- Smart machinery health
- Smart safety
- Smart asset optimization
- Smart wireless

**Smart Digital Control**
Fisher® final control elements lead the world in refining, delivering:

- Greatest breadth of supply from basic to engineered products, providing solutions for most refining applications
- Superior control performance providing lower variability in controlling stroke testing
- High reliability in the harshest of process environments such as the hot lines, burner flame instability, and the onset of fractionator flooding
- Industry-leading long term stability, lowering total cost of ownership

**Smart Machine Health**
Rosemount® analytical oxygen, CO/Combustibles analyzers:

- Detect oxygen deficiency in the event of substoichiometric combustion, assisting the operator to recover from unsafe conditions while maintaining safe operations
- Overhead receiver off gas compressor seal or bearing failure help extend this capability to all unit assets.

**Smart Safety**
Theory is a self-diagnostics and actuator uncertainties, simply configuring, retrofit, and long term use - eliminating all potential problems associated with legacy systems.

**Smart Asset Optimization**
DeltaV uses the same database for regulatory and advanced controls, simplifying configuration, setup, and ensuring health of process assets.

**Smart Wireless**
Emerson's Smart Wireless Solutions enable wireless technology to operate close to theoretical limits.

**Field Intelligence**
With the right intelligence, your field assets not only provide more precise and valuable information on the process, but they also self-diagnose their health and reliability. Emerson’s PlantWeb digital Smart Refinery architecture enables you to harness the power of predictive intelligence to operate more efficiently, safely, and effectively.

**Performance**
Smart/controllers/health.tiff

**Reliability**
Smart/controllers/health.tiff

**Theoretical Operating Limit**
Smart/controllers/health.tiff

**Energy Efficiency**
Smart/controllers/health.tiff

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SERVICES & SUPPORT

Emerson’s extensive global experience in petroleum refineries helps clients 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, 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