HONEYWELL UOP SERVICE GUIDE

Imagination, Innovation, and Discovery Inspired by Expertise

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INTRODUCTION

Honeywell UOP understands that running a successful business in modern times requires operating with high efficiency and reliability while being open to innovation and optimization improvements. To support our customer's success in this complex, ever-evolving effort, UOP has a dedicated, highly experienced service organization.

UOP employs over 2,500 engineers and scientists, and UOP expert service engineers have assisted in more than 3,000 process unit start-ups worldwide and support over 4,500 operating units. More specifically, our organization is comprised of Field Operating Services to assist our customers on-site with start-up/shut-down, and turnaround events, Regional Services to support all ongoing operations and introduce new offerings, Performance Managers to focus on profitability improvements, and Technology Services that bring the technical expertise to any situation.

This breadth and depth of knowledge is why UOP is known worldwide as the leader in service.

In addition to our world-class personnel and historically proven offerings, such as inspection and turnaround services (e.g. Elite, Showcase), UOP continues to invest in the development and innovation of new products to ensure we are bringing our customers the highest quality, most value adding support. Our development efforts span a range of offerings from supporting service events, to training services, to staying on the cutting edge of technology with our digital services portfolio.

For example, UOP's newest and most holistic service offering yet is Everystep which provides customizable end-to-end turnaround and lifecycle service support. In our digital space, UOP has a strong commitment to leveraging the latest advancements in AI to both strengthen our current offerings and innovate for the future. Read on to discover all the ways Honeywell UOP Services has distilled insights from over a century of operational best practices, to deliver proactive, ongoing services of the highest quality.

UOP Global Service community is well positioned to support our customers

WHY HONEYWELL

Proven Expertise in Process Technology

In-Depth Process Understanding

Global Support Network

Extensive Track Record

SERVICE CAPABILITY
Learn more about the expert service personnel available to support our customers.

RECURRING SERVICE AGREEMENTS
Most customers operating our process units maintain a fixed entitlement to our services by establishing a recurring service engagement in the form of a customizable service contract or subscription (e.g. Performance+).

START-UP AND RELOAD SERVICES
Leverage the UOP on-site team to support all phases of a project, from unit construction to start-up, through to catalyst loading and operations.

INSPECTION SERVICE OFFERINGS
We use our proprietary inspection methodology and deep process knowledge to help ensure optimum performance and profitable unit operation.

HEALTHCHECK
A customizable offering that through an on-site assessment will identify key areas for improvement. A best-practices review is provided for operation staff to help position your facilities for success in future.

PIC AUDITS
A comprehensive assessment engineered by UOP industry experts to enhance the reliability, performance and longevity of PIC control systems.

ELITE AND SHOWCASE
Full coverage service packages proven to support customers through turnaround processes. Showcase adds the additional benefit of installation service support for a turnkey solution.

EVERYSTEP
End-to-end turnaround and lifecycle service support that aligns people, processes, and assets from early diagnostics through post-turnaround optimization.

TRAINING SERVICES
Comprehensive training offerings that can be in person and/or web based.

PROCESS MONITOR
A foundational digital service that automates the collection and processing of operation data daily and will allow continuous tracking of key performance indicators (KPI).

PROCESS TECHNOLOGY ANALYTICS
A technology-specific feature that utilizes UOP's deep domain knowledge and robust tools to provide greater insight into specific operational capabilities.

EXCEPTION-BASED ALERTS
A continuous data connection through Process Monitor enables UOP to offer Exception Based Alerts (EBA) by UOP specialists. With EBA, UOP regularly assesses and evaluates an expanded set of critical composite operating variables and parameters to detect potential problems early and provide proactive advice to our customers.

BENCHMARKING
Gain valuable insights into unit operations by comparing a unit's key operating parameters with other operators running units under similar conditions.

SERVICE CAPABILITY

The extensive services we offer are made possible by our extensive global service community. Our in-depth knowledge of the hydrocarbon processing industries enable us to understand challenges and provide effective solutions.

Field Operating Services

The Field Operating Services (FOS) group works to maintain close contact between UOP's customers and our staff in the field during the commissioning of new UOP process units. UOP FOS group assists in checkout and commissioning of new UOP process units, catalyst and adsorbent loadings, regenerations, troubleshooting and unit testing.

Our on-site startup team typically consists of a chief process advisor, an instrument advisor and three process advisors. From the final phase of unit construction through catalyst loading and the start of round-the-clock operations, our advisors will assist the customer's personnel with unit operations, conduct plant demonstration tests, and document the unit's initial performance. FOS' regional presence allows the group to respond quickly to customer needs and the needs of UOP's on-site staff. Our FOS team is a global workforce that can be mobilized at short notice and will stay on-site for an extended period to make sure our customers receive full support.

What value does FOS provide?

UOP's FOS Advisors bring in-depth field experience and superb technical knowledge backed by support from UOP's Technical Service Specialists to our customer's field projects to substantially reduce start-up time and turnaround schedules and produce on-spec product as quickly as possible.

Customer Testimonial

As per the project execution plan, we initially anticipated challenges in adhering to the timeline. However, the task has been completed within the scheduled timeframe, thanks to the dedicated efforts of the UOP team. We highly appreciate the efforts put in by the Instrument Advisor and all involved at the site for their support in executing the job successfully and on time.

Regional Services

UOP Service Managers (SM) bring formidable industry experience to customer teams.

Our Regional Services (RS) group has two main functions: to support the delivery, startup and on-going operation of all UOP technology at customer sites; and to identify opportunities for maximizing customer profits through the use of all technology. RS managers are each assigned a group of customer sites and have the responsibility to act as UOP's initial point-of-contact for consultation and troubleshooting, as well as to respond to any technical service needs.

UOP SM are technical generalists who visit a company's facilities on a regular basis to assess the performance of UOP process unit equipment and to address operating issues.

Service Managers enable rapid response to service requests and can facilitate customer access to UOP technical specialists.

What value do Service Managers provide?

Our Services Managers, with their broad knowledge of the industry and UOP technologies serve as reliable, long-term customer partners to help solve technical issues, simple and complex, and identify opportunities for maximizing customer profits through new technologies and capabilities.

Customer Testimonial

UOP's dedication to collaboration not only met project objectives but also continued to enhance partnership between the two parties. We are looking forward to further expanding out cooperation in the future.

Performance Managers

Performance Managers are similar to Service Managers but in addition to their vast industry experience, they also focus on profitability improvements.

UOP's Performance Managers are specifically aligned to the Performance+ Service engagements. They facilitate the collaborative partnership between the customers' technical teams and UOP's experts. The Performance Manager will manage the various entitlements and deliverables of the Performance+ engagement including any digital component.

The Performance Manager conducts a performance review with support from our Technical Specialists. A performance review focuses on unit performance, reliability, and profitability improvements. The performance review will comprise of a unit performance deep dive with discussion on unit constraints and end user operating objectives. The resulting discussion should align benefits and produce a prioritized action plan that sets the baseline to improve unit performance.

Our Performance Managers provide direct and proactive service through the application of our digital solutions. This focus ensures value is created and realized.

Customer Testimonial

You met the challenge. We are generating value together, being proactive and aligning on priority. We make our catalyst and other purchasing decisions with heavy consideration of the service we get from our suppliers.

Technology Services

UOP's Technology Services (TS) group is composed of highly skilled engineers and scientists who are experts in their particular process technology. These technology experts work closely with their counterparts in UOP's research, development, engineering, regional services, and field operating services groups to deliver new technology, and transfer knowledge to our customers.

TS specialists monitor the operation of UOP processes, equipment, catalysts and adsorbents by analyzing plant data. Guidance on operating conditions and strategies is provided to support customers as they optimize their units for safe and profitable operation. Technology Services also provides startup, revamp, and reload support for customer turnaround planning and execution.

When a customer purchases UOP catalysts, adsorbents or equipment, they get more than world-class products. They also get the dedicated attention of a UOP TS specialist.

UOP's TS specialists complete rigorous training that includes assignments in UOP's field operating services, engineering, and development groups. Specialists can draw upon a significant network of R&D, engineering, analytical, and TS resources, as well as specialized tools and operating data from many other UOP units.

At the time of a catalyst or adsorbent purchase, a UOP TS specialist will review the customer's operations, equipment, and procedures to develop the most appropriate and effective startup for the new load. The specialist can also provide advice on loading and startup procedures for use by technical and operations staff.

Once the unit is operational, the UOP TS specialist will work with the customer to review post-startup operations and recommend operating strategies to ensure optimal catalyst performance. This initial review can be supplemented by periodic on-site performance reviews, which enable our specialist to provide ongoing technical support to maximize system performance through the end of the cycle.

What value does the Technology Services group provide?

UOP's TS Specialists draw upon a significant network of UOP research, engineering, and analytical resources, as well as operating data from many other UOP units to provide ongoing technical support to maximize process performance through the end of the cycle.

Honeywell UOP, through its designated laboratories, can also provide laboratory analysis of UOP catalyst samples from operating process units. TS specialists will review and deliver the laboratory analysis in form of a written report.

TS specialists are the trusted advisors for troubleshooting any operating issue and partners with customers to determine the best path forward. TS specialists also conduct data reviews for specific process units by obtaining operating data through the Process Monitor, EBA, laboratory analysis and performance report for the purpose of analyzing the heat and material balance. Other objectives from this analysis will be to maximize existing assets to enhance unit performance (e.g. optimize reactor operations, fractionator operations / evaluation, other constraints in the unit).

Customer Testimonial

It was remarkable how the team managed to overcome unforeseen difficulties during the catalyst change, as well as carry out a sulfidation process in which most of our team members had no experience.

Global Solution Center

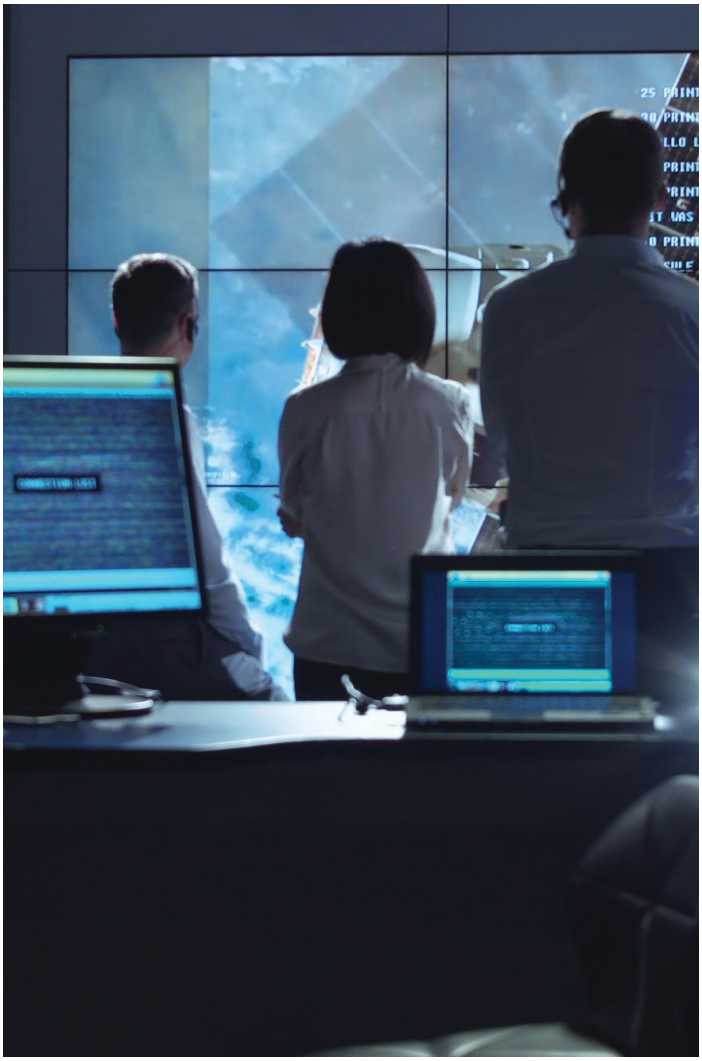
Honeywell UOP's Global Solution Center (GSC) offers 24/7 proactive remote monitoring and technical support for Honeywell's customers in the oil and gas sector worldwide. The center leverages connected solutions and digital tools to service over 200 refinery units for more than 50 customers in all UOP core technologies, with the capacity to add over 1000 units over the next few years.

The Global Solution Center Team

The GSC is comprised of unique service engineers with a variety of process technology knowledge plus expertise in data processing and utilization of different data models, including AI/ML. They use these specialized models and data troubleshooting capabilities to track key performance indicators (KPI) and generate actionable insights for each unit monitored. The GSC partners with the TS Specialist to ensure the application of sound process technology understanding is embedded in all recommendations and insights uncovered.

Maximize Enterprise Performance

The center provides another set of eyes to monitor the performance of all connected process units. The team utilizes best-in-class software applications to analyze sub-optimal conditions, troubleshoot issues, and uncover opportunities to enable end user operations to act quickly and maximize unit performance.



Inspection Services

Maximize process unit reliability, availability and profitability.

Who better to inspect and troubleshoot key process units than the company who designed them?

A robust inspection process is the cornerstone of an effective reliability and maintenance program. Finding potential problems, and correcting them before failures occur can result in significantly reduced downtime and longer equipment life. Organizations that consistently execute quality inspection programs can maximize process unit reliability, availability, and profitability.

Oil refineries and petrochemical plants worldwide have relied on UOP's field Inspection Services for over sixty years. Backed by UOP's engineering and service organizations, we identify potential problems and recommend solutions to avoid failures.

Our People Make the Difference

UOP's highly trained, experienced and certified field inspection engineers form the backbone of our services. Our inspectors receive extensive training in inspection best practices and key refinery technologies. They're backed by the entire UOP technical organization, including world-class metallurgists, corrosion experts, process experts, equipment design specialists and operating technical services.

Why Choose UOP for Quality Field Inspection Services?

- We can help you maximize the life of your UOP process unit
- We bring decades of experience to the field inspection process
- Our inspection engineers have deep expertise and broad exposure to issues our customers face
- The Inspection Services team is backed by UOP's service and engineering organizations
- We offer experienced project management for your turnaround inspection program
- We can train your team in optimal inspection practices and procedures
- We have a long history and commitment to the hydrocarbon processing industries

Customer Testimonial

UOP's team demonstrated a high level of technical proficiency and attention to detail, ensuring all tasks were performed safely, within schedule, and in accordance with the highest industry standards. The services provided by your team, including reactor inspections, supervision of catalyst change-outs, and post-turnaround startup of refinery, were executed flawlessly. UOP's commitment to providing top tier services and expertise has been truly commendable.

RECURRING SERVICE AGREEMENTS

Long history of UOP Service

With over a century of experience in innovation, licensing, and the design of process units across various technologies, Honeywell UOP has a distinguished history of supporting its licensees. We assist our clients not only in the operation and troubleshooting of these units but also in reloads and restarts, as well as process and asset modernization.

Furthermore, Honeywell UOP Services are highly regarded within the industry. Most customers who operate our process units benefit from a fixed entitlement to our services by establishing a recurring service engagement. This typically takes the form of a service contract or a subscription, ensuring they have ongoing access to our support and expertise.

Challenging Times

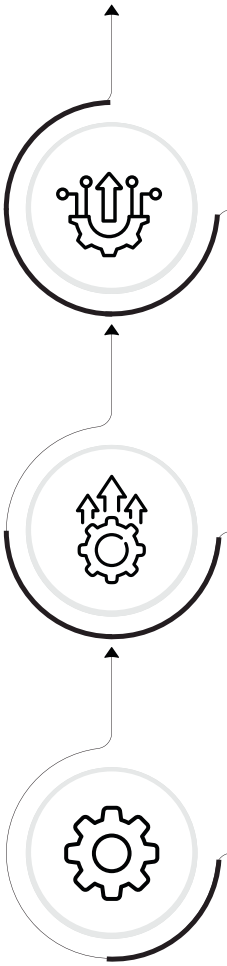
In today's market, operators must maximize profitability with aging assets, changes in workforce while achieving new energy and sustainability goals. Depending on where a facility is within the asset lifecycle, different challenges will drive different operational decisions. UOP Services are both broad and deep to help address the following needs:

- **Process issues and equipment failures lead to unplanned downtime.** Changing feed, catalyst condition, or objectives without adjustments can lead to performance being less than optimal.
- **Operators & process engineers** may not always have the time, tools, experience, and in-house technical support to quickly identify root causes and solve operational challenges or manage changes for optimal performance with reduced risk.
- **Energy & emissions monitoring** is becoming increasingly more important, as new sustainability goals and emission standards are being adopted.

Framework of a Recurring Service Agreement

A recurring service agreement is sold as a service retainer agreement, which acts as a framework for service entitlement provided by Honeywell UOP on an annual basis. The retainer agreement is periodically renewed to ensure that UOP can introduce the latest offerings and ensure the scope of work matches current changes in feeds, unit conditions, and short- and long-term operating targets. Service Agreements also enable customers to engage with Honeywell UOP.

UOP offers three Service Retainer Tiers to deliver optimal customer value: Legacy, Premier and Performance+.



PERFORMANCE+

- proactive
- connected
- value focused and customer service

PREMIER

- reactive
- connected
- on-demand service needs

LEGACY

- reactive
- non-connected
- on-demand service needs

Legacy and Premier Service Agreements

Having a service agreement provides access to Honeywell UOP Services team in time of need for immediate response and support in establishing an action plan. Honeywell UOP maintains relationships with long-time customers through a Legacy Service Agreement. The UOP Service Manager assigned to a specific customer or sites will conduct a minimum number of visits annually, either virtually or in-person to collect process unit status, answer questions, follow up on requests, and update site personnel and management on new and upcoming offerings from UOP. Depending on the scope of work, the agreement also contains yearly site visit(s) from Technology Service specialists and data reviews for specific process units. The service agreement also includes entitlement on consultation hours from Technology Service teams within the contract years, with options to request call-off services at more favorable rates.

In order to improve productivity and responsiveness and being adaptive to the ever-transforming needs of today's markets and operating landscape our technologies reside in, Honeywell UOP offers Premier Service Agreements with all the existing entitlement, plus access to our digital offerings such as Process Monitor and Process Technology Analytics.

Case Study

Power of Connected

The Challenge: An operating Gas Processing facility utilizes a TRAPS Pretreatment and Separex Membrane System to remove contaminants from landfill gas and produces renewable natural gas. The customer has engaged with UOP Premier Service Agreement using Process Monitor to provide guidance on performance optimization, membrane management and quick troubleshooting.

The Results: The Technology Service team consulted with the customer and provided a variety of recommendations that resulted in **$30k/day** of incremental revenue by:

1. Added elements over time to improve hydrocarbon recovery and overall higher capacity

2. Eliminated flaring of excess landfill gas

3. Increased gas production by 40%

PERFORMANCE+ SERVICES

UOP Performance+ Services is a digitally enabled service solution that is designed to improve UOP units' operating efficiency and reliability. This solution combines industry-leading technologies for process licensing, automation, and industrial software under the same umbrella to offer customers value-added, digital solutions. To ensure benefits are achieved and sustained on an ongoing basis, a collaborative UOP Service team, enabled by our digital services, work with our end users to achieve operational excellence. Through greater operational visibility, it allows our customer's operation staff to identify performance gaps and opportunities, all with the assistance of an expert from Honeywell UOP. This proactive service brings deeper insights and real-time recommendations through priority access to UOP technical experts to help you improve unit reliability, production rates, operational efficiency, performance, and overall unit and site profitability.

Performance+ Service is a fully customized service designed to prioritize customer needs, operating objectives and profitability. It combines UOP expertise with an integrated suite of tools enabling monitoring, operating predictions, and optimization to drive more value out of operations.

To learn more on the different digital components see Digital Services section.

How Performance+ Works

The components of Performance+ include a dedicated team of UOP experts, continuous access to operating data, plus the application of advanced digital tools to assist end-users in operational and technical business decisions. This enhanced relationship combined with the digital services will enable the exchange of actional technical recommendations to allow end-user teams to become proactive instead of reactive.

See Figure 1 on the following page to see how data is transformed into insights, converted into knowledge, and finally into actions where value is realized.

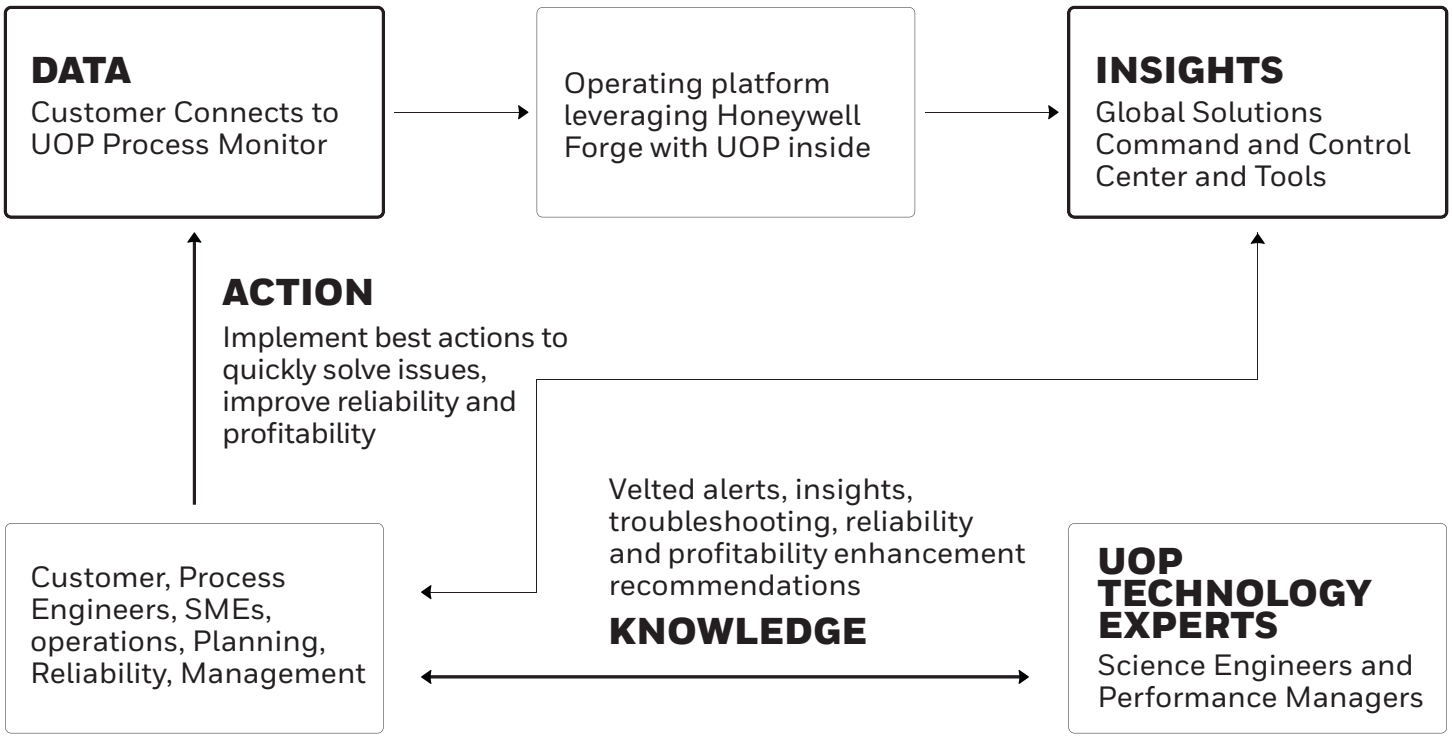


Figure 1

Power of Plus

Leverage UOP Performance+ Services to help solve problems faster and better, identify opportunities for increased profitability via reliability and optimization improvements. Typical refinery benefits range from $1MM to $5MM per year when considering the improvements in production/ yields, reliability, catalyst life, and energy usage.

Case Study

UOP has service engagements with more than 330 customers operating refining, petrochemical, and gas processing plants with most customers opting to renew over the past seven decades. Performance+ service engagements are rapidly growing with over 20 customers signing up in 18 months.

The Challenge: A North American refinery operating a typical fuel based refinery with multiple technology units was looking to improve overall performance without impacting reliability. They also were challenged with access to technology expertise within their own organization.

The Results: Within the first 6 months of the Performance+ engagement, UOP and the customer collaborated on various challenges and opportunities that led to over $4M/yr of achieved value.

SERVICE EVENTS

STARTUP & RELOAD SERVICES

New unit start-ups, revamps and reloads require additional focus from both the operating company and UOP to ensure investment meets performance expectations. From checkout, loading, commissioning, optimization and completing the demonstration test, UOP's on-site service team provide prompt guidance to achieve quality and timely startups.

Our on-site startup team typically consists of a chief process advisor, an instrument advisor and three process advisors. From the final phase of unit construction through catalyst loading and the start of round-the-clock operations, our advisors will assist the customer's personnel with unit operations, conduct plant demonstration tests, and document the unit's initial performance. FOS' regional presence allows the group to respond quickly to customer needs and the needs of UOP's on-site staff.

Customer Testimonial

I would like to extend my sincere gratitude and appreciation of your outstanding support and professionalism in facilitating the safe startup of the PSA unit. Despite various challenges we faced, your dedication to working for extended hours and your close collaboration with our team were the key success to achieve the safe startup. Thank you and I look forward to collaborating with you on more projects in the near future. - a Middle East Refiner, PSA Startup

INSPECTION SERVICE OFFERINGS

We use our proprietary inspection methodology and deep process knowledge to help ensure optimum performance and profitable unit operation.

Fabrication Shop Inspection – To help ensure equipment and plant construction quality, UOP supplies global shop inspection coverage to maximize long-term performance.

Turnaround Inspections – Our inspection engineers can provide mechanical consultation for conformance to industry codes and UOP's specifications, with unmatched expertise in UOP Platforming™, UOP Unicracking™, UOP HF Alkylation, and UOP Fluid Catalytic Cracking (FCC) Process units.

Inspection Planning – We work closely with our customers to establish the inspection requirements and plan based on UOP's methodology and experience, and the codes and specifications in force. We can also lead inspection planning workshops for your team.

Inspection Training – UOP can train your team in optimal inspection practices and procedures so that you can implement and sustain a world-class inspection program.

Inspection and Technology Service Workshops – Our team of inspectors and TS specialists can partner with the site operational team to employ Enhance turnaround planning for maintenance and inspection activities, achieve a balance of efficiency and safety and understand the key areas for process and reliability improvement. The workshops can help shorten turnaround schedules, lower costs, and reduce potential health, safety, and environmental (HS&E) incidents. They foster a collaborative approach that ensures buy-in from both leadership and the technical teams at the site.

HEALTHCHECK

Overview

The Honeywell UOP Healthcheck is a customizable solution that leverages a proven process. Over the past decade, this solution has delivered impressive results, benefiting from the extensive expertise of UOP Technology Specialists.

An onsite assessment will identify key areas of improvement and an operational best practice review with your operations staff will position your facilities for success. Further collaboration to understand your short- and long-term processing objectives, product specification requirements, and sustainability goals produce revamp solutions aligned with your vision. The output of Healthcheck is a customized roadmap of recommendations and actions to address your short- and long-term operating goals.

Benefits

By addressing the above challenges with a Healthcheck roadmap, you can identify and take action to:

- **Optimize unit operation**
- **Establish a baseline for Key Performance Indicators compared to industry standards**
- **Maximize critical asset utilization**
- **Identify potential unit updates for improved operability and reliability**
- **Training for operators and engineers**

Needs

In the current challenging economic times, end users need to maximize the economic benefit for every barrel of feed processed. However, this is achieved only when the unit operation is optimized and pushed for maximum throughput possible.

Consider:

- Are you bottlenecked and looking to push throughput?
- Does your feedstock, unit severity or contamination levels change and are you able to adjust operations to meet these changes?
- Is your unit designed to accommodate new operating objectives including sustainability challenges?
- Have you lost experience due to recent retirements or other changes in the workforce?
- How do you balance and prioritize unit reliability vs profitability?

Case Studies

Fixing a Leak

The Challenge: An Asia-based customer is operating a UOP designed CCR Platforming unit and was facing challenges to meet aromatic yield.

The Results: UOP's Tech Service expert performed the onsite Healthcheck, identified that there are high levels of unconverted methyl cyclohexane and cyclohexane in the reformate. It suggested that there was a leak in the Packinox combined feed exchanger. By completing the Healthcheck, the size of the leak was quantified and economic impact determined at $5 mm/year. **This gave the customer economic justification to repair the Packinox and to implement Low-Flow, Low-Firing to mitigate future leaks.**

Reduced HF Acid Consumption

The Challenge: A North American customer operating a UOP-designed C4 Merox unit was facing instability with product sulfur which led to high HF acid consumption in the Alkylation unit.

The Results: Operational improvements recommended in the Merox Healthcheck led to a reduction in product total sulfur of up to 15 wppm. **This directly led to a 40% reduction in HF acid consumption, with annual savings of over $200K.**

Key Equipment/Heater Healthcheck

A Honeywell UOP Process Specialist can carry out a high-level assessment of your existing equipment to help identify gaps in operability and sustainability. The mechanical review will analyze the key equipment performance and equipment evaluation for turnaround work.

With our process expertise, the Heater Healthcheck is expected to deliver a series of recommendations which could unlock potential incremental gross margin over the current operation. In addition to improving the margins, the Healthcheck also delivers additional benefits in reliability, transfer of knowledge and unit performance.

As a result of this Healthcheck, our team can identify better bottom-line results and identify a pathway for future improvement. The benefits delivered are expected to include:

- Optimized heater performance and minimizing operating expenses and maximizing unit reliability.
- Direct interaction with an expert from UOP Heater Specialist to interact with your operations, technology, laboratory and maintenance teams for a deeper dive into issues that are not possible with remote interaction and discuss best practices.
- A benchmark on current operation, with sufficient resolution to allow engineering design improvements or for an engineering study.
- Identification of improvements made while at site, including financial impact.
- A follow-up report highlighting potential short- and long-term investment options, with corresponding benefits to allow future decision making.

Case studies have shown values derived from Heater Healthchecks have ranged from hundreds of thousands of dollars to multi-million dollars per year, providing quick payback on this investment for your facilities.

PIC AUDITS

Enhance the reliability, performance and longevity of your process information and controls (PIC) system with a comprehensive assessment.

Tech Evolution and Obsolence

Advancements in technology are always ongoing. While control systems are built to meet the physical requirements for today, evolution in technology continually leads to upgrades in system functionality and performance.

If monitored properly, timely updates can be utilized to provide scalable and flexible solutions to adapt future modifications of your current installation. Left unchecked over time, a control system runs the risk of component obsolescence or even system failure.

UOP is committed to providing solutions that allow you to benefit from the latest technology available to match your current equipment configuration.

Why do a PIC Control System Audit?

- **EXTEND SYSTEM LONGEVITY** Ensure continued reliability of control systems through proactive Healthchecks and lifecycle assessments.
- **BRIDGE THE KNOWLEDGE GAP** Address training needs for refinery personnel, especially in high- turnover environments, by reinforcing PIC system understanding and best practices
- **PLAN AHEAD FOR TURNAROUNDS** Strategically prepare for software and hardware upgrades aligned with upcoming turnarounds to avoid last-minute surprises.
- **IDENTIFY OBSOLESCENCE RISKS** Evaluate current system status and recommend timely interventions to mitigate risks due to outdated components or unsupported versions.
- **BOOST OPERATIONAL CONFIDENCE** Empower refinery teams with system insights, enhancing troubleshooting capability and reducing dependency during critical operations.

Enhance Realiability and Performance

The PIC Control System Audit is a comprehensive assessment engineered by UOP industry experts to enhance the reliability, performance and longevity of PIC control systems.

By proactively identifying and addressing key challenges associated with obsolescence risks, optimizing system architecture and improving troubleshooting capabilities, this audit can help you:

- **Plan future upgrades**
- **Ensure seamless and reliable operations**
- **Maximize asset life**

ACCS
Adsorbent Chamber Control System

CRCS
Catalyst Regeneration Control System

DRCS
Drier Regenerator Control System

LHCS
Lock Hopper Control System

PSA
Pressure Swing Adsorption Control System

ELITE

Overview

Honeywell UOP's Elite Turnaround Services offering is grounded in a well-established combination of processes, tools, and systems specifically designed to tackle today's challenges. This approach has consistently demonstrated excellent results for nearly a decade, driven by the extensive expertise of UOP specialists and experts.

They focus on developing the skills and behaviors necessary for achieving improved outcomes. The path to a more successful turnaround begins with the Elite kickoff meeting far in advance of the event with delivery of key framework materials for scheduling and executing the plan, either before or after contractor selection. Throughout the Elite process, UOP essentially becomes a part of your Turnaround.

The planning team is focused on elevating their preparation and planning to best-in-class levels. Key factors that enable safer, more effective, and faster turnarounds include contingency planning, procedure development and review, as well as targeted workshops that engage your chosen contractor. This collaboration ensures that the scope is aligned among all parties and incorporates essential checklists, along with many other components.

Enhanced field support ensures that right and fast decisions are made, not only for the tasks at hand, but to also address the myriad of unknown challenges that are inevitably part of every turnaround. In the end, your turnaround can be done faster, safer and result in highest reliability after restart with Honeywell UOP's Elite turnaround Services.

Benefits

By addressing the above challenges with UOP Elite expertise and your turnaround planning and execution teams, you can achieve:

Faster completion with fewer product-out to product-in days, allowing more production.

Safer operations with more complete pre-planning and better preparedness

Improved effectiveness for maximum reliability after restart

Faster optimization post-turnaround to leverage the most from the refurbished unit

Direct access to Technical Services.

Needs

In today's environment, it is difficult to find and maintain staff with expertise in major mechanical works, especially for technologies that operate for many years before such maintenance is required. When a process unit or complex requires a maintenance event, the assets are not producing and every day lost is a day of negative margin for your business.

Consider:

- How long has it been since your unit has been turned around? Or is it perhaps the first time the unit will have such a significant mechanical event?
- How many of your staff were in the same key positions for this last turnaround? How many were present and participated in the last full turnaround of similar scope?
- Have your past turnarounds run overschedule or overbudget?

Case Studies

Reduced Turnaround Time

The Challenge: North American Refinery with 2 Parex units had much longer than planned chamber to chamber time in last Parex reload, executed 11 years earlier, and wanted to ensure that this Parex reload was executed on-time and on-budget, without sacrificing safety or quality.

The Solution: UOP's Parex Elite Turnaround Package

The Results:

- Saved over 27 calendar days as compared to prior train reload, 14 compared to original expected schedule without Elite.
- 14 days of savings valued at over $1.7M in opportunity production and over $1M in additional savings with reduced turnaround time.
- Trouble free restart, quickly attaining excellent performance and high operational reliability after restart.

Quick and Accurate

The Challenge: An Asian operator with a 23KBPD CCR Platforming Unit wanted to replace catalyst and reactor internals with minimum production impact due to high gasoline demand.

The Solution: UOP' CCR Elite Turnaround Package

The Results: Fast and Right Execution

- Finished turnaround 6 days early, oil-out to oil-in.
- Savings of 6 days valued at $1.6M in production value
- Quality reactor internals replacement and catalyst changeout performed with a quick return to optimized production

ELITE SHOWCASE

Upgrade

Elite Showcase Turnaround Services are an extension of the Elite Turnaround Services when a turnkey solution is preferred.

Benefits

By upgrading UOP Elite Turnaround Services to a UOP Elite Showcase solution, you can achieve all of the benefits of Elite plus:

- **Single point accountability for execution.**
- **Even faster execution with the subcontractor reporting directly to UOP.**
- **High quality implementation with experienced oversight by technology experts.**
- **Adjustable scope to manage other maintenance tasks.**

Case Study

Ahead of Schedule

The Challenge: An Asian aromatics complex with two Parex Trains had a turnaround window that was weeks less than was expected to be accomplished, which required a reload of four adsorbent chambers with their contractor who lacked Parex experience.

The Solution: UOP's Parex Elite Showcase Turnaround Services

The Results:

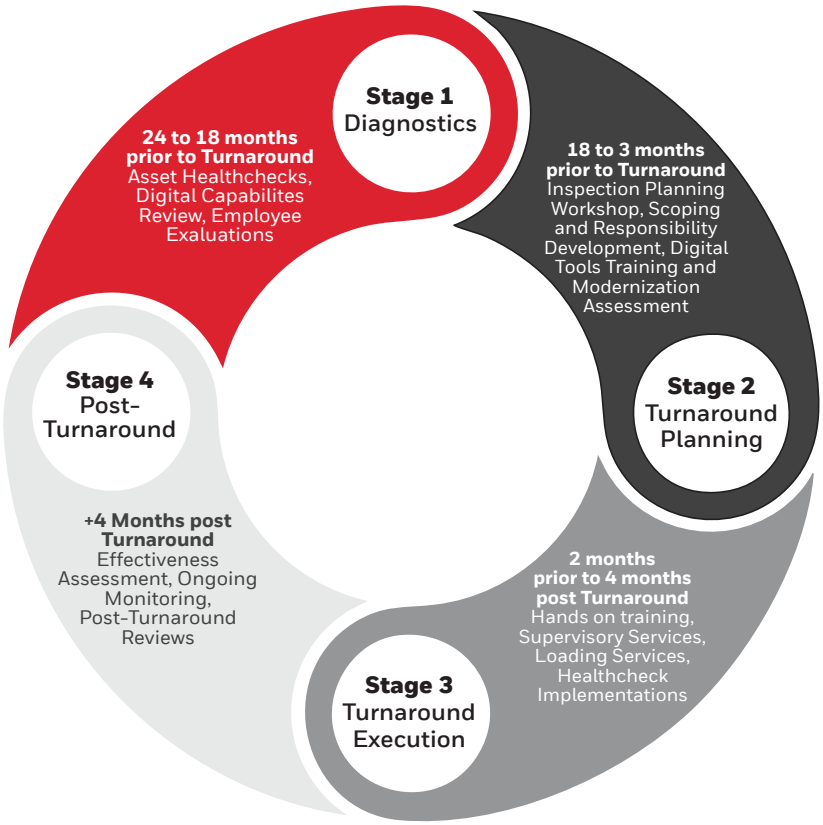
- Saved more than two weeks versus the original expected schedule and finishing mechanical work 7% faster than represented.
- Overall project completed ahead of schedule and able to restart over two weeks early, valued at over $10M in opportunity production.
- Zero injuries and smooth restart of complex.

EVERYSTEP SERVICES

Overview

During a plant shutdown or turnaround, time saved is money earned for you. Choosing the right partner to help you through this process is important. While partners promise to be your single source of turnaround expertise, there is only one organization that fundamentally understands the technology, the equipment, and the true challenges you face. Honeywell UOP brings a century of technology innovation experience to bear to help you with every phase of your turnaround.

Honeywell UOP's Everystep Services align people, processes and assets from early diagnostics through post-turnaround optimization. By combining field-proven services with digital tools, we help refineries and petrochemical plants maximize reliability, extend asset life, and enhance profitability.



Your Turnaround Is Our Priority

With over a century of experience, the most important aspect of our Everystep Services is our customer-focused approach. Our team can provide complete, around-the-clock support for your planned or emergency turnarounds. We offer end-to-end solutions, from concept to operation, and we are available 24 hours a day, 7 days a week to help you maximize your operations.

Stage 1: Diagnostics

Our experienced Honeywell UOP inspectors and engineers utilize over 60 years of expertise, backed by a global team of specialists, to provide inspection services that enhance your operational efficiency. Through our proprietary Healthcheck methodology, we collaborate with your teams to identify gaps and optimize performance.

Focusing on critical equipment, our diagnostics empower you to make informed decisions, extend asset life, and improve safety while reducing downtime and maintenance costs. This proactive approach ensures you achieve operational excellence and maximize your investment.

Additionally, we review catalyst and adsorbent selections and assess the customer's analytical capabilities, including laboratory methods and schedules. This comprehensive evaluation ensures that our clients have the best strategies in place for maintaining their operations.

PEOPLE

Honeywell UOP field personnel bring extensive multidisciplinary experience performing inspections and other on-site services on Honeywell UOP licensed units. Our certified professionals are backed by global technical organizations of metallurgists, corrosion specialists and process experts. Our industry-recognized subject matter experts are trained in best practices and technologies across all Honeywell UOP licensed units, non-licensed processes and supporting systems.

PROCESS

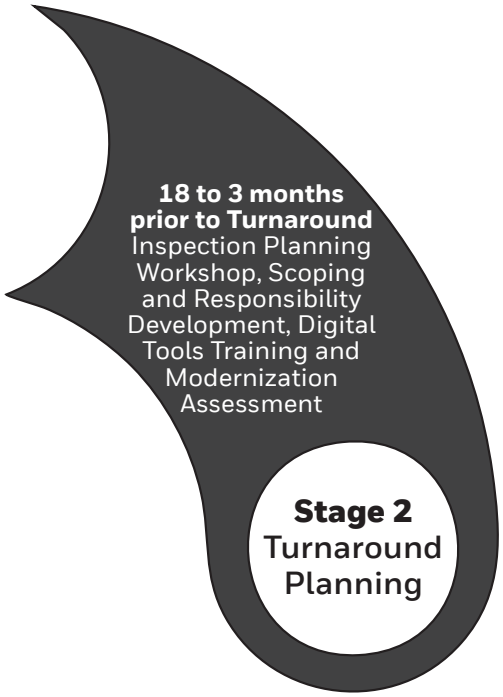
The diagnostics phase begins with Technical Services and Inspectors leveraging our proprietary and proven Healthcheck methodology. We collaborate with your teams to assess current operations, identify gaps to your future planned state, evaluate the reliability of key process units and provide recommendations for improving your bottom line. Comprehensive Healthchecks provide operational reviews, process data analysis, and benchmarking against best-in-class Honeywell UOP digital tools to detect early signs of degradation and uncover process optimization opportunities.

ASSETS

Diagnostics concentrate on essential mechanical systems and process-critical equipment, including reactors, rotating equipment, heat exchangers, and other unit-specific components. The insights gained during this assessment help Honeywell UOP evaluate current equipment health and identify at-risk assets that may need closer scrutiny during turnaround planning.

Stage 2: Turnaround Planning

Honeywell UOP Services offers expert consulting, advanced analytics, and tailored training to help you optimize operations and boost financial performance. We empower refiners and petrochemical producers to navigate complex transitions while achieving sustainable, high-performing operations with Honeywell's global expertise.



PEOPLE

Turnaround planning workshops are facilitated by experienced technical experts, project managers, and engineers who have in-depth knowledge of Honeywell UOP process technology and equipment requirements. By collaborating with your planning team, our experts help define clear scopes and timelines for inspections, equipment reloading, and capital modifications. This focused support ensures that your turnaround processes are efficient, minimizing downtime and maximizing operational readiness.

PROCESS

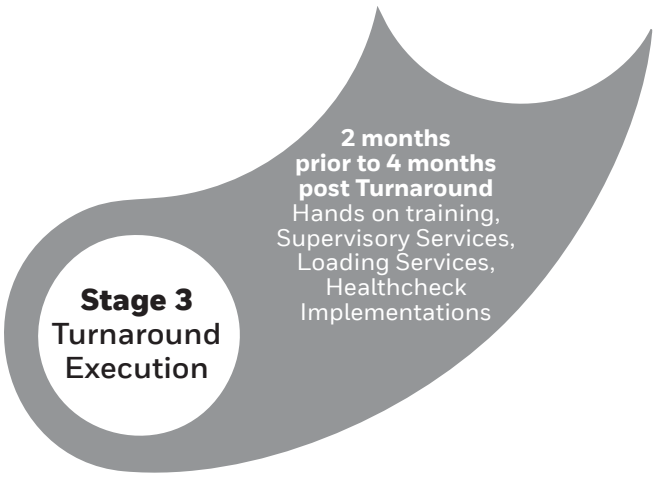
Honeywell UOP leads inspection planning sessions that allow you to co-develop work scopes and clarify roles in alignment with your turnaround timelines. These collaborative workshops utilize past failure data, future operating conditions, and best practices to create a comprehensive execution plan tailored to your needs. Additionally, we assist by screening contractors and providing essential logistics and administrative support, ensuring a seamless and efficient turnaround process.

ASSETS

We collaborate closely with your team to define the turnaround scope for new and existing assets, as well as capital equipment upgrades. Tailored inspection protocols are aligned with your asset conditions, operational needs, and process goals. Additionally, we recommend digital tools identified during Stage 1 and provide the necessary training, ensuring your personnel are equipped to enhance efficiency and drive successful outcomes.

Stage 3: Execution of Turnaround & Product Reloads

Honeywell UOP is dedicated to facilitating effective turnaround operations through our expert teams of field engineers, who are onsite to ensure safe and efficient execution. We provide specialized training for site personnel and contractors on proper catalyst and adsorbent handling, as well as unit restart protocols. Our engineers follow unit-specific guidelines to ensure all reload and start-up procedures are meticulously implemented, reducing risk and enhancing operational reliability.



PEOPLE

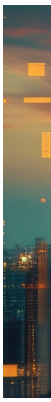
Our teams of field engineers are onsite to support safe and efficient turnaround execution. We also provide training to site personnel and contractors for proper catalyst and adsorbent handling, and unit restart. Honeywell UOP engineers ensure proper reload and start-up procedures are followed according to unit-specific guidelines.

PROCESS

The Turnaround Execution phase involves support for catalyst unloading and loading, conducting inspection follow-ups, offering mechanical consultation, and ensuring alignment with UOP specifications. We leverage our services, which integrate industry-leading process technologies and digitally enabled tools, backed by a century of expertise, to help customers achieve maximum value while minimizing operational risks. Additionally, we implement Healthcheck optimizations and study findings to enhance efficiency and reliability during turnaround projects.

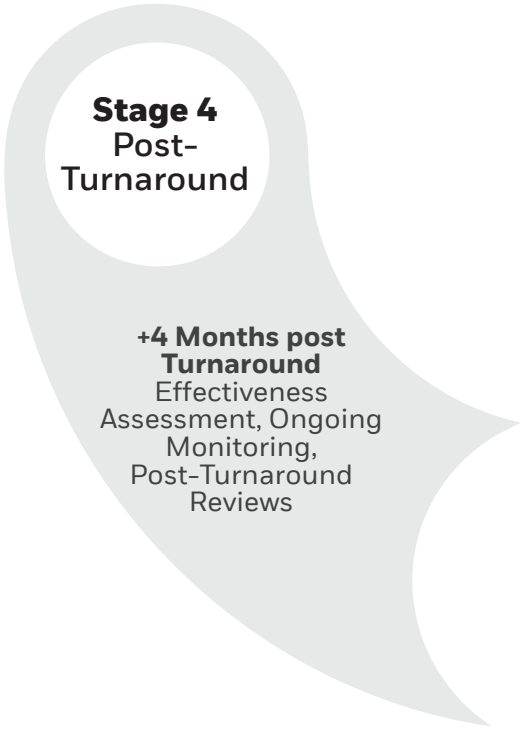
ASSETS

We manage the reloading process and ensure the mechanical readiness of process units, installing and commissioning catalyst beds, internals, and equipment according to Honeywell UOP standards. This careful oversight helps ensure a reliable startup and optimization of initial performance, providing you with both onsite and remote assistance. By following stringent protocols, we minimize risks and downtime, ultimately enhancing the overall efficiency and productivity of your operations.



Stage 4: Post-Turnaround

Honeywell UOP offers comprehensive post-turnaround support, collaborating with your operations, reliability, and maintenance teams to assess turnaround effectiveness and identify continuous improvement opportunities. Our service capabilities facilitate ongoing monitoring and benchmarking of unit performance, employing post-mortem reviews, and voice of the customer assessments to drive outcome-based performance enhancements and inform future planning.



PEOPLE

Post-turnaround support includes collaboration with your operations, reliability, and maintenance teams. UOP experts help assess the effectiveness of the turnaround and identify opportunities for continuous improvement.

PROCESS

Using Honeywell UOP service capabilities for ongoing monitoring and benchmarking of unit performance. Post-Turnaround reviews and VOC assessments help drive outcome-based performance enhancements and inform planning for the next cycle.

ASSETS

We evaluate equipment performance against expected outcomes by monitoring catalyst behavior, emissions, throughput, and reliability metrics. These insights inform digital models to extend asset life and reduce unplanned downtime.

Post-Turnaround reviews are performed to troubleshoot operations, focusing on spent catalysts and metallurgical analysis, while capturing lessons learned for continuous improvement.

TRAINING SERVICES

HONEYWELL UOP ACADEMY

Overview

Prepare your team to perform their jobs accurately and safely with flexible competency solutions from an industry leader in refining, petrochemical and gas processing technologies. UOP offers both in-person and on-demand training and tools you need to address the growing skills gap while helping to increase productivity and reduce the risk of human performance issues at your plant.

- Our courses include classroom lectures, case studies, and problem solving exercises. We incorporate the latest technology advances and industry know-how into our programs.
- Our instructors are leading experts in refining, petrochemical and gas processing.

Benefits

Equip your personnel with knowledge that contributes to your bottom line.

Improve your corporate succession planning.

Train your personnel to identify, prevent and respond to potential hazards.

Enable your personnel to achieve their highest levels of performance.

ENGINEERING DESIGN SEMINAR

This intensive 39-day program gives participants the opportunity to learn the fundamentals of refining process design. Each topic is presented in the context of the design of a refinery process unit or the selection of a specific type of refinery equipment. Seminar sessions are led by UOP process design and equipment design specialists who demonstrate how to apply engineering principles to solve design problems.

Course Benefits

Course participants will be able to:

- **Understand the practical applications of basic design engineering principles**
- **Develop steady-state simulations of process flowsheets, including design guidelines, generation of heat/mass balances, and process optimization**
- **Systematically assess hydraulic circuits**
- **Understand key criteria for designing vessels, heat exchangers, rotating equipment, piping, relief valves, fractionating columns, and fired heaters**
- **Explain how to process stream properties affect process equipment metallurgy**
- **Understand the content and applications of process flow diagrams (PFDs) and piping and instrument diagrams (P&IDs)**

Topics

- Compressors
- Carbon capture
- Energy systems
- Environmental issues
- Fired heaters
- Fractionation
- Gravity separation
- Heat exchangers
- Instrumentation
- Line sizing and hydraulics
- Metallurgy, corrosion and fouling
- Operational safety
- Pinch technology
- Process unit design
- Pressure vessel and flange ratings
- Process and project engineering
- Process fluid properties
- Pumps
- Refinery business economics
- Relief valves
- Simulation tools for process design
- Steam turbines
- Tray sizing
- Vacuum unit
- Utilities and offsites

PROCESS TECHNOLOGY WORKSHOP

The workshop enables your team to monitor and optimize unit operations, ensure safe and reliable operations, and also have the knowledge and skills to respond to both normal and abnormal events. Participants gain knowledge in process flow, equipment, troubleshooting, startup, shutdown, maintenance procedures, metallurgy and corrosion protection.

Course Benefits

Course participants will be able to:

- **Describe and understand the function of the unit**
- **Describe and understand the main process flow**
- **Understand key process indicators**
- **Understand the impact of contaminants**
- **Learn troubleshooting skills**
- **Understand the best practices for startup, normal operations and shutdown**

Topics

- Introduction, theory, chemistry
- Process variables
- Process flow
- Process contaminants
- Process equipment
- Process control
- Normal operations
- Startup, shutdown
- Unit optimization
- Troubleshooting
- Case studies

FIRED HEATER WORKSHOP

The workshop enables your team to monitor and optimize unit operations, ensure safe and reliable operations, and also have the knowledge and skills to respond to both normal and abnormal events. Participants gain knowledge in furnace design, burner operations and maintenance practices.

Course Benefits

Course participants will be able to:

- **Gain knowledge in applicable codes and standards**
- **Explain key operating parameters**
- **Recognize typical problems and identify possible causes**
- **Discuss inspection and turnaround items**

Topics

- Heater basics
- Radiant and convection section
- Flame temperature
- Heater efficiency
- Pilots and burners
- Field evaluation
- Troubleshooting
- Design and safety features
- Inspection and turnaround practices
- Reliability
- Instrumentation

CORROSION AND FOULING WORKSHOP

The workshop enables your team to monitor and optimize unit operations, ensure safe and reliable operations, and also have the knowledge and skills to respond to both normal and abnormal events. Participants gain knowledge in the science of corrosion, causes and prevention techniques associated with corrosion and fouling.

Course Benefits

Course participants will be able to:

Identify common causes of refinery corrosion and fouling

Describe types of corrosion and fouling based on location, process conditions, and symptoms

Identify control strategies, associated benefits and possible risks

Apply knowledge to troubleshoot operations, and solve less common corrosion and fouling issues

Topics

- Introduction to corrosion and fouling
- Low/high temperature corrosion mechanisms
- Unit specific corrosion information
- Corrosion from chemicals and inhibitors
- Corrosion testing, monitoring and prevention

TRAIN YOUR REFINERY INSPECTOR WORKSHOP

The workshop helps prepare your inspectors for in-service inspection of existing assets. The course also covers routine repairs to restore equipment for continued service. The course can also be used to train visual examiners to apply the API-510 Pressure Vessel and API-570 Piping Inspection Codes.

Course Benefits

Course participants will be able to:

Discuss construction, in-service inspection, examination, and routine repair of pressure vessels, heat exchangers, fired heaters and process piping including valves and instrumentation

Recognize when repair or fitness for service assessments are required

Topics

- Inspection overview
- Pressure vessels, heat exchangers
- Fired heaters
- Gunned refractory linings
- Process piping, valves, Instrumentation
- Equipment corrosion

ENGINEER DEVELOPMENT PROGRAM

Prepare leaders to step quickly into highly responsible roles with little or no drop-off during workforce transition.

Scope

This intensive 12-month program is designed to cultivate well-rounded engineering professionals through structured rotations across key departments within UOP. This comprehensive program combines fundamental design knowledge with hands-on application and equips participants with technical expertise and practical skills necessary for future roles within your organization.

Benefits

- **Accelerated professional development through the different rotations and mentorship from experienced technical specialists**
- **Develop critical thinking and problem-solving skills**
- **Develop steady-state simulations of process flowsheets, including design guidelines, generation of heat/mass balances, and process optimization**
- **Understand key criteria for designing vessels, heat exchangers, rotating equipment, piping, relief valves, fractionating columns, and fired heaters**
- **Optimize and troubleshoot processes by evaluating key data trends**
- **Understand commercial applications of core technologies and its impact on refinery economics**

Process Design

Participants will focus on design principles like gravity separation, fluid properties, equipment design guidelines that enable safe and reliable operations. Participants will apply fundamentals to real world projects. The training program spans a duration of 2 to 3 months and is focused on applying process design fundamentals to create comprehensive project specifications. Participants will learn to select appropriate metallurgy to ensure safe and reliable operations.

- Core design principles like fluid properties, gravity separation
- Equipment sizing and selection
- Process control fundamentals
- Safety and environmental considerations in design

Rotation 1
ENGINEERING DEPARTMENT

Participants will apply fundamentals to real world projects. The training program spans a duration of 2 to 3 months and is focused on applying process design fundamentals to create comprehensive project specifications. Participants will learn to select appropriate metallurgy by assessing contaminants and operating conditions while adhering to NACE guidelines for corrosion control.

The curriculum will also cover the generation of specifications for essential equipment such as pumps, trays, and vessels, ensuring that all aspects of the design and material selection process for optimal operations.

- Develop heat and weight balance
- Develop process flow and instrument diagrams - PFD, P&ID, MSD
- Generate project specifications for trays, vessels, pumps, relief valves

Rotation 2
TECHNICAL SERVICES DEPARTMENT

Participants will focus on operational excellence and technology optimization. The training program spans a duration of 4 to 6 months, designed to equip participants with essential knowledge in process technology operations. Throughout this period, trainees will receive mentoring from UOP experts, ensuring personalized guidance and support. The focus will be on technology training that aids in assessing performance, enabling participants to analyze data effectively, optimize processes, and troubleshoot issues as they arise.

Additionally, trainees will have the opportunity to engage in P&ID reviews, which will enhance their understanding of process design and safety.

Participation in multi-licensee courses will further enrich their learning experience, fostering collaboration and knowledge exchange with peers from various backgrounds and sectors.

This comprehensive approach will prepare personnel to contribute significantly to operational excellence.

- Process flow
- Effects of the process variables and the impact on performance and catalyst deactivation
- Catalyst chemistry and the impact on performance, identify catalyst poisons
- Normal Procedures
- Emergency Procedures
- Monitor the process operations, troubleshoot typical operating problems.

Rotation 3a
ON SITE FIELD SERVICES (* BASED ON SITE/ CUSTOMER POLICIES)

Participants will participate in startup activities like equipment checkout, pre-commissioning activities and verify that a unit is ready for startup. This rotation typically lasts between 4 to 6 months. Participants will learn to bridge the gap between design and operations, understand the different pre-commissioning activities required to ensure that a unit meets the performance guarantees.

Participants will establish the parameters for safe operations and will develop critical skills needed during the startup phase.

Learning to coordinate between contractors, vendors, and operations personnel is a key learning in this rotation.

- Verify unit readiness for startup
- Equipment Inspection and testing protocols
- Establish safe operating procedures
- Initial performance testing and optimization
- Troubleshooting during critical commissioning phase
- Coordinate with contractors, vendors, owners' operations personnel
- Establish normal operations and initiate test run for unit acceptance

Rotation 3b
GLOBAL SOLUTIONS COMMAND CENTER

Participants will analyze and evaluate plant data using UOP's digital solutions. Data analysis includes flow, temperature, pressure drop deviations that impacts unit economics and operating stability. Analysis will also include benchmarking against similar units and can be used to improve or optimize unit operations. Insights from the data can also be used to drive catalyst changeout to meet market conditions.

- Monitor unit performance
- Evaluate and discuss trends with peers
- Provide insight using trends for improving performance of assets and people

UOP FOUNDATIONS E-LEARNING PROGRAM

UOP e-Learning courses and modules are designed to teach operators and engineers the basic concepts of UOP process technology in a flexible environment that will meet the scheduling needs of any student. Web-based training will enhance the knowledge level and skills of your employees to improve your operations.

Cost Saving
Save costs on training large groups of employees (versus in-person, onsite training)

Enhance onboarding
Fast-track competency of early career employees with a wide portfolio of courses

Refresh & Retain
Refresher training on UOP-specific technologies for experienced employees

Details

- Unlimited access to the UOP e-Learning Library
- Preferred pricing for multiyear commitment
- Quarterly student progress reports

Benefits

- **Unlimited, 24/7 access to 1400+ hours of self-paced and engaging e-learning courses**
- **Courses range from general engineering to UOP engineering and technologies**
- **Dedicated tracks available based on specialty: EH&S, Engineering, Operator, Maintenance**
- **Save costs with the flexibility of on-demand learning**
- **Complimentary access to updated content or new courses released during active subscription**

Topics

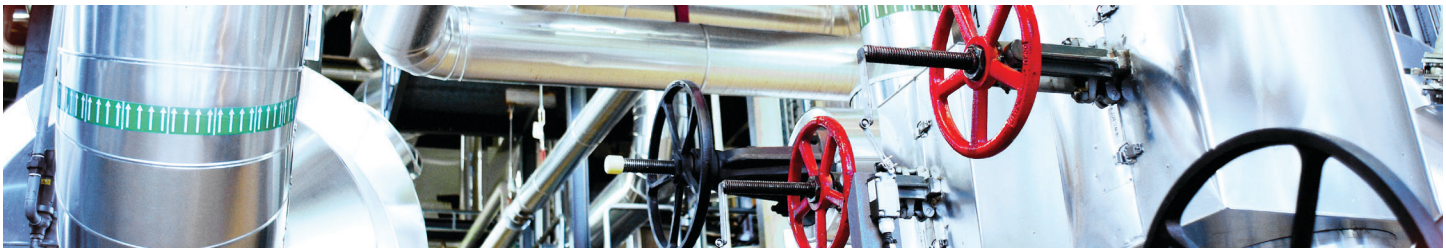
Multiple courses are available within each e-learning category offered. The UOP Foundations e-Learning subscription program offers access to over 550+ courses with more than 1400 hours worth of content.

UOP E-LEARNING

- Amine GuardTM FS Process
- Atmospheric CCR PlatformingTM Process
- CycleMax I CCR PlatformingTM Process
- CycleMax II/III CCR PlatformingTM Process
- Fired Heaters
- Fixed Bed PlatformingTM Process
- Fluid Catalytic Cracking (FCC) Process
- MeroxTM Extraction Process
- Oleflex Process Technology
- Parex Process
- PenexTM Process
- Refining Process Fundamentals
- Polybed Pressure Swing Adsorption (PSA)
- SeparexTM Membrane System
- UnicrackingTM Process
- Refining Process Fundamentals

NON-UOP E-LEARNING

- EH&S
- General Maintenance Skills and Knowledge
- Instrumentation and Control
- Math and Science Fundamentals
- Process Operations
- Refinery Operations
- Rotating and Reciprocating Equipment
- Stationary Equipment
- Utility, Safety and Facility Systems
- Electricity and Electrical Equipment
- Gas Processing Operations
- Hydrocarbon Storage and Loading
- Petrochemical Process Equipment
- Pipeline Operations
- Process Safety
- Production Operations
- Petroleum Industry Overview



PROCESS TRAINING SAFETY

Process safety training is vital for refineries and petrochemical plants due to the hazardous materials and high-pressure systems they handle.

Key components include:

HAZOP
Identifies hazards and operational issues.

LOPA
Analyzes protective layers to mitigate risks.

SIL ASSESSMENTS
Evaluates safety system reliability.

Reviewing past incidents helps prevent future accidents. This training promotes safety, enhances emergency response, and ensures regulatory compliance.

Course Benefits

Process safety training is crucial for refineries and petrochemical plants due to the inherently hazardous nature of their operations. These facilities manage flammable materials, toxic chemicals, and high-pressure systems, which pose substantial risks to personnel and the environment. Effective training encompasses methodologies such as Hazard and Operability Study (HAZOP), Layer of Protection Analysis (LOPA), and Safety Integrity Level (SIL) assessments, which help employees identify, analyze, and mitigate potential hazards. Additionally, reviewing past incidents is a vital component of this training, ensuring that lessons learned are integrated into current practices to prevent recurrence.

This comprehensive approach not only promotes a culture of safety and enhances emergency response capabilities but also ensures compliance with regulatory requirements. Investing in process safety education ultimately protects lives and contributes to the overall efficiency and reliability of refinery and petrochemical operations.

Topics

- Hazard identification and protocols
- HAZOP principles for risk analysis and management
- Layers of Protection Analysis (LOPA)
- Safety Integrity Level (SIL)
- Incident investigations and RCA
- Tools for safer design
- Overpressure protection and pressure relief valves
- Hazardous area classification schedule and drawings
- Corrosion detection and mechanisms, metallurgy selection
- Emergency Isolation Valves (EIVs) and safety measures
- Case studies

CONNECTED WORKFORCE COMPETENCY

Overview

Accelerate and improve hands-on learning with Unisim-based dynamic simulators. Dynamic simulators provide a safe environment to train operators in unit operations.

The simulators prepare the operators on normal procedures and how to respond effectively to abnormal situations as well. Both classroom instruction and the use of dynamic simulators are key to increasing competency.

Why Honeywell UOP?

Honeywell UOP has been a leader in the energy sector for over 100 years. Our experience has taught us that the only way to handle unpredictable times is by being proactive and by taking control. We know that if you wait to react, you've already lost.

Honeywell UOP brings people and process together to achieve operational excellence. We ensure your workforce has the knowledge, skills and competency to get the most from your investments and sustain the benefits.

Our courses focus on operating and new process technologies, designing refineries and process units, and optimizing operations.

We can work with you to deliver the programs and content that is best suited to meet your business goals and enable you to maximize the benefits from your most valuable asset.

Simulation-Based Training

Replicating fast-paced operating scenarios in a simulation environment is the best method for preparing operations personnel to be competent and informed decisions makers during start-up, shutdown, and process upsets. Furthermore, it enables trainers to mentor and assess trainees either remotely or in classroom sessions.

Simulation-Based Training forms the foundation of a comprehensive program that prepares operators for production scenarios before initial operations and refresher training.

Key Features

- **Trusted Simulation Technology:** First principles models and thermodynamic relationships are used to accurately represent plant behavior. These capabilities have been applied extensively and proven repeatedly in live plant applications. Honeywell simulations are cutting- edge dynamic models with high fidelity and performance.
- **Ready-Now Models:** High-fidelity models are available for both UOP and non-UOP technologies.
- **Cloud Hosted:** Training is deployed in Honeywell's Microsoft Azure cloud infrastructure which enables simulation-based learning and instructor capabilities delivered to desktop anytime and anywhere.
- **Scalable:** Virtualized cloud infrastructure can scale up and down as required from one or more concurrent local users to global enterprise-wide access.
- **Customized Models:** When appropriate, customized models can be built based on the definition of a plant as represented by Piping and Instrumentation Diagrams (P&IDs) and equipment datasheets.
- **Experience:** Dynamic Simulators have been supplied to a diverse range of verticals in Refining, Petrochemicals, Chemicals, Oil & Gas, Pulp & Paper, Plastics, Power, and Mining / Minerals / Metallurgy.

Case Studies

USA Refinery FCC

The Challenge: An American refinery's FCC unit suffered high catalyst losses in their pre-2023 start-up and between 2022-2024, the operations crew lost expertise. During this time, the customer requested a targeted training program for operations personnel.

The Results: During 2023, UOP collaborated with SITE SME to design a targeted operational training program based on identified knowledge gaps. In April 2024,the operator workshop was conducted to address key KPI's, practice start-up and emergency procedures using the UOP FCC dynamic simulator. Operators were able to apply lessons learned during an emergency in May 2024 and were able to quickly recover from an abnormal situation.

Central Europe Refinery FCC

The Challenge: A refinery in Central Europe was commencing an FCC and Alkylation complex using UOP technology with a Honeywell DCS system. While the complex was under construction, the customer mandated that all operations personnel would be trained/ certified via dynamic simulator.

The Results: The customer was able to conduct start-up on the complex ahead of schedule (~2 months) which resulted in a gross margin benefit of ~40M.

Comprehensive Training and Ready-Now Features

Benefits from comprehensive operator training programs are well known. Immediate benefits are realized through operator preparation for an effective start-up. Ongoing benefits are realized under normal operating conditions where the focus shifts to maintaining production by recognizing and avoiding incidents that result in production losses, equipment damage, personnel injury, and environmental hazard.

For operations training and competency management applications, ready-now offerings include basic coursework, problem solving and trainee assessment. Effective management of these tasks is achieved through a graphical user interface (GUI) with facilities for:

Basic User Features:

Snapshots, initial conditions, backtracks, time management (freeze, step, fast time), and feature navigation bar.

Centralized Simulation Server:

Provides a repository for managing downloadable models, performance reporting and license management.

Training Tools:

Graphic displays with faceplates, remote functions, operator trends, alarm display and annunciator, document library, video player, and event-driven help.

Advanced Instructor Tools:

Manage exercises, scenarios, upsets, instructor variables, performance monitoring and assessment, and alarm and event summary.

Models and Starter Training Content

In addition to custom model capability, Connected Workforce Competency offers the following ready-now high-fidelity process models.

UOP Process Models:

UOP Unicracking™ Process for Hydrocracking, UOP Platforming™ and CycleMax™ Continuous Catalyst Regeneration, UOP Fluid Catalytic Cracking, UOP C3 Oleflex™ Reactor and Product Recovery

Non-UOP Refining Models:

FCC, Advanced Distillation, Crude/ Vacuum Distillation Unit, Delayed Coker Unit, Naphtha Stabilizer and Splitter Unit, Naphtha Hydrotreater Unit, Diesel Hydrotreating Unit, Sulphur Recovery and Tail Gas Treating, Naphtha Isomerization, Catalytic Reformer, Amine Treatment, LPG Merox Unit Recovery

Instructor-Led Training Content:

Training content for ready-now options addresses information and experiences critical to profitable daily operations which can serve as a curriculum kick-start. Training content includes:

Process Familiarization:

From cause and effect to fundamentals necessary for operations and troubleshooting.

Control and Safety System Operation: Provides an understanding of the operation and interactions of the control and safety system.

Start-Up and Shutdown:

Simulation-based learning is one of the best methods to teach infrequent and high-consequence procedures such as unit start-up and shutdown.

Normal Operations:

Normal operating procedures are also included, as effective day- to-day operation of the unit is a key contributor to process safety, reliability and performance.

Optimization:

Optimization exercises provide the trainee with the experience of executing typical daily operating instructions, while maintaining important constraints within their safe operations range.

Abnormal Situations:

Numerous equipment failures and process conditions variations support training scenarios associated with identifying and responding to abnormal situations.

Benefits to Customers

Connected Workforce Competency enables sustained and measurable upgrades in plant reliability and operating performance and can be used by both operations and engineering team to:

Reduce operating costs by the reduction of incidents caused by human errors

Improve operations performance by providing training and validating procedures that help protect people, plant assets, and the environment

Institutionalize knowledge capture and dissemination; repurpose staff to operate new equipment and processes

- Accelerate the process of propagating, assessing diagnostic and skills, and developing relevant process know-how
- Monitor the level of attainment of operators at individual, shift, or site levels

DIGITAL SERVICES

Honeywell UOP Digital Services are designed to deliver UOP insights and recommendations faster, ultimately enabling our end users to make better operating decisions. These digital tools can be incorporated with any Performance+ engagement, a traditional service engagement, or standalone engagement.

PROCESS MONITOR

Process Monitor is the foundation for all UOP Digital Service activities. Process Monitor automates the collection and processing of operation data daily and allows customers to continuously track the KPIs of their UOP units. It is also used as the starting point for additional digital entitlements UOP offers.

Process Monitor is built on a secure cloud-hosted platform to ensure that the service produces ongoing value. Process Monitor combines UOP's in-depth process knowledge with a customer's site-specific information to provide **several key assessments through**:

- Automated data transfer of plant data from historian and laboratory systems to a secure Honeywell cloud.
- Data reconciliation, normalization, validation of the raw data.
- Calculation to transform the reconciled data into KPIs specific to your unit operations.
- Publish the calculated KPIs on a secure user interface webpage that both the customer and UOP have access.

This approach will be integrated with data from the process to deliver a consistent view of all unit operations, stream properties, and unit performance. Figure 2 on the following page illustrates the overall service architecture and key processing steps.

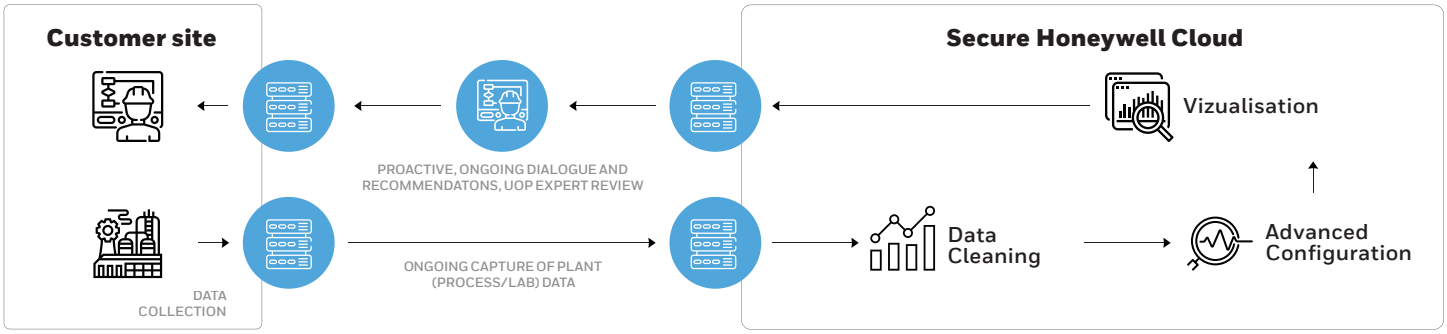


Figure 2

Key Operating Parameters

Description	UOM	Design	Value	Changed From					
				Previous Day		Rolling Week		Rolling Month	
Material Balance	wt %		100.30	0.90	0.9 %	1.04	1.0 %	1.49	1.5 %
Space Velocity (LHSV)	1/h		2.87	0.00	0.0 %	0.00	-0.1 %	0.11	4.1 %
H2 to HC ratio	mol/mol		0.34	0.09	35.7 %	0.02	-5.4 %	0.08	-19.0 %
Weight Avg Inlet Temp (WAIT)	F		1159.9	0.1	0.0 %	0.7	-0.1 %	0.5	0.0 %
Weight Avg Bed Temp (WABT)	F		1120.9	0.1	0.0 %	0.4	0.0 %	0.0	0.0 %
Reactor 1 Delta T	F		105.7	0.3	0.3 %	0.0	0.0 %	1.6	1.6 %
Reactor 2 Delta T	F		94.0	0.5	0.6 %	1.1	1.2 %	0.8	-0.8 %
Reactor 3 Delta T	F		70.4	2.0	-2.7 %	2.4	-3.3 %	2.5	-3.5 %
Reactor 4 Delta T	F		48.6	0.3	-0.7 %	1.2	-2.5 %	2.1	-4.1 %
Reactor Total Delta T	F		318.8	1.5	-0.5 %	2.6	-0.8 %	3.8	-1.2 %
Propane Conversion	wt %		28.93	0.01	0.0 %	0.05	-0.2 %	1.11	4.0 %
Propylene Selectivity	wt %		78.92	0.22	-0.3 %	0.24	0.3 %	3.82	5.1 %
Propylene Yield Per Pass	wt %		22.83	0.06	-0.3 %	0.03	0.1 %	1.15	5.3 %

Figure 3

Current unit performance is presented through dashboards on a secure website accessible by customer employees worldwide. Customizable reports and trends are also provided for all users (see Figure 3).

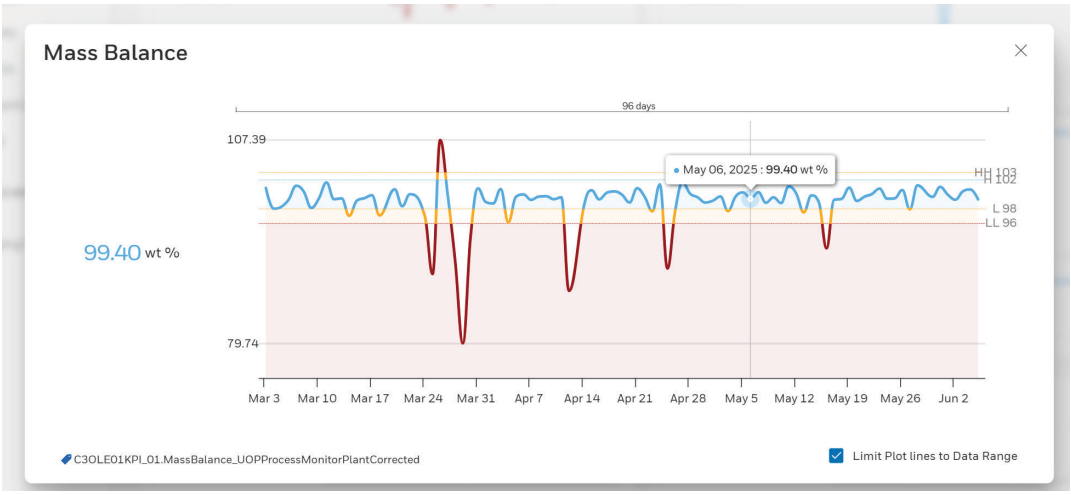


Figure 4

Process Monitor can be implemented on most UOP process units (see Figure 4). Contact your Honeywell UOP Service Manager to learn more.

PROCESS TECHNOLOGY ANALYTICS

Process Technology Analytics (PTA) is a technology-specific feature that utilizes UOP's deep domain knowledge and the robust tools to provide greater insight into specific operational capabilities. Each PTA is built on Process Monitor and leveraging the same user interface.

The PTAs enable continuous improvement through focused insights on operations. They utilize unit current operational information, UOP kinetic process models that reflect the deep domain knowledge and multiple years of UOP's experience of troubleshooting and optimizing process unit operations.

Each PTA is built to address a key customer pain point or operational challenge for optimal performance and operational planning. UOP has a dedicated development team focused on building these PTA modules that address the customer needs with the goal of developing and deploying quickly. As a result, the PTA enables faster resolutions through quick identification of operational issues with targeted appropriate remediation. It also helps to get fast responses to reduce production upsets and potentially avoids unplanned shutdowns.

See Figure 5 below to see the standard PTAs for each process category. Contact your Honeywell UOP Service Manager to find out about other PTA capabilities.

TECHNOLOGY	ANALYTIC	FOCUS
CCR Platforming	Performance Predictor	• User-defined "What if" to identify target operations before changes in feed or product properties. • Unit Optimisation to provide optimised operating variables on an everyday basis.
	Dynamic Coke Laydown	• Based on operating severity, estimates coke make throughout the reactors system.
	Catalyst Imaging Sensor and Analytic	• Estimates catalyst health properties including H2:Pt in near real-time
	Packinox Proforma	• Estimates near real-time constraint potential of the Packinox heat exchanger
Penex	Performance Predictor	• User defined "What if" to identify target operations before changes in feed or product properties. • Unit Optimization to provide optimized operating variables on an everyday basis.
Merox	Mercaptide Sensor and Analytic	• Estimates continuous mercaptide concentration eliminating the need for a shake test
FCC	Cyclone Performance Predictor	• Estimates ongoing erosion of cyclone refractories and provides a "what if" to estimate future erosion
Polybed PSA	PSA Valve Analytics	• Estimates which valves are likely to fail before causing the unit to trip or bed switchover
C3 Oleflex	Reactor Performance Optimizer	• User defined "What if" optimization for production, R4 run length, and feed consumption
	RIT Profile Optimizer	• Provides optimal reactor inlet temperatures to achieve lower feed consumption at target production rates near current operation
	Burn Zone Monitor	• Shows impact of operating changes on Burn Zone temperature profile
	Reactor Screen Monitor	• Monitors current Reactor 4 health and allows a user to see estimated timing of Reactor 4 maintenance based on current operating conditions
	Catalyst Transfer Pipe Monitor	• Reactor to Catalyst Collector transfer monitoring with alerts to notify a user of abnormal conditions that require user attention to review and evaluate if procedural actions are needed
	Sulfur Injection Monitor	• Estimates sulfur concentration throughout the reactor circuit
	Catalyst Imaging Sensor and Analytic	• Estimates catalyst health properties including Combi activity in near real-time

Figure 5

EXCEPTION-BASED ALERTS

A continuous data connection through Process Monitor enables UOP to offer Exception-Based Alerts (EBA) by our UOP specialists. With EBA, UOP regularly assesses and evaluates an expanded set of critical composite operating variables and parameters to detect potential problems early and provide proactive advice to our customers. By helping our customers identify and preemptively address issues before they become problems, we can help avoid costly deterioration of operations and help you maximize the reliability of your operations.

Each technology has a set of UOP proprietary composite-critical variables to assess operations. The EBA uses core operational variables, UOP proprietary model based KPI calculations, and advanced analytics to evaluate each technology to provide you with proactive alerts. EBA frequency of notifications is tailored to your preferences to support your operations effectively (see Figure 6).

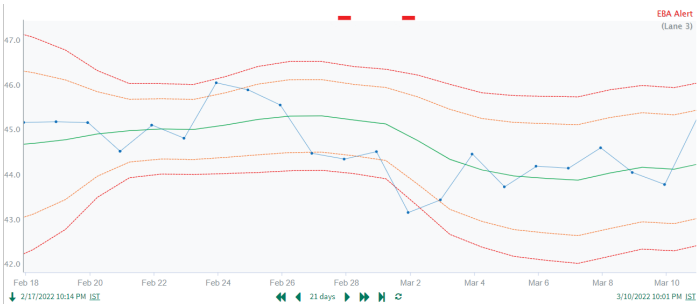


Figure 6

BENCHMARKING

Performance Benchmarking provides insights into your operations by comparing your unit's by comparing your unit's key operating parameters with other facilities operating similar process units.

Performance Benchmarking draws upon data from UOP's extensive global customer base - aggregated and anonymized to protect customer privacy - to give UOP Connected Services customers new targets for operational excellence based on actual results from similar units. The quartile-based approach for the benchmarking indices ensures a relevant assessment and identification of improvement opportunities.

When customers are already at the top of operating efficiency, Performance Benchmarking provides evidence that you are on the right track and highlights the opportunity for further improvements through technology advancements and performance upgrades. An example snapshot of a typical benchmarking report for a platforming unit is shown below (see Figure 7).

SNAPSHOT OF BENCHMARKING REPORT FOR A AROMATIC ISOMAR UNIT

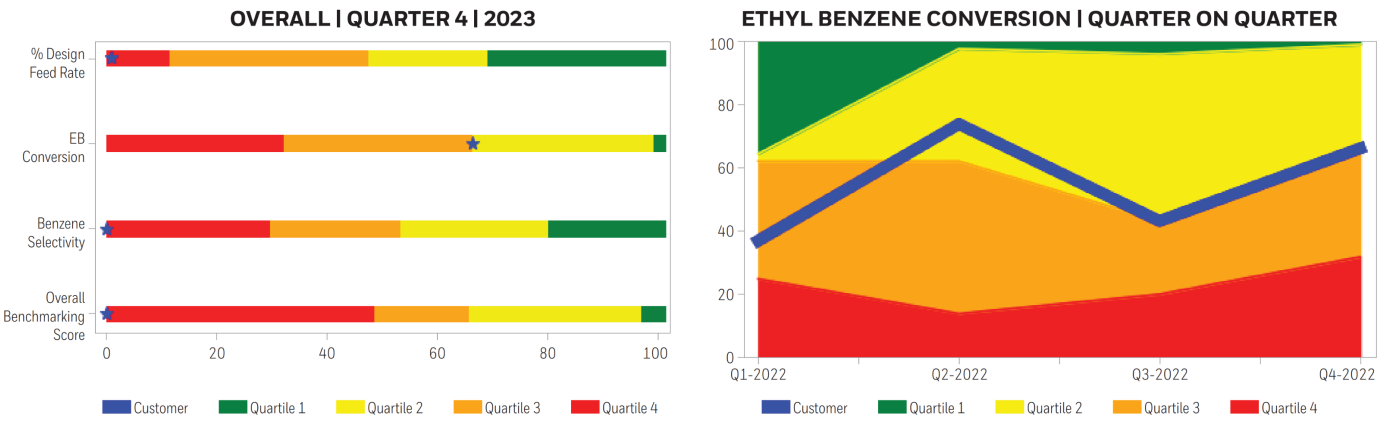


Figure 7

Case Studies

Improved Catalyst Health

The Challenge: A CCR Platforming operating unit traditionally provides an offline catalyst sample to estimate catalyst health on a quarterly basis; however, catalyst health decline can be slow moving and if not resolved quickly can result in sub-optimal performance.

The Results: With the Catalyst Imaging PTA, the customer was able to quantify the slow decline in catalyst health before it started to impact overall unit performance. Paired with Process Monitor, UOP and the customer investigated the CCR operations and confirmed plugging of the regenerator inner screen. UOP collaborated with the customer to determine the optimum timing to perform a quick CCR turn around to clean the screen. **By taking action quickly instead of waiting for the planned turn around, the customer avoided ~2 months of sub-optimal performance.**

Application of Performance Predictor

The Challenge: A CCR Platforming operator understood the potential value of operating the unit with staggered reactor inlet temperatures but elected to operate all reactors at the same inlet temperature to avoid possible unit upsets.

The Results: Through the application of the CCR Platforming Performance Predictor, UOP was able to demonstrate what staggering the inlet temperatures would enable the end user to achieve while identifying what constraints the unit would operate at these new conditions. **By using the PTA, the end user was able to achieve $3.4M/yr by maximizing the aromatics yields of the CCR Platforming unit.**

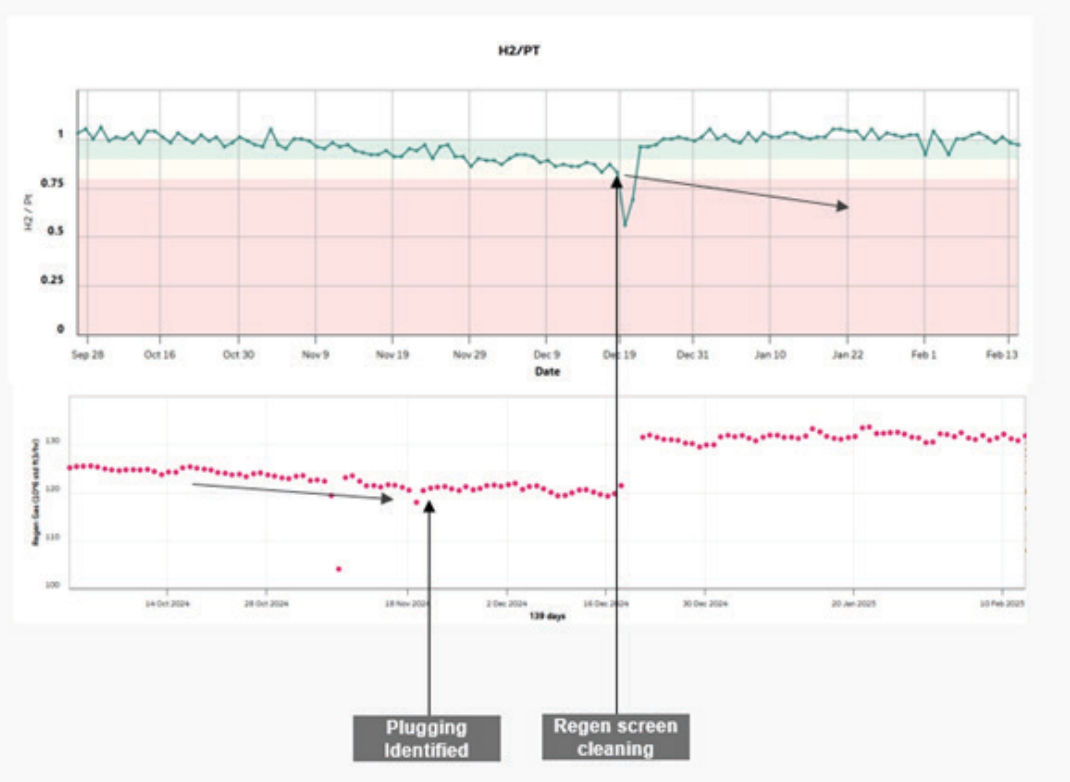


Figure 8

ADDITIONAL DIGITAL CAPABILITIES

Additional digital capabilities from Honeywell Process Solutions (HPS) can be incorporated into Performance+ Service Agreements. These solutions integrate Honeywell UOP process expertise with Honeywell's automation platforms, offering a superior solution that significantly enhances the customer's bottom line by allowing the plant to start up sooner, reach full capacity more quickly, and operate optimally throughout its lifecycle.

The different digital offerings include:

Operator Training Simulators
High fidelity operator training simulators (OTS) for the key process units with embedded UOP reactor models, scenarios and exercises and Abnormal Situation Management (ASM) Consortium compliant graphics that match the DCS graphics to train the operators in a safe environment well before plant start-up. These operator training simulators leverage UOP's process design models and can also be used to test out control strategies for the distributed control systems (DCS) and develop seed models for the Advanced Process Control (APC).

ADVANCED PROCESS CONTROL
UOP's expertise is built into every APC application in multiple ways:

The P&IDs are marked up for the additional instrumentation that is needed to enable an earlier and better APC implementation.

UOP's design and operating philosophy are captured in the APC controller design.

UOP's design correlations are encapsulated in toolkits that capture the nonlinearity of the process units and work in conjunction with the APC application. The toolkits can also calculate variables that are difficult to measure directly using other measurements allowing the APC application to push the process unit closer to its limits.

Process Technology Analytics and Process Digital Twins can update the gains, limits and setpoints to the APC on a regular basis to keep the APC evergreen.

For complex or site level optimization, UOP can offer the Plantwide Optimizer, which is based on the patented proxy-limit technology and can provide effective coordination and optimization across multiple process units and downstream blending if applicable.

Asset Performance Management (APM)
Honeywell's Asset Performance Management software provides continuous process performance monitoring and equipment health surveillance covering every aspect of the plant from instruments, valves, and compressors to an entire process unit. The software enabled with AI/ML techniques, UOP know-how (for UOP designed and delivered equipment and modular units), and /or vast OEM correlation database offers performance and fault models to detect and predict equipment health and process performance issues to help avoid unexpected plant downtime.

Process Digital Twins (PDT)
Operators are often in situations where they need to understand what operational adjustments would do to their environment, without actually making real changes to a unit. PTAs and PDTs are steady state or dynamic first principles-based models (augmented by hybrid and data driven models) that are connected to curated live plant data and automatically tuned to reflect current plant conditions and performance. The PTAs and PDTs are used by the customers and UOP experts to troubleshoot and simulate plant performance, perform scenario analysis, get optimization recommendations, and provide soft sensing in cases where there are no analyzers or when the analyzers need to be taken offline for maintenance and recalibration. The PTAs and PDTs leverage UOP's process design model and can be used to update the gains and set points of the advanced process control application.

HPS Distributed Control System (DCS)
HPS is a leader in providing DCS to refining and petrochemical producers globally. We capture UOP's know-how in the pre-packaged Experion Solution Suite templates and deliver them in Honeywell's state-of-the-art distributed control system using Honeywell's Lean Execution of Automation Projects (LEAP) methodology. This includes (remote) universal channel technology, cloud engineering and virtualization.

HPS Emergency Shutdown (ESD)
We capture the cause and effect information from the UOP Schedule A in Honeywell's safety platform. In addition, the F&G system for the process units can also be delivered on the same Safety Manager platform.

The integrated solutions described above reduce project risk, enable early start-up, improve the reliability and availability of the plant, and improve efficiency.


LEARN MORE

For more information
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