

MODIFICATION, REVAMP & UPGRADE BUSINESS

RENEWED RELIABILITY

- Powering the Future of Brownfield Excellence





“

*Engineering
excellence is not
merely about
building assets.
It is about
extending
their value for
generations.*

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About us

The MRU Business Unit

The MRU Business Unit provides integrated solutions for plant modification, expansion, and modernization projects across the energy sector. We specialize in executing revamps in operating facilities, ensuring continuous production while upgrading technology and reliability.

Our expertise spans across process & technology, mechanical, piping, civil & structure, electrical, and instrumentation disciplines. Every project is executed under stringent safety protocols and precision planning, ensuring seamless plant integration.

At Larsen & Toubro, we believe in redefining reliability through innovation, safety, and precision. The Modification, Revamp & Upgrades (MRU) Business stands as a symbol of our commitment to sustaining and enhancing vital energy assets of global oil, gas, and fertilizer industries through technology driven solutions.

This Coffee Book is a testament to our legacy in delivering complex brownfield projects safely, efficiently, and with minimal plant disruption. It reflects our team's unwavering passion for engineering excellence, technological innovation, and a customer-first approach.



CORE

Capabilities



FCC Revamps

Precision upgrades / revamps of FCC units to improve Plant Efficiency, Asset Life, and throughput.



Coke Drum Revamps & Solutions

Specialized in coke drum replacements, revamp / repairs, weld overlay, skirt replacement, skirt-to-shell repair with advanced metallurgy and IOT based life extension solution.



NGL / LNG Plant Ppgrades

Specialized end to end interventions for capacity upgradation of the facilities.



Fertilizer Plant Upgrades & Revamps

Execution of Ammonia and Urea Plant revamp / upgrade, Urea reactor refurbishments, and process optimization services.



Other Multi-disciplinary Upgrades / Revamps

Comprehensive plant modification and upgrades integrating all engineering disciplines under live operating conditions.



Emergency Repairs & Interventions

24x7 emergency revamp, repair and restoration services with accelerated mobilization.

PROJECT

Excellence



PETORABIGH HOFCC KSA



Project Highlights

- One of the largest FCC in the world.
- 15.5m Reactor & 17.3m Regenerator mega turnaround executed under stringent timeline.
- Engineered heavy lifts involving 525 MT internals and critical equipment handling.
- Digital Twin modelling enabled clash-free planning and first time-right execution.
- BROKK robots, AI-enabled monitoring and digital dashboards enhanced productivity by 30-40%.
- Diamond wire cutting, engineered SIMOP's and mobile QA lab accelerated execution.
- 1.57 million safe man-hours, Zero LTI, 100% FTR and Best Safety & Quality Awards.



ADNOC NGL Upgrade Project UAE



Project Highlights

- 5 Shutdowns; 6.5+ Mn Safe manhours
- Prestigious EPC award for a strategic national asset
- Proven, quantified capacity gains delivered
- World-class safety and full multi-train delivery in a live plant

Gujarat State Fertilizers & Chemicals Ltd., India



Project Highlights

- 58 years old aging plant Revamp
- 1.9 Mn Safe Man-hours
- Full-scope EPC revamp of a 58-year-old fertilizer complex
- Significant capacity boost with energy efficiency
- Complex Urea-grade equipment engineering & manufacturing capability
- Integrated brown-field execution in a live plant environment

ORPIC Oman FCC Revamp Oman



The project witnessed total heavy lifts of ~1670 MT with single heaviest lift of 740 MT for installation of New Reactor. Key strengths displayed by Larsen & Toubro during this project are efficient detailed engineering, timely procurement, manufacturing to the highest quality standards, excellent planning & execution of site activities during turnaround

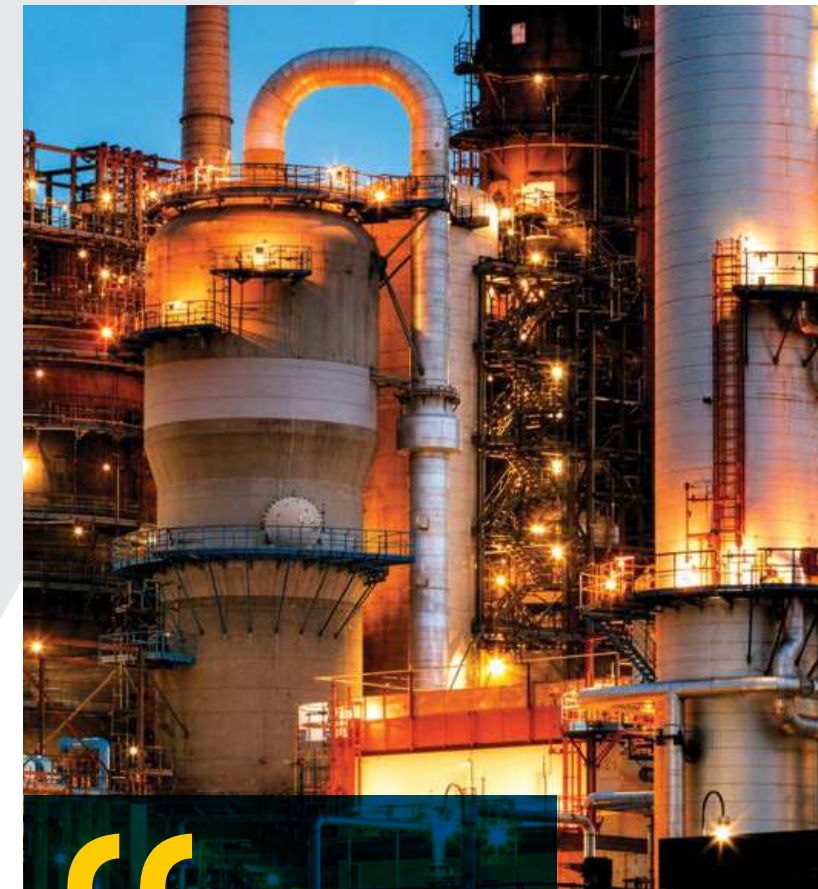
Hamed Faqir AL BALUSHI
- Manager, Project Management Services

Project Highlights

Replacement of

- RFCC Reactor (740 MT, 37 metre long)
- Deployment of 1600 MT PTC- 35 Crane for 99-meter lift
- Scanning and Strengthening of the existing structure
- Dry cutting of critical and heavy thick refractory joints
- Extensive Digital Interfaces

FCCU, Esso Refinery Southampton UK



You have overcome many technical challenges associated with the unique design – particularly refractory and dressing. Your responsive and proactive style of management has been extremely helpful.

Neil Thomas
- Project Execution Leader, Fawley

Project Highlights

- Replacement of 50-year-old FCCU Reactor
- Manufactured & supply of FCC Reactor 9.8 mtr diameter, 900MT, 3 sections refractory lined
- Erected 11m high, 140m long temporary skid-way over five pipe racks to transport the reactor sections inside refinery
- Individual sections lowered and assembled in-situ using Strand Jack Method

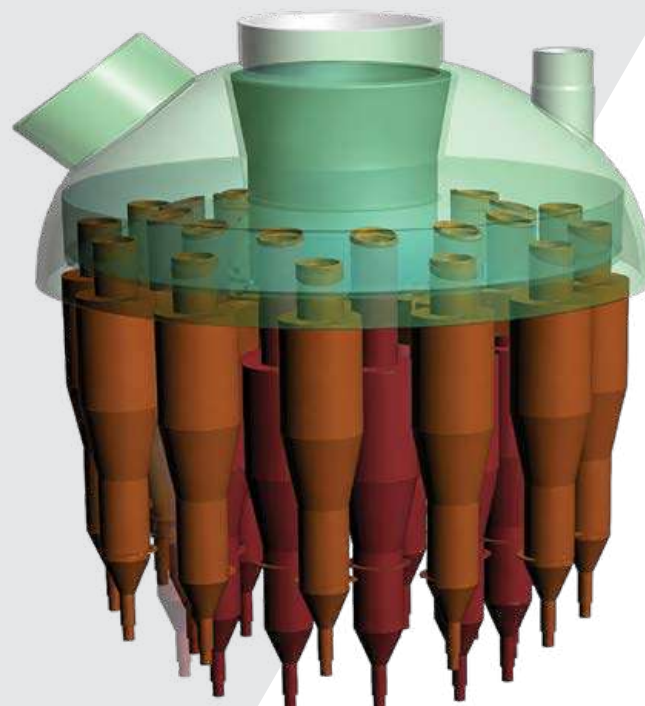


Dome - TSS & Cyclone Replacement, ADNOC UAE

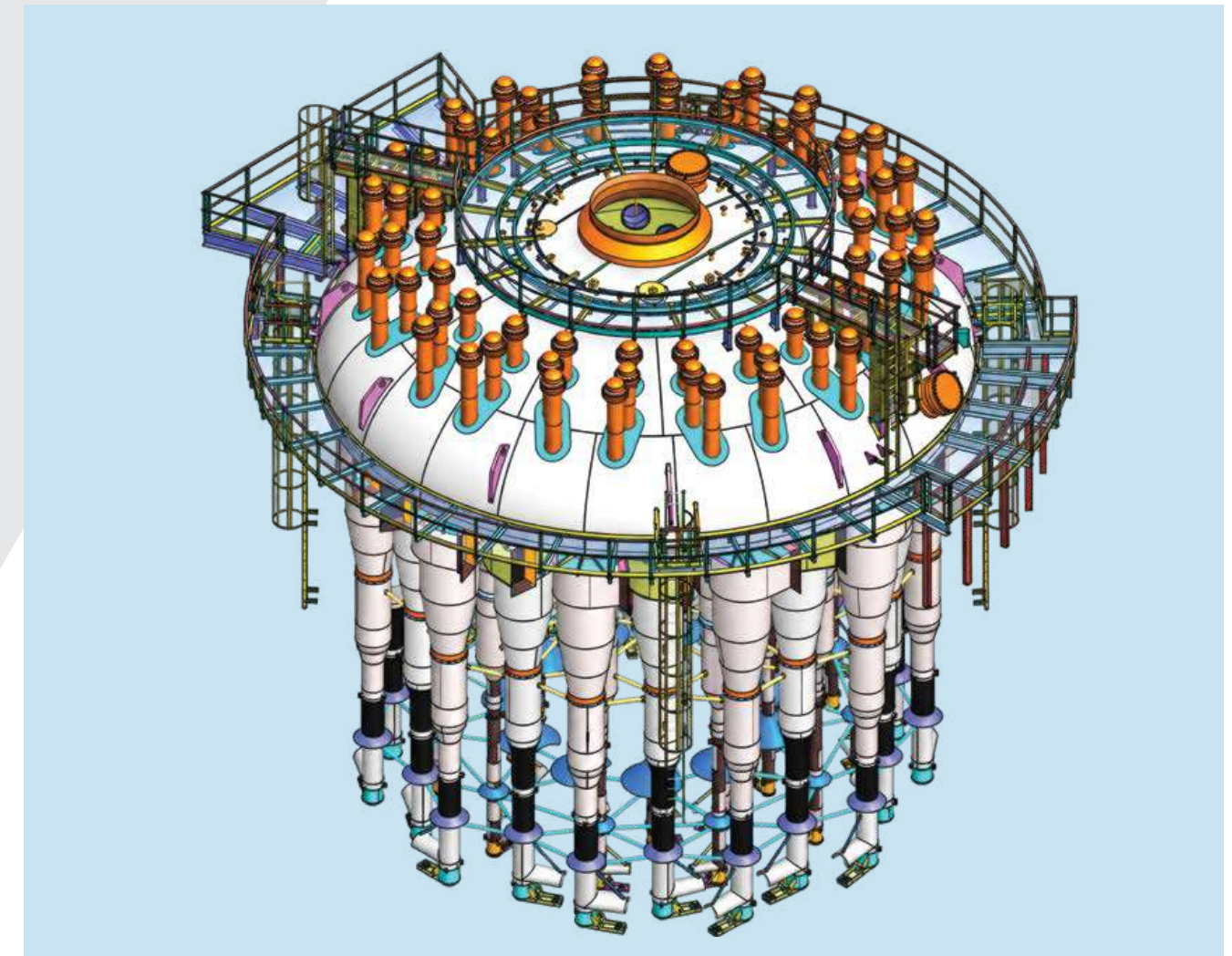


Project Highlights

- Landmark FCC unit revamp for a national oil major
- Heavy-lift engineering excellence on massive equipment
- Ahead-of-schedule delivery with a flawless safety record
- Innovation-led execution that de-risked the shutdown
- Supply & Replacement of Reactor top dome along with Cyclone
- Mechanized Cold cutting for Dome to Shell joint

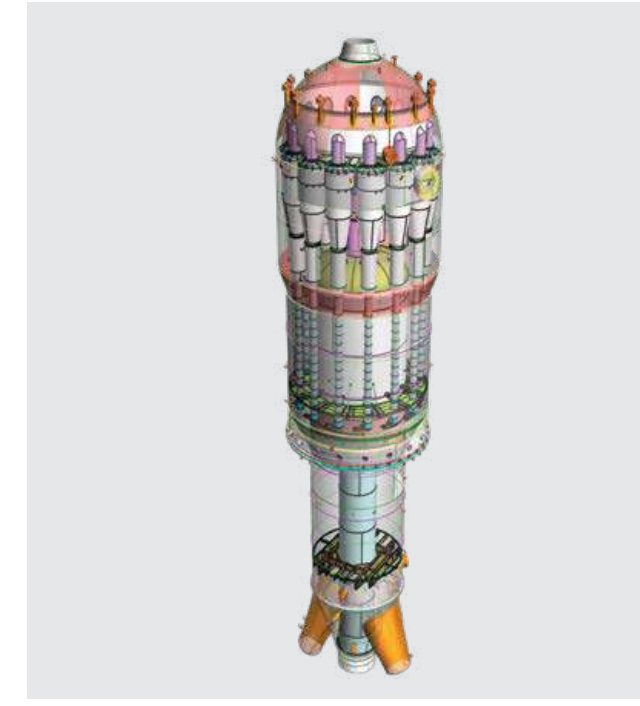


Reliance DTA FCCU Revamp, Jamnagar India



Project Highlights

- Mega brown-field FCCU revamp for one of the world's largest refineries
- World-class super-heavy lift capability
- Massive multi-discipline execution scope
- Outstanding safety, quality and digital innovation
- Replacement of Rg dome along with cyclone
 - Reactor weight: 1500 MT
 - Regenerator Dome weight: 940 MT



FCCU, IOCL Mathura India



Project Highlights

- Regenerator Dome (Dia 5664 mm) replacement
- Reactor Dome (Dia 4500 mm) replacement
- Spent Catalyst Standpipe (SCSP)
- Regenerated Catalyst Standpipe (RCSP)
- New Orifice Chamber
- New Operating Structure for Flue Gas Piping
- New 54" Refractory Flue Gas Piping
- Electrical & Instrumentation
- Pre-commissioning & Commissioning



Our appreciation for the excellent work carried out by M/s Larsen & Toubro towards the FCCU revamp at Mathura refinery. The work was completed by your site team in a safe manner & with zero quality giveaways despite the immensely challenging target.

Sanjib Kumar
- Executive Director, Technical



FCCU, IOCL Vadodara India



we would like to express our sincere thanks and appreciation to the entire working hand in hand with the Gujarat Refinery team towards ensuring successful completion of the shutdown activities at Gujarat Refinery.

S. K. Dhar Gupta
- Executive Director, IOCL Gujarat Refinery

Project Highlights

- Supply & Replacement of Reactor Dome (Dia 4300) with cyclone
- Supply & Replacement External Riser in 5 sections
- Replacement of Regenerator cyclone on ground (Dia 5664)
- Installation of new Air Grid, VSS riser & Catalyst Distributor
- Regenerator Dome & 4 nos. proprietary optimix feed nozzles salvaged during shutdown
- Safe Man Hours: 192,000

EO Reactor and Gas Cooler, Sharq Saudi Arabia



Project Highlights

- In-situ repair of 7 Circ seams and 10 Nozzles in confined space
- Reactor Dia 7670 mm, thk. 118 mm, SA 543 Gr B Class I
- First Time Right: All welds
- Safe Man Hours: 185,000
- Turnaround: 54 days, completed 12 days ahead of schedule



It is really admirable that you have completed the repairs prior to the desired time frame, giving a long lasting impression & joy of achieving a planned program. I am pleased with your professional way of approach.

Mohammed Al-Wadaey
- President (Sharq)

EQUATE Kuwait WHT Modification Kuwait



Project Highlights

- Supply & Replacement of Reactor Dome (Dia 4300) with cyclone
- Replacement of old exchanger in Styrene Plant
- 3D scanning & H/E & adjacent area to measure exact dimensions, ovality & tolerances
- Water jet cutting at 18 mtr height
- Safe Man Hours: 41,000

Coke Drum, RIL Jamnagar India

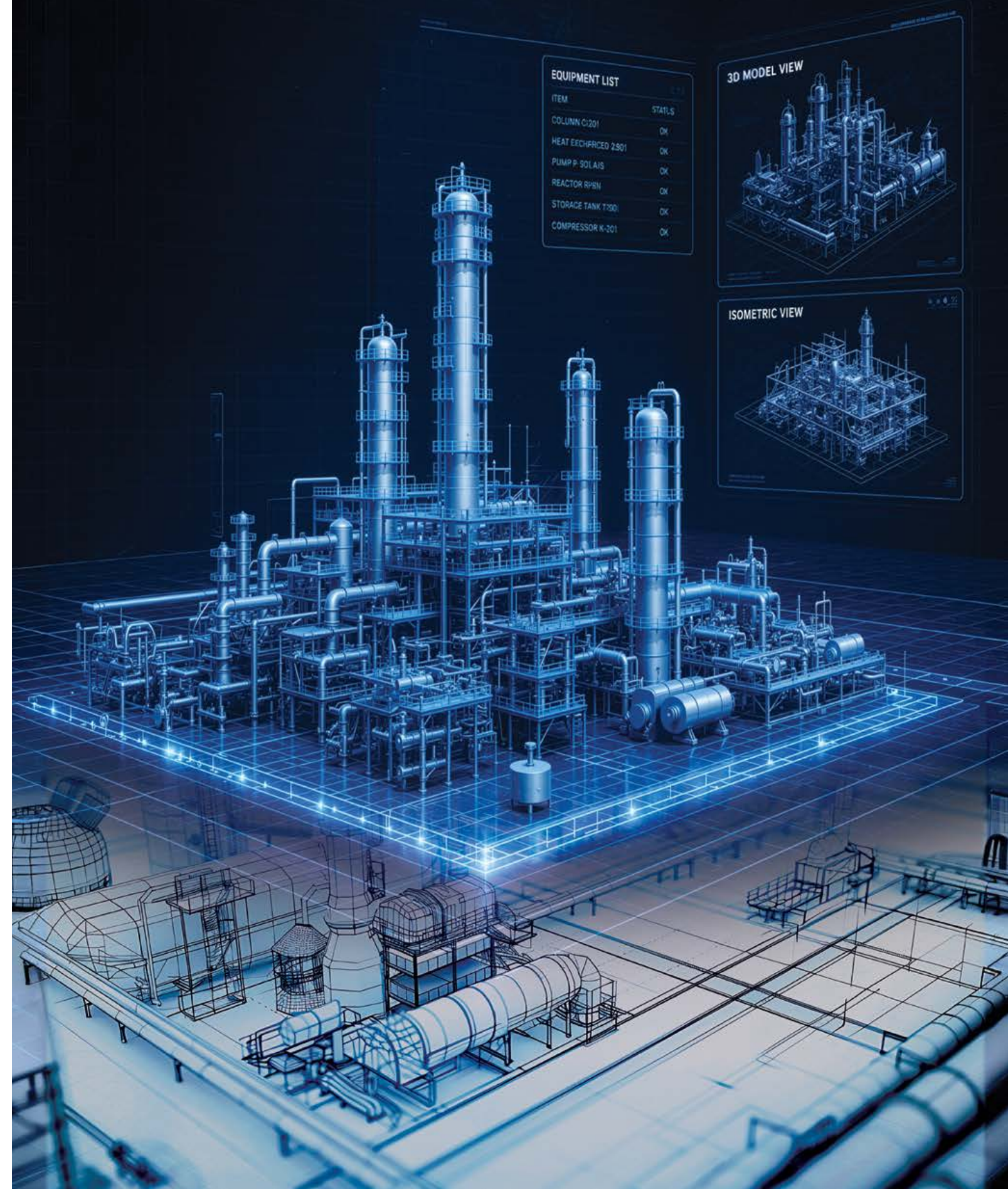


Project Highlights

- Weld crack repair & bulge overlay
- Automated welding system (TBW & CDW)
- Total weld deposition: 2150 Kg
- Shutdown Duration: 17 days
- Safe Man Hours: 31,000; Zero LTI
- Quick response rescue system for confined work



ENGINEERING CAPABILITIES



Multi-disciplinary Engineering Capabilities

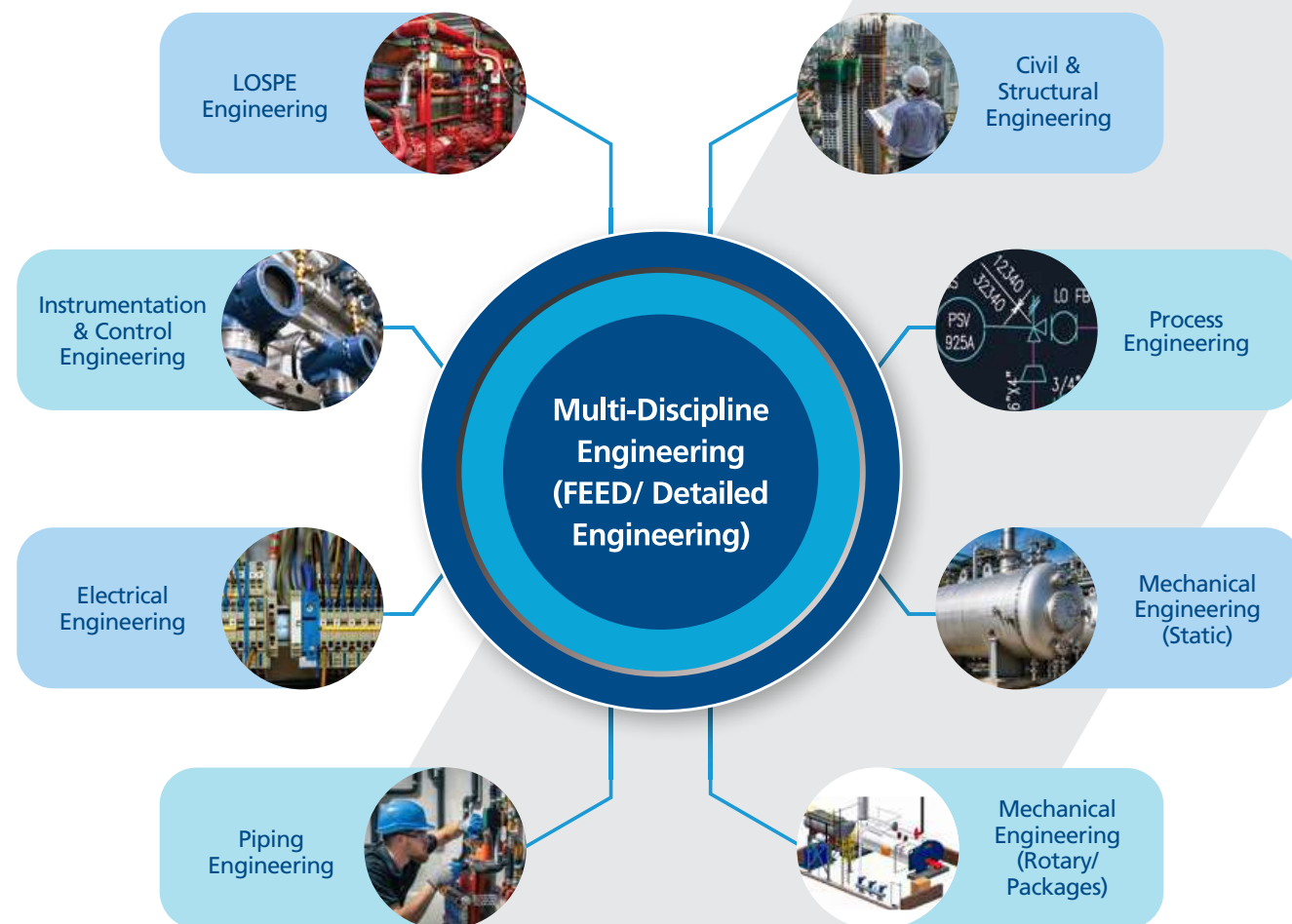
Recognizing Design & Engineering as the backbone of any project, MRU has dedicated and experienced team of Design Engineers specialized in Brownfield projects in Oil & Gas, Petrochemicals and Fertilizers Industry. The team has continuously evolved its methodology beyond conventional practices recognizing stringent timeline and site constraints associated with Brownfield Projects. MRU Engineering has skills and knowledge to execute Detailed Engineering projects, Capacity enhancement projects, short shut-down projects and emergency repair projects.

MRU Engineering Team is equipped with latest software and digital assets to perform and manage design calculations, drawings/deliverable generations, 3D modelling, design reviews and engineering management.

The Team has developed in-house technology and methodology for complex integration and interaction analysis tailored to suit Brown-field execution. Artificial Intelligence (AI) is embedded throughout engineering life cycle to enhance reliability, predictability and consistency.

Multi-disciplinary Brownfield projects encounter numerous challenges which are not typical to conventional greenfield projects, which require team to be highly agile and adoptive. MRU Engineering has demonstrated such capabilities through successful project execution.

MRU Engineering has specialized in providing proprietary, technically complex and innovative solutions, e.g. advance FEA, localized PWHT, Weld-distortion prediction, to support in-situ equipment revamp and emergency repair.



Process Engineering

- Process Simulation & HMB
- Process Flow Diagrams (PFDs)
- Piping & Instrumentation Diagram (P&ID)
- Equipment sizing & Process Calculations
- HAZOP, HAZID & SIL Reviews



Mechanical Engineering (Static & Rotary)

- Static Equipment Design
- Mech Calculations, FEA of critical areas
- Rotary Equipment Engineering
- Package equipment review
- Lifting, transportation analysis



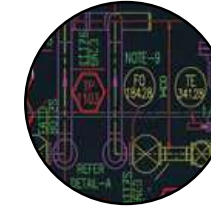
Electrical Engineering

- Power System studies
- Cable schedule and layouts
- Lighting & Earthing calculations
- Single Line Diagrams / GADs / Layouts
- Sub-station Engineering



Piping Engineering

- Plot Plans and Equipment Layout
- 3D Modelling
- Piping routing and stress analysis
- Tie-in Engineering
- Constructability Review



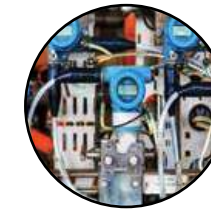
Civil & Structural Engineering

- Foundation Design
- RCC & Steel Structures
- Pipe Racks
- Structural analysis and Adequacy check
- Underground facilities

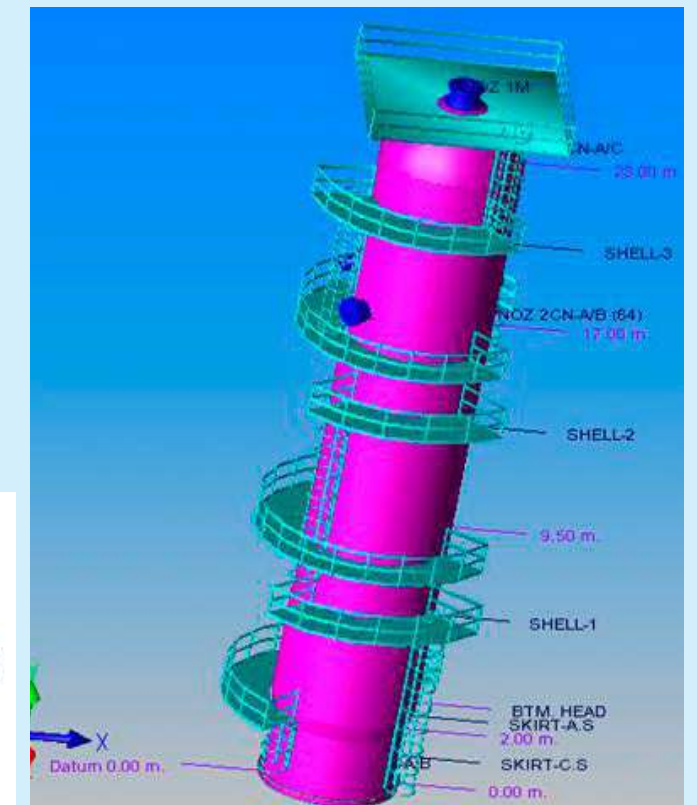
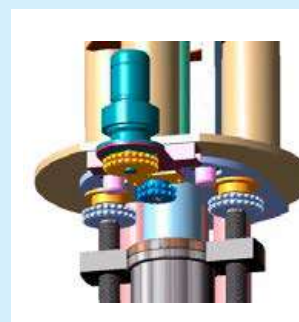
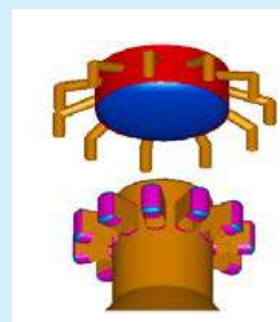
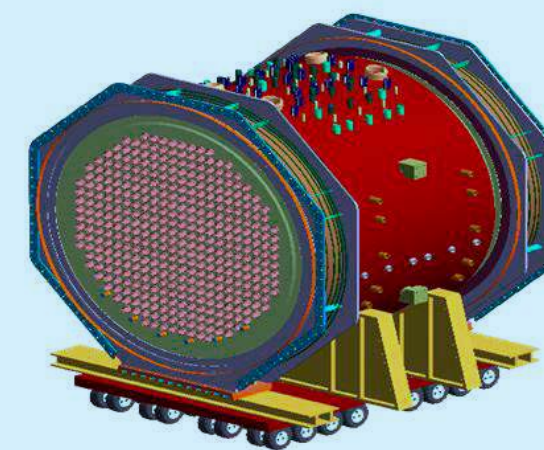


Instrumentation & Control Engineering

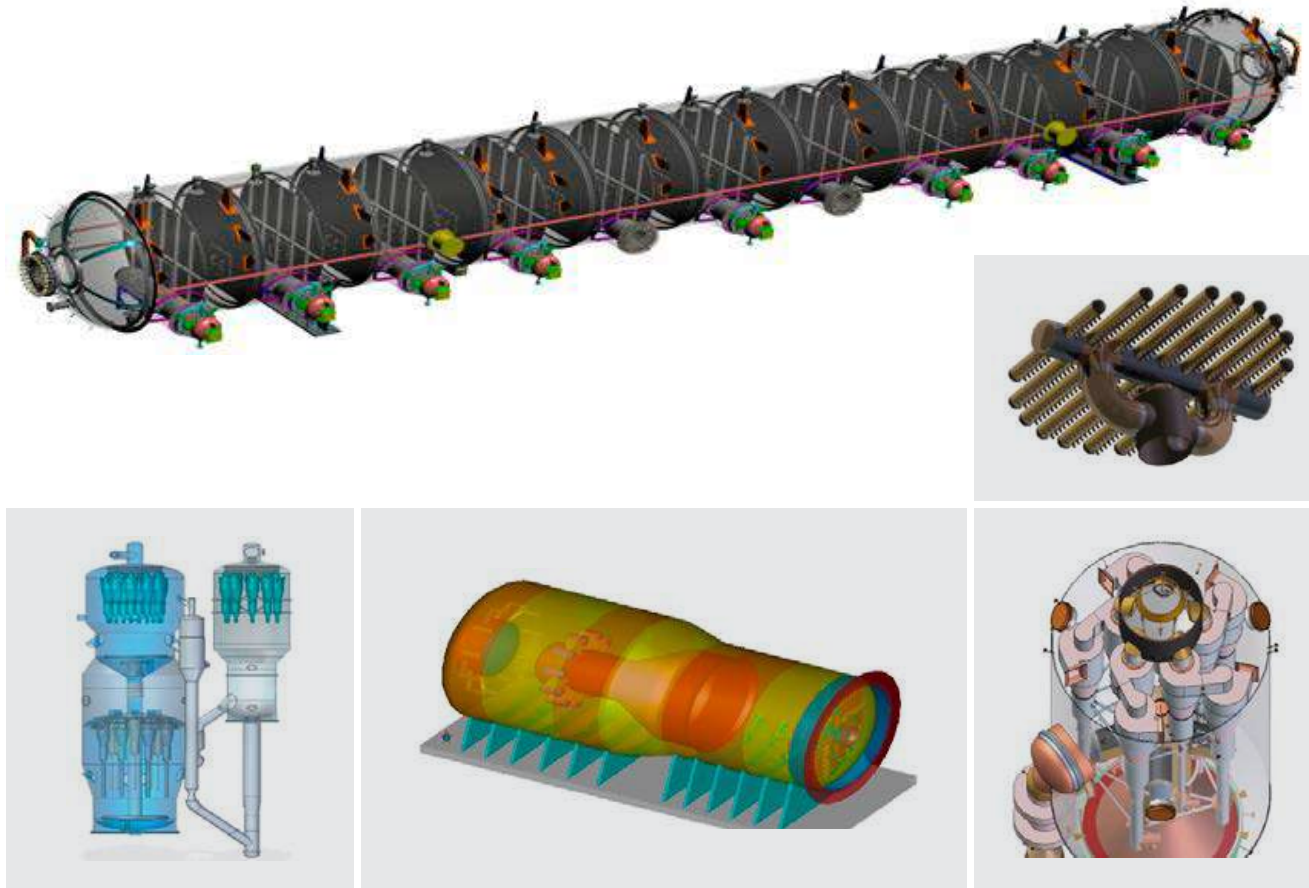
- Instrument index and data sheets
- Control system (PLC/DCS/SIS) Engg.
- Instrument loop design & wiring diagrams
- Control Valve sizing



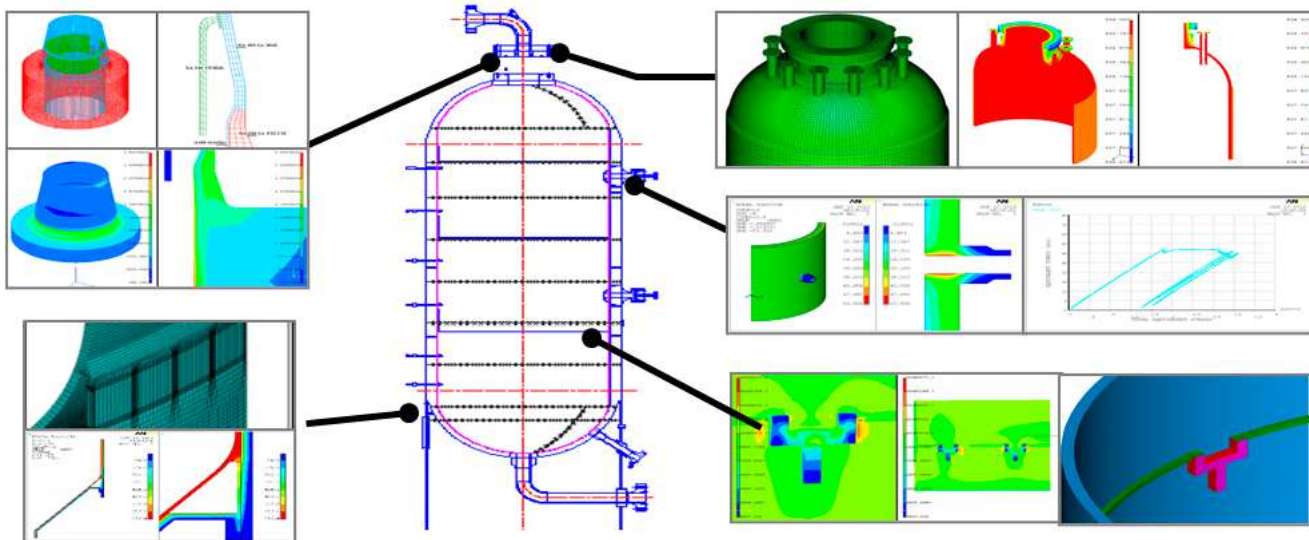
Mechanical Design Capabilities



3D Modelling



FEA Analysis Capabilities



Planning



Planning Capabilities

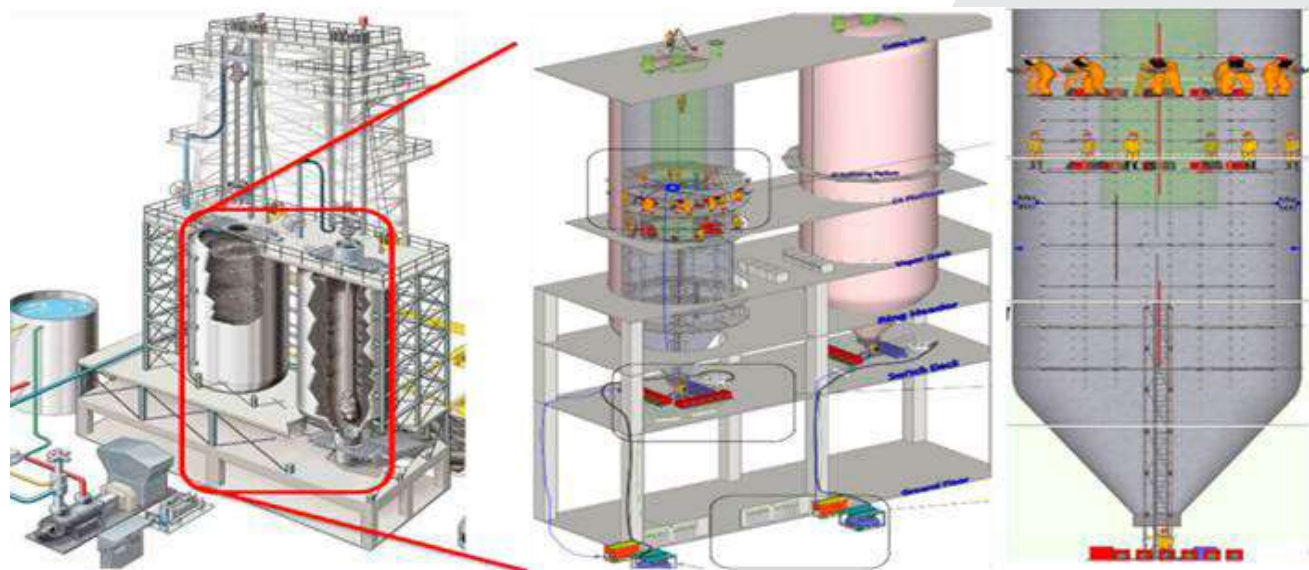
MRU Planning provides end-to-end project controls and execution planning capabilities for complex brownfield EPC projects, refinery shutdowns, turnarounds, revamps, debottlenecking, and equipment replacement works. The function supports the entire project lifecycle from bid preparation to project closure through development of execution strategies, WBS structures, milestone schedules, resource plans, cost estimation inputs, and risk-optimized project schedules.

The team specializes in detailed project scheduling using Primavera P6 and Microsoft Project, critical path analysis, resource optimization, interface management, shutdown planning, SIMOPS integration, safety scheduling, and contingency planning. Advanced digital tools such as Teamcenter Dynamic Simulation and Navisworks are leveraged for constructability reviews, clash detection, equipment movement studies, heavy-lift validation, and

4D visualization, enabling safer and more predictable execution.

MRU Planning also focuses on productivity engineering, workface planning, performance benchmarking, risk management, schedule forecasting, KPI-based monitoring, and executive reporting through digital dashboards and automated reporting systems. The function supports manpower forecasting, crew optimization, and multi-site resource deployment to maximize efficiency.

Customised Resource Planning



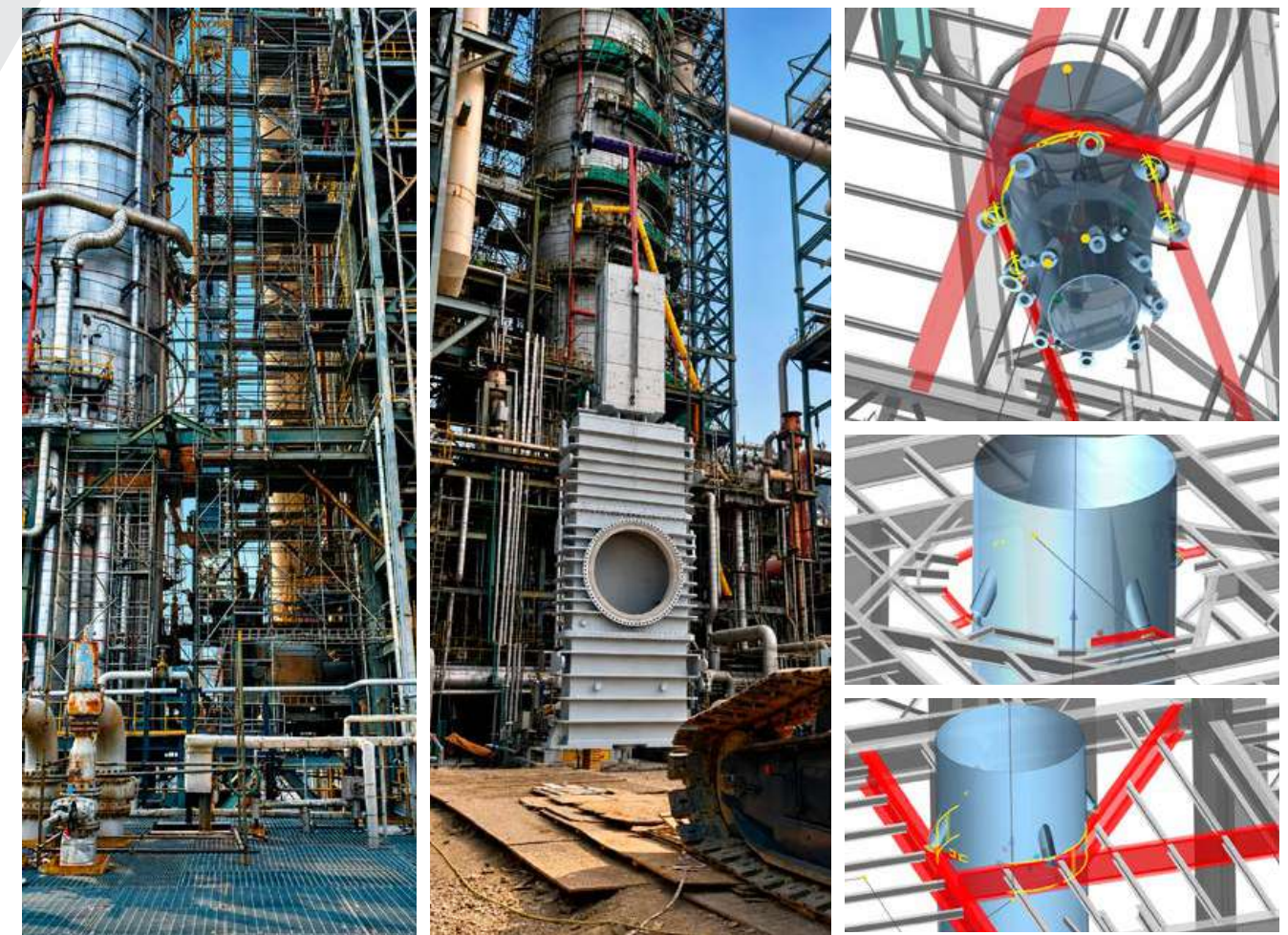
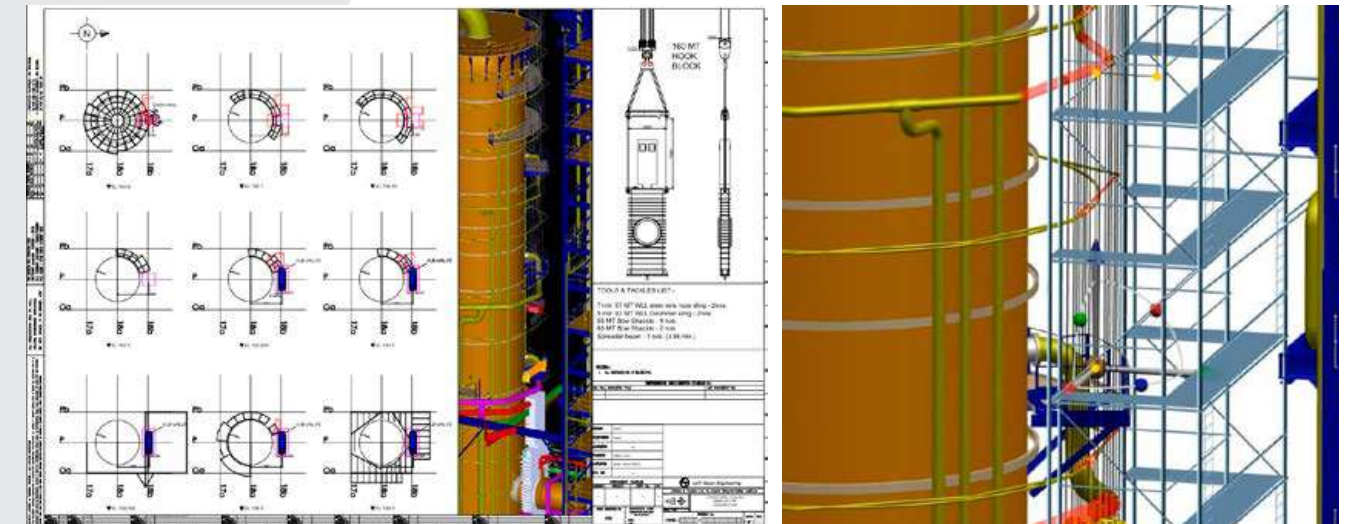
Dynamic Simulation

Dynamic Simulation is a path-planning solution used to simulate the removal, installation, and movement of equipment within complex industrial environments before actual execution. It enables engineering and construction teams to identify clashes, optimize lifting

paths, validate constructability, and reduce execution risks in brownfield and shutdown projects.

The software creates a virtual representation of the plant environment by integrating 3D models from various platforms and

allows planners to perform detailed movement simulations of equipment, modules, piping systems, and heavy lifts. This capability is particularly valuable in refinery shutdowns, revamps, and EPC projects where space constraints and existing structures pose significant challenges.



Critical Handling

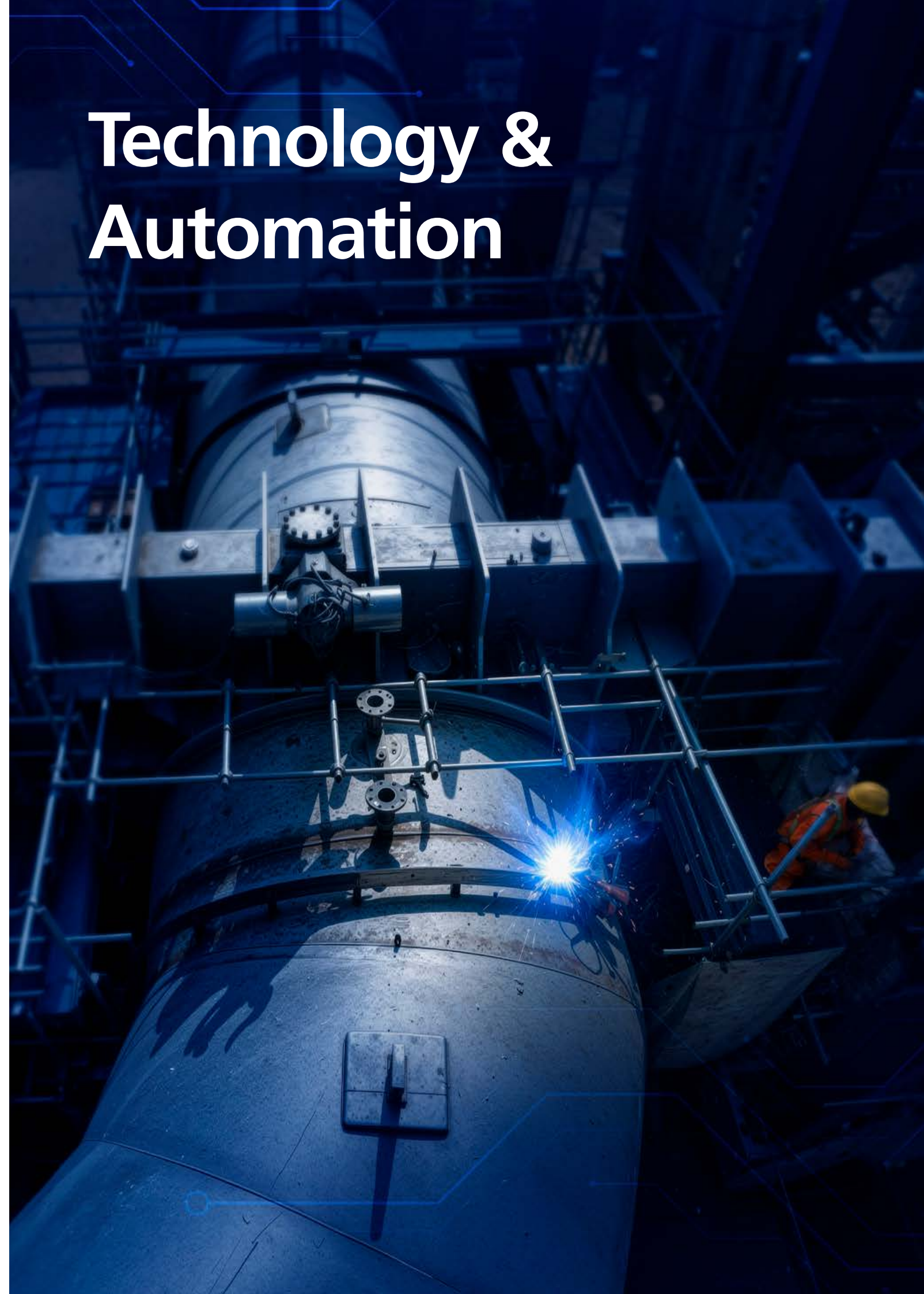
In the MRU (Modification, Revamp & Upgradation) business, Critical Handling plays a vital role in ensuring the safe and successful execution of complex turnaround, shutdown, revamp, and brownfield projects. Critical handling typically involves the lifting, transportation, skidding, positioning, and installation of heavy, oversized, or high-value equipment and components within operating or congested plant environments. Internal MRU execution guidelines emphasize identifying critical handling requirements during planning, preparing detailed handling plans, obtaining customer approvals, and validating lifting studies, load paths, crane locations, and exclusion zones prior to execution.

Given that MRU projects frequently involve critical crane heavy lifts, manual rigging, internals handling, large piping modules, slide valves, exchangers, and other critical equipment, a robust critical handling strategy is essential for achieving zero incidents, schedule adherence, and successful project delivery.

“Critical handling is not just a lifting activity; it is a key project success factor that safeguards people, protects assets, and enables safe, timely, and reliable execution of MRU projects.”



Technology & Automation



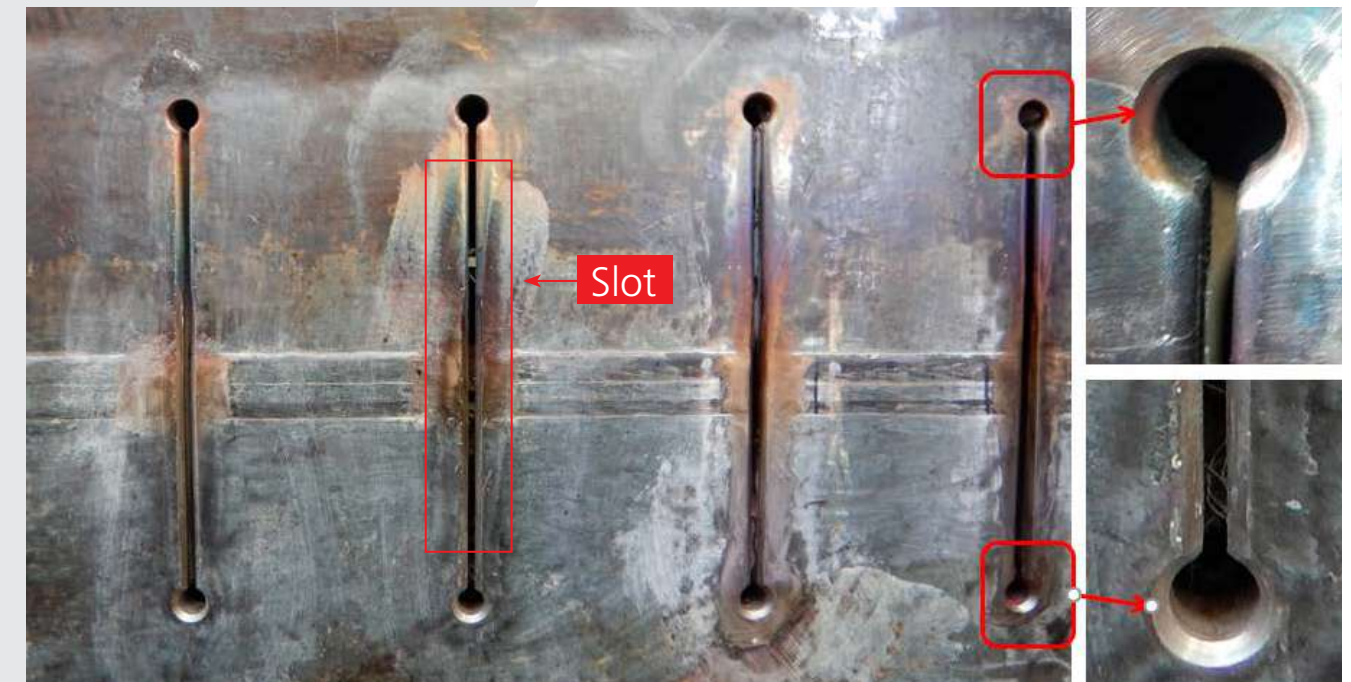
Coke Drums Skirt Slot Cutting

Coke Drums are Vertical pressure vessels installed in refineries that refine complex Hydrocarbons into lighter products, such as gasoline, diesel, and jet fuel by using heat and pressure. It Operates under severe Thermal Cyclic Conditions involving heating and quenching in a complete

cycle depending on the through put.

Earlier Coke Drum skirt was not designed to reduce or distribute thermal stresses impacting severely on equipment Life Cycle. To address this issue, Skirt is designed in latest Coke Drum with Slots near the top of

the skirt, thereby reducing the local stiffness close to the weld. Inclusion of the Slot design effectively reduces stress in the junction weld. It has also been found that the critical stress location migrates from the shell-to-skirt junction weld to the slot ends.



There have been Coke Drums already installed in Refinery for which Customers are asking to carry out necessary modifications for increased equipment life. This modification is required to be carried out in Plant Running Condition. There have been limited market Competitors available for them & L&T – MRU is one of them.

L&T – MRU has created process innovation in Coke Drum Skirt slot cutting in-situ process by developing a customized SPM (Special purpose machine) fully automatic & CNC controlled machine that can be directly mounted on the skirt. Special and customized cutting & deburring tools are used to complete the activity.

This is a complete dry cutting process without any sparks & hence No Hot work process. This modification work on Coke Drums can be done without taking any plant shutdown during the cooling cycle of the Coke Drums thereby saving huge production loss to the customer.

Coke Drum Automatic Weld Overlay System

L&T MRU is pioneer and market leader in Coke Drum repair by engaging multiple GMAW machines in series for weld overlay cladding from inside the confined space.

L&T has also obtained & holds the PATENT in India for the above process invention titled “Automated System for Weld Overlay and method thereof”

The overlay / cladding process involves deposition of Inconel 625 using GMAW temper bead technique



by maintaining constant electrode stick-out on a non-uniform bulged coke-drum shell of LAS material.

One welding operator controls two machines remotely using PLC based hand held HMI.

Piping Automation



Automation of piping welds at site remains a significant challenge due to constrained workspaces, pipe rack congestion, variable joint accessibility, and dynamic field conditions. **L&T MRU has successfully established orbital welding automation for large-bore piping** and is progressively extending the technology to small-bore piping applications.

The solution employs track-mounted orbital welding systems that maintain precise torch positioning and controlled welding parameters throughout the weld cycle, ensuring consistent and repeatable weld quality across field fabrication and erection activities.

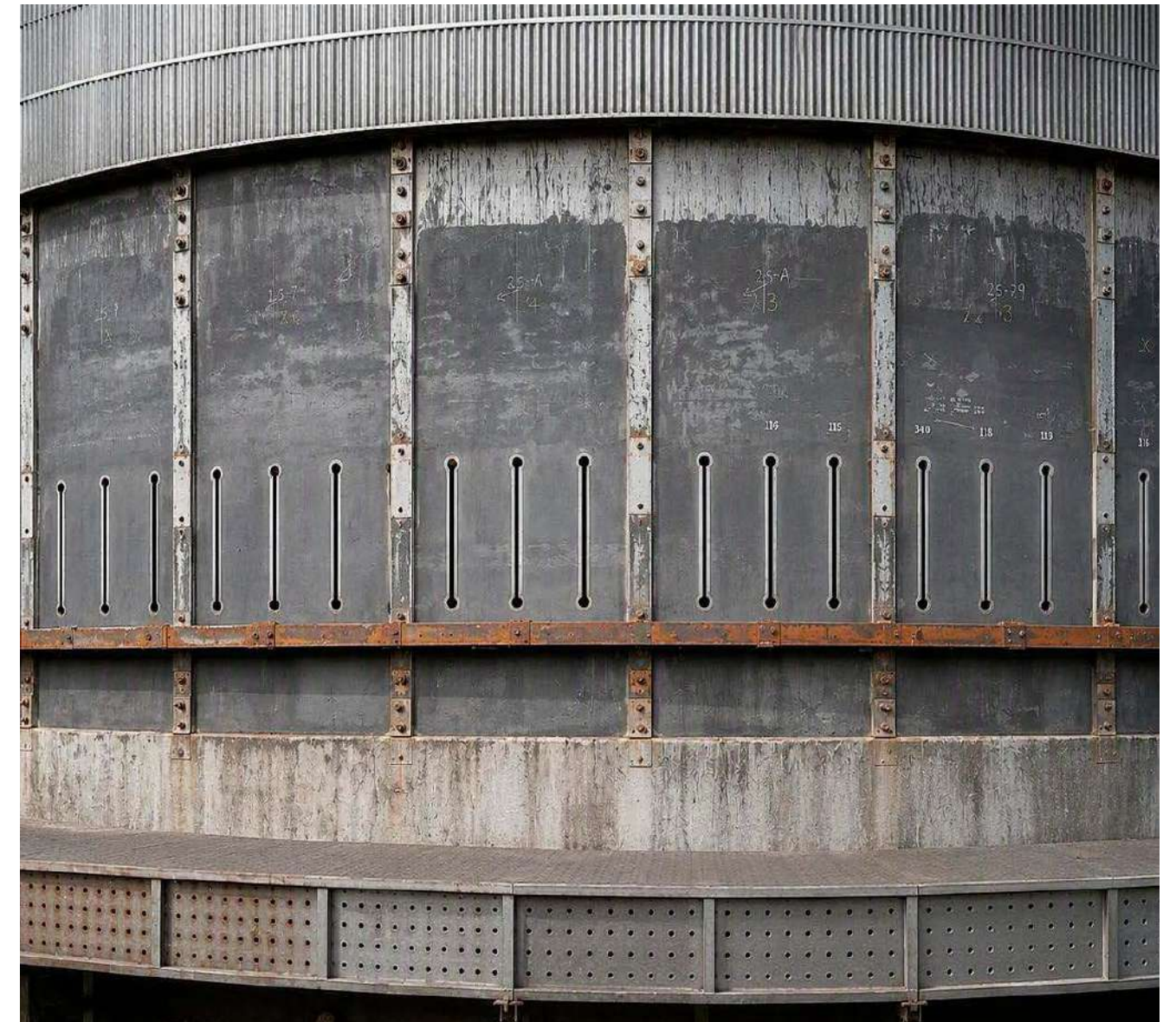
Customized automation solutions have been developed to suit challenging site conditions, including restricted clearances, congested pipe racks, and varying field configurations, enabling practical deployment of welding automation in operating and construction environments.

A highly skilled in-house piping fabrication and erection workforce complements the automation initiative, enabling effective deployment of orbital welding systems, rapid adaptation to site-specific challenges, and consistent execution of high-quality welds across diverse project environments.

By integrating automation with **digital monitoring, parameter logging, and complete traceability of welding data**, the system enhances weld quality, improves productivity, reduces dependence on manual welding skills, strengthens safety, and supports the broader objective of **digital transformation and Industry 4.0 adoption in construction welding**.



Zero Shutdown Initiatives



Coke Drum Slot Cutting for In-Operation Coker Plant

MRU's Zero Shutdown philosophy enables critical refinery modifications to be executed while the unit remains in operation, eliminating costly shutdowns and production losses. A landmark example is the **in-situ dry slot cutting of coke drum skirts** at Reliance's Jamnagar Delayed Coker Unit (DCU), completed with **zero shutdown, zero safety incidents, and zero rework**.

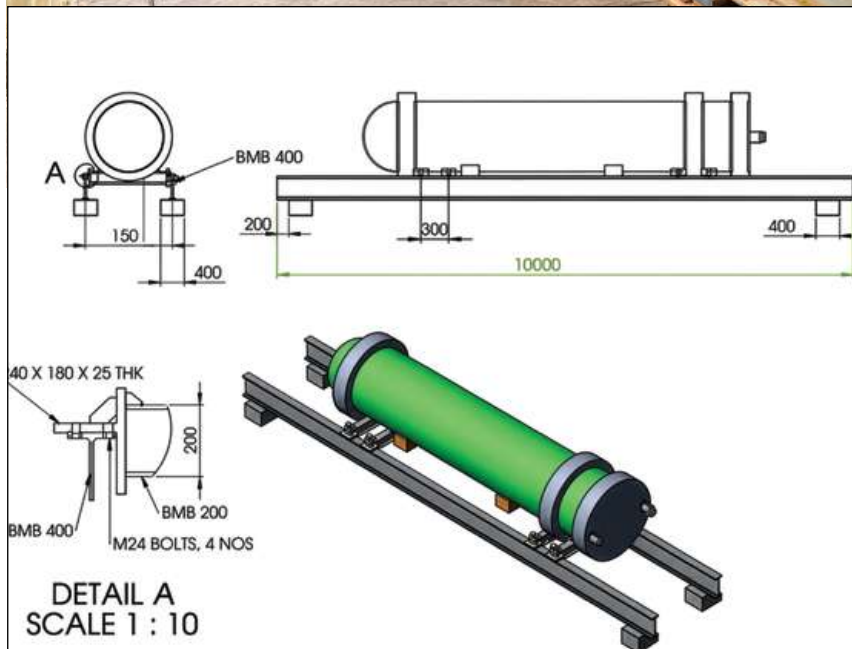
Traditionally, retrofit slot cutting requires a **25 to 30-day DCU shutdown**, resulting in substantial lost production and profit in addition to modification costs. MRU's in-service methodology eliminates this revenue loss by enabling the refinery to continue operating at normal capacity while the modification is executed.

CLIENT VALUE DELIVERED

- **Eliminates 25-30 days of potential production loss**
- **Preserves refinery revenue and profitability**
- **Extends coke drum service life with zero operational disruption**
- **Zero shutdown, zero productivity loss, zero rework**

Outcome: A proven solution that maximizes asset reliability while protecting refinery margins by converting a shutdown-driven activity into an in-service execution opportunity.

Zero Shutdown Initiatives



Key Highlight:

Engineered temporary support enabled safe exchanger modification in a running refinery, achieving approximately 91% reduction in shutdown duration.

Hot Tapping

MRU's Hot Tapping solutions help refinery, petrochemical, oil & gas, and process industry clients implement critical modifications while maintaining production continuity. By combining engineering excellence with field-proven execution, we enable plants to expand, upgrade, and modernize without disrupting business operations.

In-line Replacement of Equipment (through isolation)

Conventionally, exchanger replacement and foundation modification required approximately **33 days of refinery unit shutdown**.

L&T MRU developed an engineered temporary support system to hold the operating exchanger safely, enabling foundation demolition and reconstruction during the pre-shutdown period.

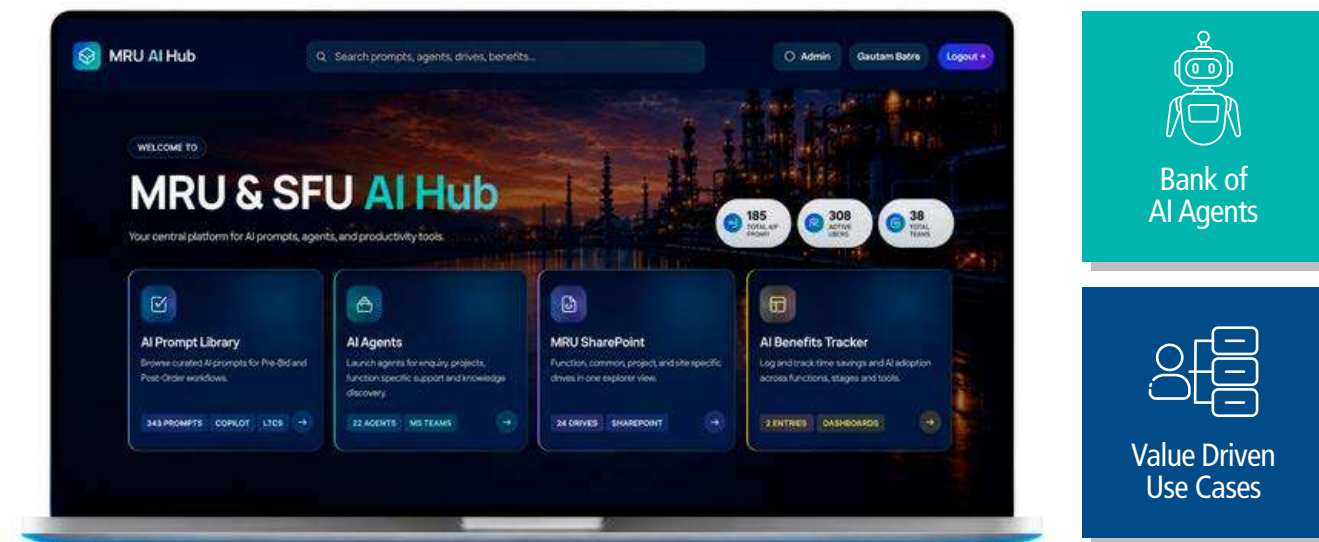
Where feasible, individual exchangers were process-isolated and modified without shutting down the complete unit. The solution was successfully implemented for multiple exchangers in the HPCL MREP project.

The methodology shifted major civil and preparatory activities outside the turnaround window, reducing the shutdown requirement from **33 days to only 3 days**.

DIGITAL & AI



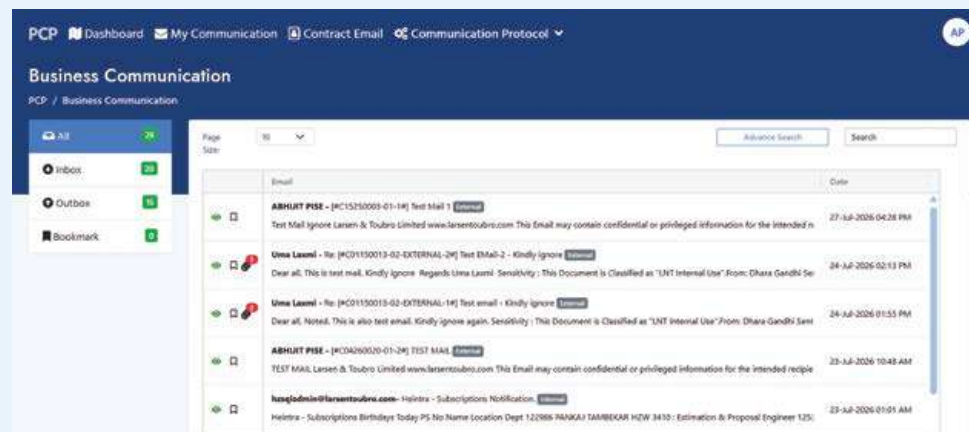
AI Adoption in MRU



PERFORMANCE. INNOVATION. SAFETY.

PROJECT COMMUNICATION PROTOCOL

- 1 Install Protocol bot in outlook
- 2 Contract Definition
- 3 Email Capture in Platform
- 4 AI Enablement Search / View



AI-Driven Project Intelligence

At MRU, we leverage Artificial Intelligence and digital technologies to enhance project visibility, accelerate decision-making, and proactively manage risks throughout the project lifecycle. Our AI-powered ecosystem combines Project AI Agents, Enquiry AI Agents, a centralized Project Data Lake, structured Communication Protocols, and AI-Based Risk Analysis to ensure that critical information is available when it is needed most.

For our customers, this translates into faster issue identification, enhanced project awareness, proactive risk management, and more predictable project delivery. By enabling teams to detect potential issues earlier, leverage insights from past projects, and respond more effectively to emerging challenges, we support safer, more reliable execution of revamp, shutdown, and brownfield projects.

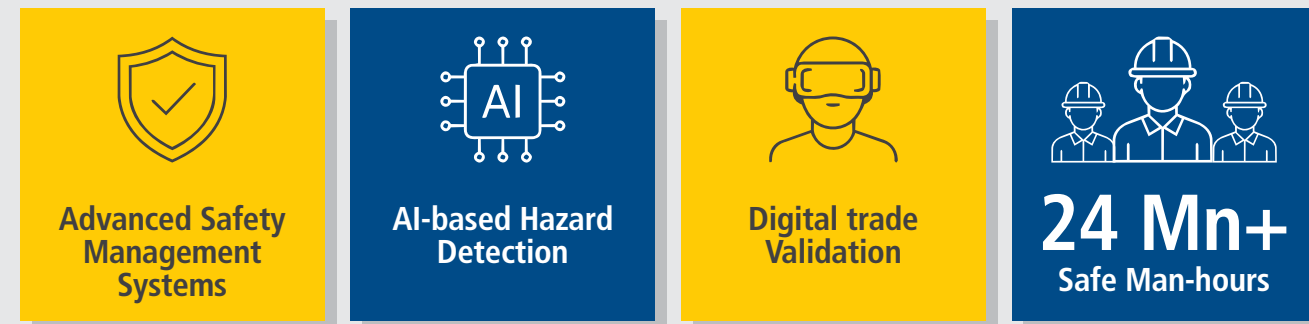
Value Creation

- Faster issue detection and resolution
- Enhanced project awareness and informed decision-making
- Better communication and stakeholder alignment
- Proactive identification and mitigation of technical and execution risks
- Faster response to unforeseen challenges & risks through AI-enabled access to a centralized knowledge repository and lessons learned from similar past projects.
- Enhanced schedule reliability and delivery predictability
- Continuous learning across projects to strengthen future project outcomes

Delivering certainty through intelligent project management and institutional knowledge.

HSE Leadership and Safety Milestones

Our “**Vision KNOW HARM**” policy, reinforced through continuous Back to Basics training initiatives, empowers every team member to perform with the highest standards of vigilance, competence, and operational excellence.



Awards & Recognitions



MRU has embraced digitalization as a key enabler for improving safety performance, workforce competency, and operational assurance across its brownfield project sites.

Digitalization in Safety at site:

AI-based safety surveillance systems deployed at high-risk activity zones provide real-time monitoring of work activities to identify unsafe acts and conditions, while digital confined space monitoring enhances oversight of personnel, worker entry / exit logs, and critical workplace conditions such as gas levels; enabling proactive intervention.

Digital Trade Validation:

The Digital Trade Validation System further strengthens workforce readiness by validating worker competencies and delivering customized trade-specific safety training modules & videos tailored to their job roles, ensuring the right safety knowledge reaches the right worker before work begins.



Sustainable Future

The MRU Business Unit remains committed to being a trusted partner for global energy companies. Through engineering excellence, sustainable practices, and technological leadership, we continue to transform legacy assets into future-ready facilities.



Together, we build reliability that lasts generations.

Manufacturing Facilities



Hazira
Area (m2): 3,600,000
Covered Area (m2): 98,500
Annual Cap. (MT): 200,000
No Size & Weight Limitation



Special Fabrication Unit
Area (m2): 111,400
Covered Area (m2): 23,200
Annual Cap. (MT) : 18,000



Ranoli
Covered Area (m2): 13,000
Annual Cap. (MT): 2,000



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L&T Modification Revamp and Upgradation

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