Refining

Your investment in safe hands
Amec Foster Wheeler

Refining

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As an EPC contractor or project management consultant, we have executed projects with a total installed cost far exceeding $80 billion.

- >40 new refining projects executed
- >200 revamps, expansions, upgrades, and turnarounds for 50 refineries in 30 countries
- >50 visbreakers
- >250 RCC/FCC residue catalytic cracking/fluid catalytic cracking projects in the last 50 years
- >80 Delayed Coking Unit licenses

4M barrels per day vacuum unit capacity designed and constructed
70 Hydrocrackers and 150 hydrotreaters in last 20 years
A complete service for refiners

Today’s refiners face many challenges: fluctuating crude prices, selecting the right feedstock, matching the product slate to the changing market demand, greater yield demands, stretched performance boundaries, tighter environmental legislation and product specification. Whatever the challenge, we can help.

We have a long and successful track record in refining, covering a broad spectrum of investments from world-scale grassroots refineries, to major expansions and revamps, complex turnarounds, refinery/petrochemicals integration, clean fuels projects to meet new legislation, residue upgrading to produce higher-value products, right through to smaller maintenance-type projects and ongoing asset support.

From studies to commissioning and beyond, we add value:

- Market analysis
- Master-planning
- Investment planning
- Licensor selection
- Feasibility studies
- Environmental consultancy
- Due diligence
- Engineering
- Front-end design (FEED)
- Engineering, procurement & construction (EPC)
- Project management
- Commissioning & completions
- Asset optimisation
- Operations & maintenance support
- Turnarounds & shutdowns
- Training

Consistently delivery of safe and successful projects for OMV resulted in the award of a five-year integrated services agreement to provide project management and EPCm services a privileged basis for the OMV refineries located in Burghausen, Germany, and Schwechat, Austria. The services include front-end loading for projects of any size, as well as EPCm services for projects up to a specified threshold limit.
Complete range of value-added services
We have a reputation for delivering high quality conceptual designs, feasibility studies and FEEDs which give our customers a robust basis upon which to take their planned projects forward.

Whether our customers are planning a grassroots refinery, upgrade, expansion or a single unit revamp, we help them shape or re-shape their project to get the ‘green light’ to proceed with their investment, developing phased investment plans, optimising the refinery configuration, and using innovation and creativity to meet objectives.

Solutions based on reality
As a renowned, experienced EPC and project management contractor, our conceptual design solutions, FEEDs and implementation plans are practical, constructable and based on real costs, real project execution experience and local knowledge.

Technical expertise
We have extensive knowledge and experience in all refining processes and technologies, including:

► ‘Open art’ units - we design units based on our own know-how
► Licensed process units such as hydrotreaters, hydrocrackers and catalytic crackers - we have strong relationships with all major process licensors
► All offsites and utility systems

Adding value at the front-end
► Market analysis in association with leading market consultants
► Master-planning & investment planning for revamps, upgrades & grassroots facilities:
  • linear programming
  • configuration optimisation
  • objective technology selection & evaluation
  • licensor evaluation & selection
  • site selection
► Conceptual plot plans
► Environmental planning & permitting
► Due diligence/plant efficiency/maintenance assessment
► Energy efficiency & integration
► Total integration of utility & offsite systems
► Hydrogen management & optimisation

Nassiriyia Refinery
Iraq
We completed the FEED for the planned 300,000 bpd New Nassiriyia Refinery, around 200 km from Basrah. The FEED was based on 27 process units, ranging from crude/vacuum distillation for the primary distillation of the crude to hydrocracking, fluid catalytic cracking and residue hydrocracking units for upgrading the atmospheric residue streams. The refinery consists of two identical trains with common process units and is designed to be capable of processing local heavy, high-sulphur crude to produce a range of products for domestic use, plus white oil products suitable for export to international markets, designed to meet both Iraqi quality specifications and Euro IV/V specifications.

STAR Refinery
Turkey
We won the FEED and PMC contracts from STAR Rafineri A, a subsidiary of SOCAR Turkey, for the new 10 mtpa Aegean Refinery to be built adjacent to the PETKİM facilities at Aliağa. We also provided the licence and basic design package for the delayed coker unit, based on our leading SYDEC(SM) delayed coking technology.
Proven EPC delivery

Our global network of operations delivers high-quality project execution, in-depth technical expertise and real local knowledge. Our customers receive the best of Amec Foster Wheeler, wherever in the world they are investing and whatever the scope and size of the project.

We have a long and proven EPC track record, ranging from huge world-scale billion-dollar investments to small projects often executed under long-term service agreements.

We invest in developing relationships for the long term, and are successfully working with customers around the world. We have a long and illustrious client list and secure significant repeat business.

The scale of some of the projects in which we are involved is truly breathtaking. Developing, managing, engineering and building complex refining projects in challenging locations is one of our key core skills. Customers trust us with their largest-ever investments and this is something of which we are really proud.

We strive continuously to improve our already very impressive safety record, achieved while executing projects in remote locations, live plant, restricted plot space and under very tight schedules. We have received over one hundred safety awards from customers, safety and industry organisations and government bodies around the world.

SONARA Limbé Refinery
Cameroon

We executed the FEED and EPCM for the modernisation project at this 50-year-old refinery. Our scope of work includes the revamp of the existing crude distillation unit, addition of a new vacuum distillation unit, new catalytic reformer unit, and power generation and associated offsites and utilities facilities. On the revamp side, the major works are in the topping unit to integrate the new pre-flash and vacuum distillation sections.

Repsol Petronor Refinery
Spain

We were the EPCm contractor for the new delayed coker at the Petronor Refinery in Bilbao, in northern Spain. This was a complex project with some unique challenges. We were able to execute it in a safe manner, receiving the maximum incentive fee for safety. The coker, based on our leading SYDEC\textsuperscript{(SM)} technology, started up successfully. This confirms that our clients can have real confidence in the successful outcome of delayed coker projects if they engage us not only to provide our leading delayed coking technology, but also to design and build the coker complex.
Delivering EPC success
Grassroots refineries, major expansions and upgrades

One of our key core skills is developing, managing, engineering, integrating and building complex refining projects in remote or challenging locations.

The first critical success factor is to shape the project in line with our customers’ objectives. This is where our proven study capability and EPC experience combine to add significant value.

We provide a full range of services to help our customers shape their planned investment to get the optimum solution, and then to develop the right execution plan to give the best chance of delivering success once the investment has been approved.

Our value-added front-end services include feasibility studies, configuration studies, technology evaluation and recommendations, risk-management assessment, global siting, financing planning, constructability reviews, asset and lifecycle optimisation, and front-end engineering.

When it comes to delivering the project in the EPC phase, we have a track record of which we are very proud. We are well-known for our project management skills, we’ve implemented innovative construction strategies, including significant modularization, and our logistics planning expertise is highly regarded.

5 PetroChina
China

PetroChina Guangxi Refinery Project (PGRP) is a world scale, world class grass roots 10MM tpy refinery project based in Qinzhou, Guangxi Autonomous Region in the Southern part of China. As the project management contractor in the basic and detailed engineering, procurement and construction phases, our team received awards for the HSE programmes that resulted in achieving 20 million man-hours without a lost time incident.

6 IOCL Paradip Refinery
India

15 million tonnes per annum grassroots Paradip Refinery, for which we completed the FEED and then worked as overall managing project management contractor and also PMC for a number of process units and the utilities and offsites facilities managed directly by the various contractors.

13 KNPC New Refinery
Kuwait

We are PMC for KNPC’s new multi-billion dollar oil refinery, which will increase country’s refining capacity by 615,000 bpd. The refinery has a strategic goal of supplying low sulphur fuel to the local power plants and will be one of the largest oil refining facilities in the world.

16 PDVSA
Venezuela

PDVSA awarded us, with our consortium partners, an EPCm contract for the El Palito Refinery Expansion Project in Venezuela. This major expansion includes new hydrotreaters, CCR reforming, a new crude/vacuum distillation unit, a new hydrogen production unit and a sulfur recovery/tail gas treatment unit, plus associated offsites and utilities. The expansion is intended to double the refinery’s capacity to 280,000 bpsd, processing heavy and extra-heavy crudes from the Orinoco Belt, and increasing production of clean fuels.
We deliver projects, from concept to commissioning and beyond.

For any development, we start adding value from day one, helping our customers to evaluate the opportunity, screen options, select the right option, and then realise the revenue as quickly as possible.

We deliver value at the front end, then can bring our global EPC skills and experience to bear, developing the right execution strategy, and then delivering on time, safely, cost effectively, and right first time. Right through the life of your asset we can provide the right support, from turnarounds and brownfield projects through to long term asset support, performance improvements, through to asset conversion, closure and remediation.

Consultancy services

- Environmental
- Marine and coastal
- Geotechnical
- Permitting and regulatory
- Community and social affairs
- Water and wastewater
- Transportation

Project delivery

- Feasibility studies, concept and pre-FEED
- Cost and schedule planning and control
- Technology integration
- FEED design
- Engineering and procurement
- Fabrication and construction
- Project management
- Start-up and commissioning
Amec Foster Wheeler has an outstanding track record in executing refinery projects, from world-scale grassroots refinery complexes, to major expansions and revamps, complex turnarounds, refinery/petrochemicals integration, clean fuels projects to meet new legislation, residue upgrading to produce higher-value products, right through to smaller maintenance-type projects and ongoing asset support. We also have over a century’s worth of fired heater experience.

Asset management

- Due diligence and site assessments
- Asset integrity and optimisation
- Operational readiness and implementation planning (OIP)
- Operator training, systems and management
- Operations & Maintenance term services
- Brownfield upgrades and expansions
- Shut-downs/ turnarounds
- Dutyholding
- Late life management
- Mothballing and decommissioning
Integrating refining and chemicals production delivers benefits:

► Economies of scale and the opportunity to share facilities
► Adds value to refinery streams
► Diversification
► Allows processing, offsite and utilities to be fully optimised across the whole integrated complex

We have extensive experience in refining, chemicals and their integration:

► Our study and concept design capability adds real value in helping our customers select the right configuration and processes
► These are often very complex facilities, which play to our strength in designing and building large and challenging projects

We have been involved in some of the world’s largest refinery/petrochemicals projects:

► ExxonMobil’s second petrochemical project in Singapore
► Shell Eastern Petroleum, Singapore
► Petro Rabigh, Saudi Arabia
► Nizhnekamsk, Tatarstan, for Tatneft
► Nghi Son, Vietnam

Petro Rabigh (Saudi Aramco/Sumitomo Chemical Co.)
Saudi Arabia

We were awarded the overall FEED and project management, and EPC of the utilities and offsites for this prestigious project at Rabigh, one of the largest integrated complexes ever to be built at one time.

Nghi Son Refinery
Vietnam

EED for the 200,000 bpd Nghi Son Refinery and Petrochemical project, designed to process Kuwaiti crude, and comprising a fuels refinery based on residue hydrodesulfurization feeding a residue catalytic cracker integrated with petrochemical production. The complex includes 30 process units, many of which are licensed technology.
Onsan Refinery viewed from the Port of Ulsan, South Korea

Adding value to refinery streams
Residue upgrading

Residue upgrading can enhance refiners’ margins by:

► Converting low-value residues into higher-value fuels
► Processing lower-cost higher-sulphur heavier crudes

We are experienced in all residue upgrading technologies. In fact, we believe we have world-leading expertise and world-leading technology.

We own state-of-the-art proprietary technology for delayed coking, and also offer solvent deasphalting and visbreaking jointly with UOP.

Our SYDEC℠ delayed coking technology is the market leader, achieving maximum clean liquid yields and minimum fuel coke yields. We have supplied our delayed coking process technology worldwide for more than 80 new cokers, including some of the largest in the world, and have executed more than 70 delayed coker revamps.

We also offer state-of-the-art hydrogen technology based on our Terrace-Wall™ steam reformer to provide the hydrogen that residue upgrading and projects to produce cleaner fuels will require, to enable products to meet latest specifications.

BP Products
Whiting Refinery, USA
Engineering, procurement, fabrication and construction management for a large coker project, a key part of an upgrade, to allow the refinery to process Canadian heavy crude and increase its motor fuels production.

S-OIL
South Korea
FEED for a residue upgrading project at S-OIL Corporation’s world-scale Onsan refinery in Ulsan, South Korea. Our specialist consultancy group performed the pre-FEED, with our execution centres in the UK and Thailand working together on the FEED. The upgrade of the refinery includes the addition of a residue hydrodesulphurisation unit, a residue fluid catalytic cracker, and multiple downstream upgrading units to enable the refinery to produce more higher-value products and, in particular, maximise production of polymer-grade propylene.

Duqm Refinery
Oman
FEED for Phase 1 of the Duqm Crude Oil Refinery and Petrochemical Complex. Phase 1 comprises the development of a grassroots refinery with a planned processing capacity of 230,000 barrels per day of crude oil. Our FEED includes the design of the crude distillation/vacuum distillation unit, sour water strippers, amine units, and offsite and utility systems, and the management of four licensors who are developing process design packages for licensed units.
Clean fuels

We are a leader in designing and implementing solutions to meet current and future clean fuels regulations that now face refiners around the world, in their domestic markets and their export markets, including government mandates on the sulphur, aromatic, and oxygen content of fuels.

The need to consider current and future fuels specifications will figure in many planned refinery investments. Whether a new refinery, upgrade, expansion or specific clean fuels project, we have the expertise and experience to help our customers find the right solution.

We have extensive experience in all aspects of clean fuels projects, from investment planning and phasing, selection of technology, through to design and EPC. We have been involved in clean fuels projects since the first clean fuels specifications were introduced and have implemented a wide range of innovative execution strategies to help our customers produce cleaner fuels in line with their targets.

With so many clean fuels projects ‘under our belt’ we have developed an in-depth knowledge of the available technologies. And we continuously update this knowledge, through our close relationships with technology licensors and catalyst suppliers, keeping abreast of latest development in technologies and catalysts.

Our customers can benefit from the learning we’ve gained in developing and executing clean fuels projects around the world.

Kuwait National Petroleum Company
Clean Fuels Project, Kuwait

Project management and consultancy services for KNPC’s clean fuels project in Kuwait. Major upgrade and expansion of the Mina Al-Ahmadi and Mina Abdullah refineries to increase their combined throughput by 264,000 bpsd to 800,000 bpsd, increasing conversion of fuel oil to higher value products to meet market demand and tighter sulphur specifications.

Hellenic Petroleum
Greece

We have enjoyed a long-term relationship with this customer, for whom our work includes detailed engineering and construction management for upgrading of the FCC and CCR at the Aspropyrgos refinery, FEED and basic engineering for the upgrade of the Elefsina refinery to eliminate heavy fuel oil, and EPCM and commissioning management for a major upgrade of the Thessaloniki refinery to produce low sulphur fuels.

Ecopetrol Barrancabermeja Refinery
Colombia

FEED and owner’s PMC for major upgrade to achieve deep conversion for processing domestic high sulphur heavy crude, to increase production of distillates, to eliminate fuel oil production, and to produce clean fuel. New units include a Foster Wheeler SYDEC(SM) delayed coker.
Hydrogen

With increasing demand for diesel, increasingly stringent product specifications for cleaner fuels, and reduced fuel oil demand, the demand for hydrogen in refineries continues to grow.

We can provide:

► Methodology for establishing the best route for increasing hydrogen production/recovery
► Possible revamp options for existing hydrogen plants
► Options for new hydrogen production units

We recognize that refiners do not want to invest in new hydrogen plants if they don’t need to. So we can help establish whether increased hydrogen demand can be met by using existing spare capacity or through relatively small revamps.

If a new plant is needed, we can provide leading hydrogen generation technology using our Terrace-Wall™ steam reformers.

This design offers key benefits:

► Modular radiant section capability reducing site construction time and cost
► Can operate in natural draft mode
► Steam reformer outlet temperatures up to 920°C can be used with heat fluxes above 100,000 kcal/hr m²
► Very compact design
► Minimum number of low-NOx burners
► Operating, investment and maintenance cost savings

We have designed, engineered and constructed over one hundred hydrogen and synthesis gas plants with a total installed capacity of over three billion scfd.

Confidential Client
Russia
BEDP of hydrogen production unit, incorporating 135 mmscfd from steam reformer plus 30 mmscfd from an additional PSA unit.

Nghi Son Refinery
Vietnam
Won contracts for the licence package for the hydrogen production unit and two Terrace Wall™ hydrogen reformers for the Nghi Son Refinery and Petrochemical complex. The reformers will be designed to be capable of producing a combined total of 145,000 tonnes of hydrogen per annum.

Confidential Client
South America
FEED and PMC for refinery upgrade, including two hydrogen trains, each 110 mmscfd, using natural gas feed.

OJSC ‘Oil Company Alliance’
Khabarovsk Refinery, Russia
Technology licence and BEDP for a 27 mmscfd mixed feedstock plant.

BOC Gases
Teesside, UK
Full FEED and EPC scope and Terrace-Wall™ reformer supply for a 36 mmscfd plant.

Jizan Refinery
Saudi Arabia
Our proprietary hydrogen production technology was selected by Saudi Aramco for its Jizan Refinery. We supplied a licensed process design package, which is based on two hydrogen production trains, each with a design capacity of approximately 92,000 normal cubic metres per hour (Nm³/h). Based on our steam methane reforming technology, the unit’s overall design capacity will be approximately 364,000 Nm³/h, and includes a pressure swing absorption unit for the treatment of the oloffgas from the continuous catalytic regeneration unit.
**Turnarounds & FCC revamps**

**Turnarounds**
We aim to deliver the shortest possible, safe turnaround, either by managing an entire operation or working as part of an integrated team. Our extensive experience in planning and implementing these difficult operations and our ability to react quickly and manage emergent work allows our customers to meet the toughest schedules and budgets while never compromising on safety. We have extensive experience in undertaking associated revamp work for turnarounds from study through to EPC.

**FCC Revamps**
Since 1980, Amec Foster Wheeler has undertaken well over 200 fluid catalytic cracking (FCC) projects for over 40 refineries in 24 nations. We understand the technologies and deliver real solutions. Our technology specialists are fully supported by the skills and resources of our global organisation, providing a complete ‘one stop shop’ for any FCC project.

**Sarpom FCC Turnaround**
*Italy*
Challenging and very intricate FCC turnaround including replacement of reactor and 200-tonne regenerator heads on a structure with just a few centimeters of clearance.

**Essar Refinery**
*UK*
We developed the concept, completed the design and oversaw the manufacture and delivery of the new regenerator head and cyclones for the FCC refurbishment at Essar’s Stanlow Refinery. We also supported Essar with transportation and lifting of the new and existing equipment on site by a specialised heavy lift contractor.

Planning for the FCC turnaround started four years before the new head and cyclones were delivered to site. This meticulous planning paid off, with the 450-tonne unit, the world’s largest transported regenerator head and cyclone assembly, was lifted to 70 metres above the ground and into its final position in just over three hours!

**SAMREF Refinery**
*Saudi Arabia*
We have been supporting the SAMREF refinery at Yanbu with their turnarounds over many years, since the mid1990s, providing a range of services, including FEED and engineering, procurement and construction planning services.

**Lukoil-Neftochim FCC Revamp**
*Bulgaria*
Detailed design for revamp and modernisation of the FCC unit at Bourgas refinery, to increase processing capacity from 1.7 million t/y to 2.0 million t/y. Scope included supply of main equipment, new state-of-the-art control system and construction supervision. We also supplied a 65 MW crude fired heater at the same site.

*Image: courtesy of ESSAR*
Amec Foster Wheeler (www.amecfw.com) designs, delivers and maintains strategic and complex assets for its customers across the global energy and related sectors.

With pro-forma 2014 scope revenues of £5.5bn and over 40,000 people in more than 55 countries, the company operates across the whole of the oil and gas industry - from production through to refining, processing and distribution of derivative products - and in the mining, clean energy, power generation, pharma, environment and infrastructure markets.

Amec Foster Wheeler shares are publicly traded on the London Stock Exchange and its American Depositary Shares are traded on the New York Stock Exchange. Both trade under the ticker AMFW.

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