KBR DELIVERS INNOVATIVE AND COST-EFFECTIVE
REFINING TECHNOLOGY SOLUTIONS THAT HELP
OPERATORS STAY COMPETITIVE

Refinery owners continue to confront many challenges — rising feedstock prices, shrinking margins, varying global demand, a changing regulatory landscape including ever more stringent specifications for product sulfur content and carbon footprint, and competition from around the globe.

As refinery owners debottleneck and enhance existing facilities, they call on KBR Technology to deliver. Our state-of-the-art technologies, coupled with our extensive experience in refining processes, continue our long-standing commitment to deliver leading-edge, cost-effective solutions for diverse refining needs in every market, every day.

KBR delivers world-class results to the petroleum refining market. Our business as a process developer and licensor, in addition to our widely acclaimed project delivery capabilities, has resulted in licensing, designing or constructing more than 60 greenfield refineries and well over 1000 refining units of every type and size around the world. Our licensed technology is found in more than half of the world’s FCC units, an overwhelming majority of resid upgrading units and more than 100 hydroprocessing units. Our emphasis on heavy oil upgrading, improving the bottom-of-the-barrel material, producing clean fuels, and providing a wider range of operating flexibility to refiners makes KBR a clear partner in any refining challenge. From grassroots design to revamps, no job is too large or too small. We know refining, and we know how to make refining make money.

In addition, KBR Automation & Process Technologies (APT) delivers services such as Operator Training Simulators, Advanced Simulation services and Operations Management Systems including Maintenance and Reliability to improve plant operations.

KBR also provides comprehensive technical services for all its technology segments including refining to allow refiners to maximize their return on investment throughout all asset life stages.
Refining Technologies

**BOTTOM-OF-THE-BARREL AND RESIDUE UPGRADING SOLUTIONS**

Refiners globally are looking into options for reduction of heavy residues or elimination all the way to a “bottomless” refinery, resulting in strong demand for bottom-of-the-barrel technologies.

- **ROSE®** – Residuum Oil Supercritical Extraction (ROSE) solvent deasphalting technology recovers high-value products from residue streams that would otherwise be lost to low-value fuel oils. ROSE uses up to 60% less energy with supercritical solvent recovery and specially designed heat recovery exchangers.

- **VCC™** – Veba Combi-Cracking (VCC) technology was developed through decades of research and innovation, resulting in this unique solution capable of processing a variety of feedstocks — from refinery residues to coal. With 95% conversion in a single pass, VCC enables production of fuels that meet environmental specifications without further upgrading.

- **AiMS™** – Asphaltene integrated Management Solution (AiMS) offers the opportunity to solidify the asphaltene removed in the ROSE process for easier handling and sales.

- **Resid FCC** – Fluid Catalytic Cracking (FCC) technology is based on decades of continuous improvements and broad commercial experience and can be designed specifically to handle heavier residues for upgrading into valuable components.

**CLEAN FUEL AND HIGH-OCTANE SOLUTIONS**

Global demand for motor fuels continues to rise to record levels, while stricter environmental standards and oxygenate blend requirements for gasoline place a premium on clean-burning, low Reid Vapor Pressure components.

- **K-SAAT™** – A safer, low-cost alternative for high-quality alkylate production, featuring a revolutionary solid-acid catalyst engineered to provide stability and robustness and maximize the yield of motor fuels and enhance the production of high-octane, ultra-clean blendstock.

- **MAX-ISOM™** – The technology of choice produce high-octane isomerate free of benzene and other aromatics, oxygenates and olefins from a C₄ – C₇ feedstock. Features a flexible and energy-efficient catalytic distillation column design that isomerizes n-paraffins, separates the iso-paraffin products and efficiently recycles unconverted n-paraffins within the same column.

- **NExOCTANE™** – A proven technology for dimerization of isobutylene to iso-octene and hydrogenation to iso-octane. Produces clean-burning, non-aromatic hydrocarbons with premium octane values from a wide variety of C₄ feedstocks at minimum costs.

- **NExTAEE™ & NExTAME™** – The optimum process technologies for producing fuel ethers from C₆–C₇ tertiary olefins, combining fixed-bed reactors with a distillation column to reach extremely high conversion rates.

- **NExETHERS™** – Combined ethers technology capable of processing any olefinic hydrocarbon feed in the C₄–C₇ range to produce MTBE, TAME and heavier ethers.

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**Refining Process Overview indicating KBR-licenced technology**

[Diagram showing the refining process with various streams and technologies, indicating KBR-licenced technology.]
PETROCHEMICAL INTEGRATION AND OLEFINS PRODUCTION

Petrochemical demand is expected to outpace growth in traditional fuels demand in the decades ahead. Refineries can benefit from increased production of naphtha—a main feedstock for the production of olefins and aromatics—attractive margins and price stability from increasing yields for ethylene, propylene and aromatics.

- **MAXOFIN™** – This Dual-Riser FCC process enables refiners to maximize propylene production by 20% or more with significantly less ethylene than traditional steam cracking, with flexibility to operate as a conventional FCC to produce Fuels (gasoline, LCO etc.), depending on changing market demands.

- **K-COT™** – Catalytic olefin technology converts low-value olefinic, paraffinic or mixed streams into high-value propylene, ethylene and aromatics through the combination of the KBR Orthoflow™ FCC converter and a proprietary catalyst, and offers feed flexibility, high yields, low maintenance and greater energy efficiency.

- **AED-BTX Process for Aromatics Recovery** – An extractive distillation process for the recovery of aromatics that does not require any proprietary solvents or additives. It offers lower CAPEX and OPEX, smaller plot space, reduced energy consumption and wider feedstock range compared to conventional liquid-liquid extraction processes. Can be integrated into refining and petrochemical operations.

FCC TECHNOLOGIES

Modern refineries are focused on expanding their conversion capacities. The Fluid Catalytic Cracking Unit (FCCU) is important because it converts larger, heavier molecules into smaller, lighter valuable molecules like gasoline, distillate and olefinic gases. KBR has been on the forefront of FCC developments since the 1940s and continues to provide a wide array of proprietary and specialized solutions for refineries worldwide.

- **Orthoflow™ FCC/Resid FCC** – KBR delivers a portfolio of FCC solutions to meet refiners’ specific production goals, with flexibility in order to adjust their product mix according to market conditions. We offer FCC options for increasing propylene production, maximizing diesel production, minimizing environmental issues, processing low value residue streams and processing bio-feed and other non-traditional feed stocks.

- **MAXDIESEL™** – Flexible, cost-efficient FCC solution repurposes existing FCC units to increase diesel yields with a reduced capital investment. Turns high-quality, light-cycle oil into higher cetane products while offering the flexibility to revert to maximum octane barrels or maximum liquefied petroleum gas.
Refining Technologies

HYDROPROCESSING SOLUTIONS

Hydroprocessing technologies include a wide array of hydrogenation, hydrocracking and hydrotreating solutions that can be found in all major refinery product streams. They are based on the use of hydrogen to remove impurities, resulting in cleaner products, or to break down carbon-carbon bonds, resulting in shorter, more valuable molecules.

- **Hydrotreating** – Shell Global Solutions’ hydrotreating process, licensed by KBR, combines advanced process technology, high-performance catalyst systems and efficient internal reactor designs. Oil fractions react with hydrogen with a catalyst to produce high-value, clean products. Available in several configurations, including for hydrotreating of naphtha, kerosene, diesel and VGO.

- **Mild Hydrocracking** – Shell Global Solutions’ hydrocracking technology, licensed by KBR, processes a wide range of feed qualities at different conversion levels, while meeting stringent fuel quality regulations. Heavy gas oil fractions are partially converted to produce high-quality middle distillate products, while the unconverted fractions are used as pretreated FCC or ethylene cracker feedstocks, or lubricant base oils.

- **Full Conversion Hydrocracking** – Shell Global Solutions’ hydrocracking technology, licensed by KBR, maximizes premium diesel production from a wide range of feedstock qualities. We offer both single- and two-stage designs, with each tailored to the type of feedstock, the capacity of the unit and the specific processing objectives to help optimize both capital and operating costs.

HYDROGEN

For more than 60 years, KBR has used catalytic steam reforming to manufacture hydrogen, ammonia, methanol, syngas and HYCO (hydrogen and carbon dioxide). We have provided design and construction services for more than 34 low-energy, low-cost refinery hydrogen plants using the KBR top-fired Steam Methane Reformer (SMR), the KBR Reforming Exchanger System (KRES™) and KBR Autothermal Reformer (ATR).

DISTILLATION CAPACITY

Distillation construction Distillation capacity controls the overall refinery throughput potential. Distillation is the separation of crude oil into different products based on their physical properties, like boiling point.

- **DISTILL-MAX™** – Advanced distillation configuration combines two distillation columns within a single shell to enable three or more products to be separated from a feed stream, offering superior fractionation performance and enhanced separation efficiency.

- **Crude and Vacuum Distillation** – Shell Global Solutions technology, licensed by KBR, can help refiners improve their distillation performance and debottleneck their operations through the licensing of bulk crude distillation units, high-vacuum units, work-up sections for upgrading units and column and vessel internals.