

# Energy, Petrochemicals and Chemicals

Serving the entire value chain



**KBR**



**For more than 90 years, we have worked side by side with clients the world over to meet project objectives and help them succeed**

# The Right Partner for Your Business Critical Energy Projects

High demand, record prices, resource shortages, geopolitical uncertainty, the growing complexity and rising costs of projects – navigating the challenges of today’s energy landscape takes more than knowledge and hard work. It takes the right kind of partner.

KBR is one of the world’s largest and most diverse providers of engineering, procurement, construction, commissioning and start-up (EPC-CS) services, process technology, consulting and industrial services to the energy, petrochemical and chemical industries. For more than 90 years, we have worked side by side with clients the world over to meet project objectives and help them succeed.

Our experience spans the entire range of the energy services cycle – from field development planning and feasibility studies, to engineering, construction and project management to on-site plant operations and maintenance – on some of the biggest energy projects on land and offshore.

These efforts are backed by the full force of a global organization of more than 50,000 employees in over 45 countries and six business units. Four of these business units - Upstream, Downstream, Technology and Services - serve clients in the energy, petrochemical and chemical industries. What this means to you is a deep reservoir of talent, resources and experience across our business that can respond quickly and effectively to your project requirements. When there’s a job to be done and there’s no margin for error, you can trust KBR to deliver.





On the Tangguh LNG project in the Papua region of Indonesia we achieved more than 30 million construction work hours without a lost-time incident with a workforce of 9,000 that included around 600 local Papuan villagers and 2,700 regional Indonesian laborers.

# Providing Solutions to Business Challenges

Value for service is a foundation of every business transaction. At KBR we define it as doing what it takes to ensure your project's success. In a market of tight resources and record demand, that means delivering projects that meet your requirements for schedule, cost efficiency, ongoing operating performance, as well as your health, safety, environment and sustainable development commitments.

## Creating Safe, Productive Workplaces

Health, safety and environment (HS&E) performance is a critical factor that can greatly impact a project's success. Poor HSE performance can cost you time and money and damage your company's reputation.

With one of the best safety records among EPC contractors, KBR has developed a

system of HSE standards and best practices that enables us to safely deliver your projects – whether it's a small capital construction project or a mega project with workers from all over the world speaking a multitude of languages.

## **KBR's single-minded dedication to HSE has earned KBR numerous awards from clients and leading industry organizations for outstanding safety performance and best practices, including Most Outstanding Multinational Contractor in 2006 and 2007**

KBR has also attained numerous ISO 9001, ISO 14001 and OSHA's 18001 certifications for individual facilities signifying our commitment to quality, environmental and safety management. In addition, KBR is one of the first engineering, procurement and construction companies to achieve Global Integrated Certification in Quality, Safety and Environment by a third-party certifying and accreditation agency for all KBR operating centers around the world.



KBR's commitment to HSE is a core value that pervades every level of our organization. Our goal on every project is zero incidents and we work hard to achieve that aim. In the last three years we have lowered our recordable incident rate from .39 in 2005 to .25 in 2007. During the same period, our lost time incident rate was reduced from .05 to .02.



Nigeria LNG Train 6 is the 4th EPC project KBR and its partners have executed for Nigeria LNG, which was completed with an excellent safety and quality record in just less than 41 months from contract award to ready-for-start-up. The project recently achieved 10-million man hours without a lost time incident.

## The Right People with the Right Skills for Your Project

More than ever, the scale, financial investment and technical demands of your projects require the right experience to achieve your financial and performance objectives. KBR employs a global workforce of some of the best and brightest minds in the engineering and construction industry to provide solutions and help to ensure

the success of your project. This includes over 700 chemical engineers and more than 600 engineers with masters and PhDs in a wide range of disciplines – civil, electrical, mechanical, chemical, petroleum, environmental, structural, metallurgical, marine, ocean, agricultural, material sciences and water resources.

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## Partners in Sustainable Development

The phrase “work globally, think locally” has taken on new significance for most companies in this time of growing globalization. KBR has a long history of developing programs that help our clients meet their environmental, social and local content commitments.

Beginning in 1983 on the National Fertilizer Company of Nigeria (NAFCON)

ammonia plant project, KBR established a methodology for recruiting, training and developing local workers. While each project and client has its own unique requirements, we have successfully employed variations of this methodology on projects in far-flung places such as from Nigeria to Malaysia, Azerbaijan and Brazil. We use a similar approach to identify promising local suppliers.



As contractor on the Nigeria LNG project since 1995, the KBR has helped train more than 15,000 workers on Bonny Island. Our partnership with NETCO, Nigeria's first national engineering company, has evolved into a relationship that benefits NETCO, KBR and the country of Nigeria. The work sharing arrangement has expanded to other projects, including more than 300,000 man hours on the Abgami FPSO project. In 2006, KBR also opened an office in Lagos, Nigeria to deliver work and maintain local content capabilities.



On the massive ACG phased development project located in the Azerbaijan sector of the Caspian Sea, KBR evolved a tightly coordinated “production line” approach for the six platforms. By coordinating the design, fabrication and installation schedules and interfaces and incorporating lessons learned, we achieved significant reduced cycle time to first oil for our client and delivered predictable outcomes of CAPEX, schedule and ongoing operability.

# Delivering Complex Projects in the Toughest Places on Earth

Helping clients economically execute complex oil and gas production facilities has been a KBR specialty for more than 60 years. Since then, we have been unsurpassed in our ability to deliver large-scale technically complex onshore and offshore facilities, floating solutions and subsea installations and pipelines in all regions of the world and the most difficult places on the planet: in the Arctic, landlocked seas, equatorial forests, the Sahara desert and in ultra-deepwater fields.

## Upstream Oil and Gas Production Facilities

Executing large-scale, challenging hydrocarbon projects in today's high-demand, resource-constrained environment requires a rare combination of people, skills and proven systems and processes.

At KBR, we provide a complete range of services to deliver the most efficient, cost-effective and environmentally safe projects – from consulting, through engineering, procurement, construction and program management - for the entire spectrum of hydrocarbons production facilities onshore and the offshore shallow water and the

offshore deepwater markets. We are constantly challenging ourselves to find better and more cost-effective ways to do it. Our extensive EPC experience in lump sum and reimbursable contracts and subcontracts management enables us to add value at every phase. Whether identifying the best conceptual solutions, developing cost-effective designs, or providing procurement, logistics, construction and support strategies to overcome location and schedule obstacles, KBR helps our customers derive the greatest value from their assets.

**KBR is a world leader in floating, production, storage and off-loading vessels (FPSOs), designing nine of them and performing the front-end engineering and design on several others**



The world's largest FPSO, Agbami off the Nigerian coast, is a floating factory: 13 interlocking modules with production trains capable of processing a quarter-million barrels of oil and nearly half a million cubic feet of gas a day. Storage capacity of more than two million barrels allows the Agbami to collect several days of production from 36 subsea wells, 4,700 feet below the surface before offloading. KBR completed the design, engineering and procurement support for the topsides in only 12 months.



To achieve SEGAS LNG's record-setting delivery of 35 months from EPC award to ready for start up, KBR drew on three decades of LNG EPC experience, devising innovations in global design execution, procurement and logistics. The largest LNG train in operation since start-up in late 2004, SEGAS is one of the most cost-effective LNG plants in the world, with a compact, elegantly simple design that lends itself to greater ease of operation and maintenance.

## Gas Monetization

With the enormous escalation in the cost, complexity and risk involved in building new liquefied natural gas (LNG) facilities, the ability to deliver technically challenging projects on schedule in difficult environments is absolutely critical. KBR and our joint venture partner JGC have one of the longest and most successful LNG track records in the industry. We are also establishing ourselves as leaders in the technically challenging GTL market, where the magnitude of the projects - from \$12 billion to \$15 billion, with a peak construction workforce of 30,000 to 50,000 - is changing the face of EPC execution.

## Setting New Standards with Pearl GTL

KBR is currently executing the two largest GTL projects in the world: Pearl in Ras Laffan, Qatar, which has a capacity to produce approximately three billion barrels of oil equivalent per year; and Escravos in Escravos, Nigeria with an eventual capacity of 120,000 barrels per day.

Since 1976 we have built LNG plants that currently provide 56 percent of the total LNG production, and we have executed more than half of the existing LNG

receiving terminals outside of Japan.

During this time we have set new standards for design, train size and delivery. We have also worked with our clients to benefit the local community surrounding our projects by building roads, power facilities, hospitals and schools and trained local workforces, equipping them with skills that will benefit their countries for years to come. Customer loyalty and repeat business is one of KBR's biggest success stories, and an affirmation of how we do business.



Bintulu, Malaysia is the site of Malaysia LNG, the world's largest LNG plant. KBR has operated here continually since building the first train more than 20 years ago through the recently completed third expansion phase TIGA. The entire time KBR has maintained a close relationship with the client and the people of the community, training and fielding an increasingly nationalized work force and setting safety milestones – including 50 million man-hours without a lost time incident on MLNG TIGA.



More than 50 ROSE units have been licensed, with an average on stream factor of 95 percent. KBR is also pioneering a ROSE in the field application that reduces transportation costs from the wellhead.

# High-Value Solutions for Maximizing Hydrocarbon Assets

Today's refineries and petrochemicals plants are under increasing pressure to improve margins and profitability in the face of a dwindling supply of quality crudes and stringent environmental regulation. Continuous improvements have made KBR downstream technologies industry leaders in long-term reliability, superior operability and lower installed cost.

We support these technologies with global EPC-CS and project management resources that can execute a safe, reliable plant. Our Canadian operations supply construction, turnaround, pipe fabrication and modular services to the country's leading refining and petrochemical operators. We also offer a full spectrum of on-site maintenance and turnaround services to our North American and international clients that help combat the rising cost of plant upkeep and maintenance. With innovative management systems and a database of more than 19,000 skilled employees that can be deployed worldwide, KBR can maintain your facility in peak operating performance.

## Solving problems and saving money for clients is one of the reasons KBR's facilities services teams have average tenure of over 17 years at existing projects

### Refining

With rising feedstock costs and the need to process greater quantities of heavy oil and convert challenge crudes into high-value transport fuels squeezing margins, refiners are being tested like never before.

A leader in petroleum refining for the past 50 years and a specialist in heavy, low-value hydrocarbons, KBR offers a variety of refining solutions to help you squeeze the most value from every barrel. A pioneer in fluid catalytic

cracking (FCC) technology, since 1990 KBR has designed more than a dozen FCC units and revamped more than 160 FCC units worldwide.

Our market-leading ROSE™ deasphalting technology is helping refiners and heavy oil upgraders worldwide achieve higher yields of high-value transportation fuels – reliably and cost efficiently and with 50 percent less energy usage compared to conventional deasphalting.



At the Eastman Chemical plant in Longview, Texas, KBR employees routinely work with the client to solve their daily challenges. This has included finding an alternative approach to adjust the cooling water in one of the plants, shaving off a half-million dollars from a \$10 million dollar project. KBR also saved the client \$750,000 by finding a better way to repair the floor of a heater without losing the refractory. It has also meant a nearly-flawless safety record – three-and-a-half years without a recordable injury, five years without a lost-time injury.



The PetroChina Lanzhou Petrochemical ethylene plant in China has a total capacity of 600,000 ton/year and has produced excellent yields for the client, who stated that KBR's SCORE technology process is quite flexible, which contributed to a rapid startup, and the yields are excellent.

## Petrochemicals

Whether it's a modern large-scale grassroots plant, a revamp or a process unit, KBR has the skill sets to meet the needs of global petrochemical operators.

It starts with our proven technology perfected through years of experience that delivers maximum yields with the least amount of feedstock. Our Selective Cracking Optimum Recovery (SCORE™) technology offered through a licensing agreement with ExxonMobil is one of the most efficient ethylene processes on the market. Depending on the feed, SCORE technology produces from four percent up to 12 percent more ethylene than typical designs, with less energy input per unit of ethylene produced.


KBR's SUPERFLEX™ propylene technology converts low value olefins streams into high value propylene and ethylene for Polymers production, as well as components for clean fuels. Unconverted components are recycled to extinction, maximizing propylene production and eliminating waste. Typically, SUPERFLEX produces olefins with a 2 to 1 propylene/ethylene ratio – the exact opposite of most liquid-based ethylene plants.

We support these technologies with seasoned engineering teams who have the know-how to deliver the most cost-effective and efficient design for your feedstock. We also offer global EPC-CS and project management resources that can execute a safe, reliable plant that's easy to operate and maintain – all within your timeframe and budget.

With a track record of nearly 60 years of petrochemicals experience, KBR has the right processes for your applications and your business goals.

**“Construction of a propylene plant with a capacity of 200,000 tons/year, using KBR’s SUPERFLEX technology, will not only sort out the need for increased propylene during China’s 11th Five-Year-Plan period, but will also provide a new approach to deep processing the low-value olefins byproducts from oil refineries and crackers in the region”**

- Mr. Li Dianjun, vice president and chief engineer of JiHua, was quoted as saying.



KBR provided technology and basic engineering for the 450 metric ton per day Tianji Fangyuan Chemical Development Co. Aniline Plant located in Lucheng, Shanxi, China. Tianji selected this technology because the process offers them a lower cost of production and a higher quality product.

## Chemicals

In today's competitive petrochemicals market, companies must find ways to diversify their product portfolio to gain higher margins and penetrate new markets.

KBR offers a range of technologies, including aniline, phenol, N-paraffins and NExOCTANE™, that can help clients bridge the gap between commodity petrochemicals and intermediate chemicals that utilize more feedstock and command higher prices.

## Greatest Value

As the leader in phenol technology for more than 50 years and experience with a wide range of projects to help you throughout the project lifecycle, from the project development phase by helping you determine the best mix of products for

the greatest value through engineering, procurement and construction of the plant, (and any combination of services therein), KBR helps you achieve your performance goals.

**“As we increase our plant capacity to world-scale limits, meeting our business requirements for capital projects is even more critical. This was an important consideration when choosing KBR.”**

- Mr. Liao Zengtai, President of Ningbo Wanhua



The DuPont aniline process allows Wanhua to implement a technology that reduces their project costs while ensuring safety and performance.



The 2,000 mtpd EBIC project represents the largest commercial application of KBR's proprietary KAAP™ technology since its introduction to the market in 1992, and the first in Egypt. KAAP positions the plant owner as a low-cost producer in the highly competitive ammonia business.

## Ammonia

There's a reason why operators the world over turn to KBR for ammonia technology. With more than 60 years experience and over 200 KBR-licensed ammonia plants to our credit, KBR ammonia process technology is the cornerstone of the fertilizer industry. Our plants are known worldwide for delivering safe, low-cost, reliable performance year in, year out.


KBR has a portfolio of ammonia technology options from which we select the best combination to meet your technical and economic needs. We offer flow sheet options for the three main sections of the plant - syngas preparation, syngas purification, and ammonia synthesis. One flow sheet option that minimizes energy consumption has demonstrated that it consumes less than 6.5 Gcal per ton, the industry benchmark.

Complementing KBR ammonia technologies is a full range of services available individually or as part of an integrated package - from project development and feasibility studies, through execution and startup, operation and maintenance and advance process automation. For reliable startups, reduced energy consumption and low-cost dependability proven over time turn to the recognized leader in ammonia process technology - KBR.



KBR has been involved in the licensing, design, engineering and/or construction of more than 200 ammonia plants worldwide, including almost a dozen plants in Trinidad.

# Alternate Energy Solutions



An engineering scale, 50 MTPD demonstration unit of the TRIG has been in operation since the mid-1990's, at the Power Systems Development Facility (PSDF) in Wilsonville, Alabama, USA. The unit has run successfully on a wide range of coals, including bituminous, sub-bituminous, and various lignites. One of the unique advantages of the TRIG is its ability to operate in the air-blown mode for IGCC power generation applications or the oxygen-blown mode that produces syngas for a variety of chemicals and fuels applications.

## Coal Gasification

As oil prices continue to spiral to higher levels, operators around the world are looking for lower cost energy alternatives to meet growing demand. For many the answer is coal, which comprises some 60 percent of world fossil energy reserves including vast deposits in North America, Europe, Russia and Asia where the energy demand is greatest.

KBR's transport integrated gasifier (TRIG™) technology offers a better way for power generation and chemical production from the world's plentiful low-grade coals – more economically, reliably and with lower emissions than any other gasifier on the market. Not only does it effectively handle low rank sub-bituminous and lignite coal, KBR's process is expected to deliver power commercially at a cost lower than that of the most advanced coal fired plants.

Depending on your requirements, KBR offers a range of services to the coal monetization market – from technology and front-end engineering design (FEED) through full EPC services, commissioning and start up. We can also integrate our gasifier technology with other technologies, such as ammonia and methanol, enabling you to minimize energy consumption and reduce water usage. KBR's experienced engineers can put together an entire plant using integrated process design to deliver the greatest efficiencies.

## Carbon Capture and Storage (CCS)

Heeding the call from governments and citizens to lower greenhouse gas emissions, operators are seeking innovative solutions to one of their more complex environmental challenges: what to do with CO<sub>2</sub> emissions from hydrocarbon processes.

KBR offers a variety of solutions for capturing, compressing, transporting and storing CO<sub>2</sub> based on more than 60 years of experience with urea plants.

For one major gas development project we used a method known as geologic storage to capture and isolate excess carbon dioxide and inject it into a brine formation a mile below the surface.

As a leading EPC contractor, we have experience with every commercially available CCS process. We will use this knowledge to design a solution that meets your application and requirements.

# KBR Technology Center

Using the unique 360° views that the center affords them, the KBRTC's engineers scan technology developments from university and industry R&D departments, finding ways to synthesize and combine them for commercial applications. An example of this is SUPERFLEX™, which is based on a process developed by ARCO. Using our expertise in olefins and refining and catalytic cracking, KBR developed a complete SUPERFLEX technology that uses low value refinery streams to make high value propylene and ethylene for polymers and plastics.



## Serving Our Clients for More Than 80 Years

When you purchase KBR technology you have the added comfort of knowing that you have the full support of our Technology Center behind you. Located in Houston, Texas, the KBR Technology Center has a legacy in technology research and development that dates back to the mid-1920s when Morris Kellogg started the industry's first research laboratory.

The center contains a number of pilot plant and pilot plant fabrication facilities, analytical laboratories and a talented staff of engineers, chemists, pilot plant specialists and craftsmen who can test your feedstock and help devise the best plant configuration for your application and specifications. We can also quickly devise solutions should any problems arise.

In addition to supporting our current licensed offerings and developing new technology for the market, the KBR Technology Center also works with joint venture partners to develop and commercialize new technology for the energy and chemicals industry.

## KBR's Technology Center has a legacy of investing in new technology and improving existing technology that dates back to the mid-1920s

### Global Solutions to Today's Energy Challenges

Oil and gas operators the world over are being challenged like never before to meet increasing demands on energy supply. KBR has the experience and resources to help our clients to successfully meet these challenges. Whether it's providing the latest and best process technologies to maximize hydrocarbon assets; designing

and constructing the infrastructure and facilities to exploit energy resources in some of the world's most remote locations; or navigating the intricacies of undertaking major projects in geopolitically challenging environments, you can depend on KBR for single-source, integrated solutions and efficient, reliable project execution.

For more information about KBR technology and services, e-mail [marketing@kbr.com](mailto:marketing@kbr.com) or visit [www.kbr.com](http://www.kbr.com)

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