

frontiers

The BP magazine of technology and innovation

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When the pendulum swings

Installing the Shah Deniz
platform in the Caspian Sea

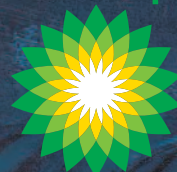
Field of the Future

Instant access in
the Gulf of Mexico

Clearer chemistry

Looking into
fluidised bed reactors

bp

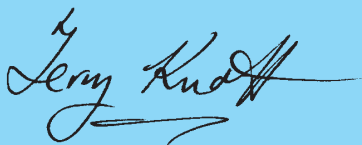


From the editor

In this issue of *Frontiers*, we revisit BP's 'Field of the Future' technology initiative. Three years ago this was a concept – now it has become reality, most notably for BP's deepwater assets in the Gulf of Mexico, where the latest technology for real-time information management is bringing the onshore and offshore workplaces closer together. Also in the offshore exploration and production arena, we take a close look at the engineering innovations required to safely and successfully install the giant Shah Deniz gas platform in the Caspian Sea, readying the region for a stable new energy supply.

Other features point the spotlight at BP's global lubricants business and its technology centres in Japan and Germany, two of five centres developing advanced lubricants to meet different transportation challenges around the world, while in the UK we get to grips with the latest methods for observing and analysing what goes on deep inside fluidised bed reactors. And to complete the international flavour of the stories in this issue of *Frontiers*, we learn of BP's drive to 'clean' and rationalise the masses of information held in the myriad databases among the company's 230 business units worldwide.

We hope you enjoy this issue of *Frontiers*.



Terry Knott, Managing Editor

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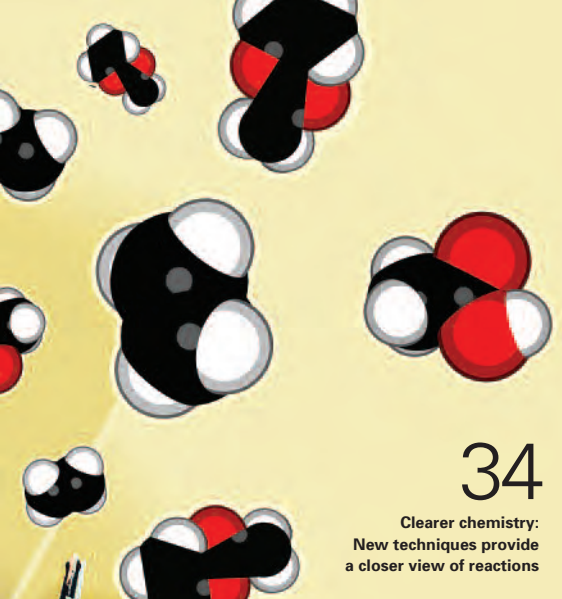
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Installing a massive new platform in the Shah Deniz gas field required innovative engineering solutions, developed by BP and its partners, to match the unique challenges posed by the Caspian Sea. *Terry Knott* reports on the project

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Justin Adams is BP's director of long term technology. He talks to *Hester Thomas* about how technology is helping to shape the company's long term future

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BP has adopted a state-of-the-art, tailor-made approach to ensuring the vast array of data across its worldwide businesses is accurate and coherent. *Eric Bobinsky* digs into data quality management

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BP is applying highly advanced visualisation and modelling techniques to improve the production of vinyl acetate monomer. *Michelle Brown* has the details

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Giving corporate data
a thorough cleaning

China looks to hydrogen

BP and SinoHytec have marked the opening of China's first hydrogen refuelling station in Beijing.

Located at Zhongguancun Yongfeng High-Tech Industrial Base, Beijing Hydrogen Park is the first demonstration project for new energy vehicles in China. The hydrogen park covers an area of 1.3 hectares and includes an R&D centre, hydrogen refuelling station, and fuel cell vehicle garage and maintenance workshop.

The Park is designed to offer real-world experience in hydrogen fuelling infrastructure through the demonstration and operation of new energy vehicles, and is also intended to help build public awareness of hydrogen vehicle technology. It will provide a fuel filling service for several large-scale hydrogen fuel cell vehicle trial programmes which are being developed and co-funded by the Chinese Ministry of Science and Technology, as well as supplying the fuel cell vehicle fleet that will be in service during the 2008 Beijing Olympic Games.

SinoHytec was set up in July 2004, supported by the Ministry of Science and Technology, Beijing Municipal Government and Tsinghua University, in response to the national call for self-innovation and accelerated commercialisation of R&D



Filling up: refuelling with hydrogen in Beijing

innovation, focusing on renewable energy and energy-saving transport technologies. Additional information about SinoHytec can be found at www.sinohytec.com

Meanwhile, as part of BP's drive to make alternative fuels more widely available, the company has added to its growing number of hydrogen refuelling stations around the

world with the opening of a station in the city of Taylor, Michigan, USA, in co-operation with the city and Ford Motor Company.

BP is a leading producer of hydrogen at its refineries, producing 5000 tonnes of hydrogen per day. Additional information about BP's hydrogen programme can be found at www.bp.com/hydrogen ■

Whiting to get \$3 billion investment

BP has entered the final planning stage of a \$3 billion investment in Canadian heavy crude oil processing at its Whiting refinery, located in northwest Indiana, USA.

The company intends to reconfigure the refinery so that most of the feedstock can be Canadian heavy crude oil, a move which has the potential to increase production of motor fuels by about 15 per cent – equivalent to about 1.7 million additional US gallons of gasoline and diesel per day.

Bob Malone, chairman and president of BP America, said: 'BP is pleased to invest in a project important to the economies of both the United States and Canada, which increases the diversity and security of oil supplies that can be refined into gasoline, diesel and other petroleum products in demand by consumers in the Midwestern United States. It also provides a significant market for Canada's abundant heavy crude oil resources.'

The Whiting refinery currently produces about 4.5 billion gallons of transportation fuels each year, enough to supply more than five million vehicles. After the refinery reconfiguration, it will have the potential to supply motor fuels to about six million vehicles. Construction of the project is tentatively scheduled to begin in 2007 and be completed by 2011, pending regulatory approvals.

The project will increase capacity for process operations including coking, hydrogen production, hydrotreating and sulphur recovery.



BP's Whiting refinery

The replacement processing units and enhancements to existing refinery units will increase Canadian heavy crude oil processing capability by about 260,000 barrels per day.

Dan Sajkowski, BP's refinery manager for Whiting, said the company's planned investment is expected to create jobs for approximately 2500 workers during the peak of its three-year construction phase, plus 60 to 80 permanent full-time employees to operate enhanced processing units and other refinery improvements.

Whiting is one of five refineries operated by BP in the USA. BP owns or has part ownership in 19 refineries worldwide, with an operating share of 2.8 million barrels of crude oil per day distillation capacity. ■

Third Solar City for Australia

In Australia, the BP Solar-led 'Blacktown Solar City' consortium has been successful in its bid to become a Solar City.

Blacktown Solar City is a \$30 million project which has now secured \$12 million in government funding, and is the third bid to be awarded Solar City status, following the success of the Adelaide and Townsville bids.

Solar Cities is a \$59 million Australian federal government initiative, designed to demonstrate how solar power, smart meters, energy efficiency and new approaches to electricity pricing can be combined to provide a sustainable energy future in urban locations throughout Australia.

The project will result in the installation of over one megawatt of BP Solar products in the Blacktown City area over the next six years, including residential, commercial and community solar installations.

For more information, see:

Blacktown Solar City

www.blacktownsolarcity.com.au

Solar Cities

www.greenhouse.gov.au/solarcities

BP Solar

www.bp.com/solar ■

Tallows highlights BP's young talent

Four young BP technologists have received awards for excellence in the application of technology during the course of their work. The annual awards, presented by the Tallow Chandlers Livery Company of London to people less than 30 years of age, are made for outstanding contributions in the innovative application of technology through research, engineering or science, understanding of business needs, and team involvement. The awards were presented in November at the Tallow Chandlers Hall. The winners were:

■ **Nathan Stoddard** (pictured), a silicon scientist working in BP Solar's facility in Maryland, USA, for his work in improving BP's process for manufacturing silicon ingots for subsequent use in solar cells. The improvements focus on the casting process used in producing silicon, and in particular the development of a technique that completely changes the crystallisation process involved. Laboratory trials have indicated a 5 to 8 per cent improvement in cell efficiency as a result, accompanied by shorter manufacturing times and better material utilisation. In addition to the medal and certificate awarded to all four winners, Nathan also received the outright winner's Special Award.

■ **Joe Ariyaratnam**, a reservoir engineer in BP Australia, for developing innovative methodologies for optimisation and efficient



Nathan Stoddard, winner of the Special Award

recovery of oil lying beneath refineries, and also solar powered remediation systems for recovering the oil.

■ **Brian Odelson**, a senior research engineer in BP's facility in Naperville, USA, for developing advanced computer modelling techniques for the production of purified terephthalic acid (PTA), which is used in the manufacture of polyesters for fabrics and plastics. BP is the world leader in PTA production.

■ **Matthew Symonds**, a mechanical engineer working in BP's Castrol technology centre in the UK, for his work in developing a test sequence for 4-stroke motorcycle engines, which are rapidly taking over from 2-stroke engines. ■

Setting sail for Tangguh

The first of two offshore platform jackets has been installed in the Tangguh gas field, located in Bintuni Bay, offshore Indonesia.

Following a 3200km voyage to the field, the 2100 tonne jacket – fabricated in 13 months at the Guna Nusa fabrication yard in Cilegon, West Java – was installed in 60m of water where it will support gas production topsides facilities. The platform is the first of two installations of this kind in the Tangguh field, which will be controlled from shore. The second jacket left the yard in West Java in November, bound for the field.

Tangguh has proven gas reserves of over 400 billion cubic metres. Gas for the field will be transported some 22km to shore via 600mm diameter pipelines to a new two-train liquefied natural gas (LNG) manufacturing plant, expected to come into operation in 2008 with a production capacity of 7.6 million tonnes of LNG per annum. BP is leading the \$5 billion development project, which is on schedule and more than 50 per cent complete. ■

The first offshore platform jacket on its way to the Tangguh field



Patents

The BP patents described are published applications except where stated. US patents, formerly published only after grant, may now also appear as pre-grant published applications. Recent US patents are not included if previously listed as applications published elsewhere. This column was compiled by Joseph DiSalvo, Chicago (+1 630 821 2449), and John Bullen, Sunbury (+44 1932 762650), who can supply patent copies if required.

Full versions of the patent documents are available to BP staff on the BP intranet through the Information Resources (InfoRes) Patent Order website at <http://bp.patentorder.com>

Gas sweetening membranes

Non-combustible gases such as nitrogen, carbon dioxide and hydrogen sulphide must be removed from natural gas before this is burned or transported by pipeline. The historical methods of removal involve high costs and produce greenhouse gases. Stephen R Frantz has developed membranes that efficiently separate combustible and non-combustible gases without generation of greenhouse gases. (US Published Application 20060042463)

Conversion catalyst

In the Fischer-Tropsch process to convert synthesis gas (a carbon monoxide and hydrogen mixture) to hydrocarbons, one technical hurdle is to produce, in a single step, hydrocarbons of the desired carbon chain length and with sufficient chain branching. Usually too much methane, or hydrocarbons with not enough branching or aromatic content, are produced, with the result that the gasoline fraction does not have a

sufficiently high octane number, and the diesel fraction is too waxy and solidifies at fairly moderate temperatures. Joep Font Freide *et al* have discovered that the addition of an organo-silicon compound during either the preparation or post-treatment stages of catalyst manufacture results in hydrocarbons with the desired characteristics, that also have extended lifetime. (WO2006-087522)

LNG conditioning

In the regasification of liquefied natural gas (LNG) to produce gas (methane), it is often found that the gas has a calorific value too high to be used in domestic applications due to the presence

of the regasification plant that reduces the cost of conditioning the LNG and maximises the production of NGLs free from methane. (WO2006-087520)

Solar performance monitoring

The performance of a photovoltaic solar system depends on many factors, including the amount of sunlight, the cell materials, dirt and dust, spectral distribution of the incident light, DC to AC conversion, and many other factors. Inventors Donald B Warfield and Paul Garvison of BP Solar have developed and installed a series of signal generators with solar roofs that can report on the state of these



Solar reporting: signal generators can tell homeowners how well their solar panels are performing

of C2 and higher chain length hydrocarbons (these are referred to as natural gas liquids, or NGLs). It is necessary to 'condition' the LNG to separate these NGLs, not only to produce gas of the right calorific value but also to realise the higher value that these hydrocarbons can command in the market place. Lee Phillips *et al* have devised a novel design layout of

factors to homeowners. (US Published Application 20060085167). In a separate development, Paul A Monus and George J Kelly of BP Solar have developed an anti-distortion rectangular frame for solar panels, which not only serves as a sturdy shipping container, but is also easily installed on the roof of the job site to simplify installation, and continues to

prevent distortion of the solar panel after installation. (PCT Published Application WO200644510)

Refinery feedstock check

Graham Butler *et al* have devised a method, using high throughput experimentation techniques, to evaluate the propensity of refinery feedstocks to cause fouling. The invention enables a refinery feedstock to be evaluated prior to its use, and potentially even before its purchase, to assess its likely impact on refining processes. It can also aid selection of the most appropriate refinery at which a feedstock should be processed, where more than one option is available. (WO2006-064212)

Acetic acid production

Andrew Miller *et al* (WO2006-064178) and Brian Ellis (WO2006-061560) have devised new processes and catalysts for the carbonylation of alcohols (especially methanol) with carbon monoxide, to produce acetic acid in both the liquid and vapour phase. Heteropolyacids form a significant part of the catalyst composition in each invention.

Designer chemicals

Room-temperature ionic liquids have been shown to be of great value in a wide variety of solvent applications due to the ability to tailor their physical properties to the particular application, achieved by varying the molecular structure of the components that make up the ionic liquid (*Frontiers*, August 2005). Ian Collins *et al* describe ionic liquid surfactants that form emulsions for downhole drilling fluids, having low vapour pressures and wide 'liquid' temperature ranges. (WO2006-111712) ■

In brief

Underwater record-breaker

BP has used an autonomous underwater vehicle (AUV) to conduct a 22km-long pipeline survey in the Clair field, breaking the existing 4km record for continuous unassisted pipeline tracking. The achievement came during inspection of 85km of seabed pipelines in waters around the UK's northerly Shetland Islands.

The sophisticated tracking system, known as Autotracker, uses sonar to follow a pipeline on the seabed, and can intelligently manage issues that can occur during a survey mission to ensure good data is obtained – Autotracker is able to replan the pre-programmed AUV mission dynamically if it identifies a problem in the survey.

The tracking system is the result of a joint industry project funded by BP and managed by underwater services company Subsea7, with technology development by Seebyte. The free-swimming AUV achieved tracking speeds of three knots, about six times faster than surveys carried out by remotely operated vehicles – currently the industry's main method of conducting underwater inspections – which have limited range due to the large control umbilicals tethering them to surface vessels. The Autotracker module, which promises to be an important integrity management tool for subsea pipeline surveys, was carried in a GeoSub AUV assembled by Subsea7, capable of working in 2000m of water.



AUV being launched during trials recently carried out by BP

BP has recently announced several new hydrocarbon discoveries, including: the Kaskida oil discovery in 1786m of water in the Gulf of Mexico in Keathley Canyon Block 292; the Titania oil discovery in Block 31 offshore Angola in 2152m of water – the 11th discovery in the block; and the Malyk field, part of the Uvat oil project in Russia, operated by TNK-BP. Meanwhile, oil production has started from the East Azeri field in the Azerbaijan sector of the Caspian Sea, four months ahead of schedule.

BP and its partners have completed the construction of the \$680 million, 1074 megawatt K-Power gas-fired combined cycle power plant in South Korea.

This plant represents a major component of BP Alternative Energy's low-carbon power business, and from 2008 will use liquefied natural gas (LNG) supplied from BP's Tangguh LNG project in Indonesia. The plant was built safely with the construction team achieving 4 million manhours without a DAFWC (day away from work case) or recordable injury during the period. K-Power is a 'merchant' plant, and as such it will sell the electricity generated through the open market. BP has a 35 per cent share in the plant with the other 65 per cent being owned by SK Corporation, South Korea's leading energy company.

BP is to invest £5 million per year in the UK government-led Energy Technology Institute (ETI). The government will be contributing £500 million over the next 10 years, doubling the investment in energy research and development (R&D) in the UK, when the institute is fully operational. The ETI is expected to promote a step change in R&D

geared toward secure, reliable and affordable low-carbon energy technologies. Funding for the ETI, which will be located at a UK university and is hoped to be operational by 2008, is to be provided on a 50:50 public:private partnership basis. Other energy companies which have so far committed to funding the project include Shell, EDF Energy and E.ON UK.

To learn more about the ETI, visit: www.dti.gov.uk/science/science-funding/eti/page34027.html

BP has purchased Greenlight Energy Inc, a US-based developer of large scale wind power generation projects. The purchase will allow BP to accelerate its plans to develop a leading wind power business in North America. Founded in 2000

and based in Charlottesville, Virginia, the company has a portfolio of some 39 mature and early stage development projects across the USA, with a potential total power generating capacity of 6.5 gigawatts. This portfolio contains a number of projects which BP expects to be able to develop over the next five years, and will further accelerate the rapid growth of BP's US wind power business, a key part of BP Alternative Energy.

BP Solar has unveiled its plans for a \$70 million expansion project at its North American headquarters in Frederick, Maryland. The expansion will result in nearly doubling the facility's current casting and sizing capacity to approximately 150 megawatts. ■

Helios Awards winners announced

The winners of the 2006 BP Helios Awards, which recognise BP teams who demonstrate the company's brand attributes (Innovation, Progressive, Green and Performance) while delivering value to BP's business and surrounding communities, were announced in November. This year, 1456 teams entered the competition from over 60 countries, resulting in 168 commended entries and 16 finalists. The winners of the six Awards categories are:

- Next generation desalter interface control increases competitive advantage – Refining & Marketing, USA (Innovation)

- Opal non-sniffable fuel – saving lives, creating futures – Refining & Marketing, Australia (Progressive)
- Harnessing billion year old microbes to minimise wastewater treatment sludge – Refining & Marketing, USA (Green)
- Creation of the Innovene business and sale to Ineos – Mergers & Acquisitions, UK (Performance)
- Imaging the invisible: beating the seismic challenge to see beneath subsurface salt – Exploration & Production, USA (Partnership)
- Saving lives in Papua: health workers and social-marketing improving community health – Exploration & Production, Indonesia (Human Energy)