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Magnus platform turns 30

bp



THE INTERNATIONAL MAGAZINE OF THE BP GROUP

ISSUE 4 2013

BP MAGAZINE

20 SPOTLIGHT: NORWAY

NORTHERN STAR

BP Magazine reports from northern Norway, where the Skarv field – one of the company's major new Upstream projects – is having a significant impact on the local economy.

Welcome. The past few years have seen some big changes in the global business environment, including the worst recession in 80 years and a further shift in economic influence towards the world's emerging economies. What does this changing landscape mean for multi-national companies such as BP? In this edition of *BP Magazine*, we talk to BP managing director and chief executive of Refining and Marketing Iain Conn and former CBI director-general and now BP advisor Lord Jones of Birmingham (page 6) to get their views on challenges and opportunities facing today's corporate leaders. Meanwhile, the end of the year is always a good time to reflect on achievements past. On page 44, we celebrate the 30th anniversary of the Magnus platform – the UK's most northerly in the North Sea – and find out more about the work going on to extend its production life. On page 36, we mark the 20th anniversary of the Upstream Challenge graduate programme. It's also almost a year since BP's offshore Skarv field came onstream in the Norwegian Sea. *BP Magazine* visits the nearby town of Sandnessjøen to see how the offshore development is helping local businesses build for the future (page 20).

Lisa Davison > Editor

BP MAGAZINE

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Cover image: Onboard BP's Skarv floating production, storage and offloading vessel in the Norwegian Sea. This shot was taken from inside the offloading 'hose reel'. The hose is reeled out and used to offload crude onto shuttle tankers that ship it back to shore. **Photograph by Stuart Conway**

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Photography by Shain Abasaliyev

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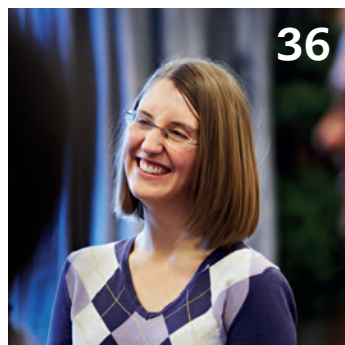
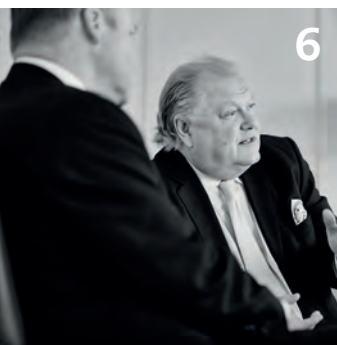
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BP Magazine observes a major BP Shipping oil spill drill to find out how the business tests its ability to respond.



For the record

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the quarter in numbers

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The number of major Upstream projects started up so far in 2012 and 2013

16-18

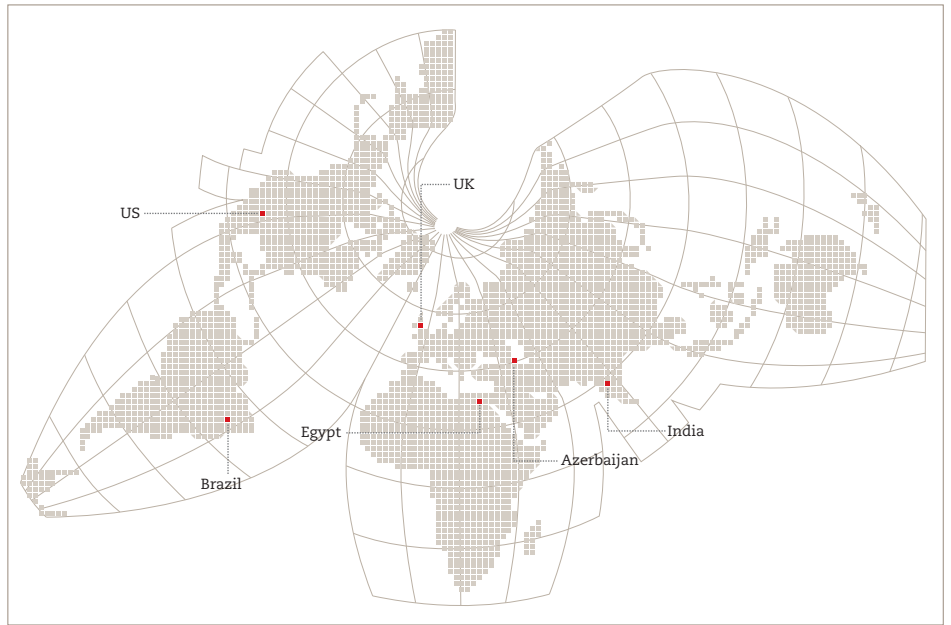
Number of exploration wells BP expects to complete in 2013. So far, it has completed 12

95.3%

BP's Solomon refining availability level in 3Q 2013. This shows the time units are available for processing and represented a nine-year high, sustaining performance improvements from second quarter of 2013

2,200 trillion

The number of calculations (called floating point operations) that BP's new supercomputing facility in Houston can perform per second



GLOBAL: NEW EXPLORATION HEAD

Richard Herbert is to become BP's new head of exploration. He will succeed Mike Daly (below), who has chosen to retire from BP at the end of 2013, after 28 years with the company. Daly has led BP's exploration function for the past eight years, overseeing the re-energising of its resource renewal activity. Under his leadership, BP has accessed new deepwater exploration positions, including in Angola, Australia, Brazil, Canada

and Libya, and deepened existing positions in the Gulf of Mexico and Egypt. He also led resource access deals for BP in the Rumaila field in Iraq, the partnership with Reliance Industries Limited in India, tight gas in Oman, Canadian oil sands, and shale plays around the world. Herbert will rejoin BP from Talisman Energy, where he has held the position of executive vice president for Exploration since 2009. Before joining Talisman, he spent six

years with TNK-BP in Russia, serving first as vice president for exploration and then executive vice president for technology. Prior to TNK-BP, Herbert had a 19-year career with BP. BP group chief executive Bob Dudley said: "I am pleased to welcome Richard back to BP. He brings a wealth of exploration and leadership experience and expertise, gained across the world, which is aligned well with BP's Upstream and exploration strategy."

Daly retires: BP's present head of exploration, Mike Daly, is to retire at the end of 2013, following a 28-year career with the company. He will be succeeded by Richard Herbert.



NEWS IN BRIEF

Azerbaijan

Gas sale

The Shah Deniz consortium has announced that 25-year sales agreements have been concluded for a little more than 10 billion cubic metres a year (bcm) of gas to be produced from the Shah Deniz field (below) in Azerbaijan, as a result of the development of Stage 2 of the Shah Deniz project. Nine companies will purchase this gas in Italy, Greece and Bulgaria. The Shah Deniz Stage 2 project is set to bring gas directly from Azerbaijan to Europe for the first time, opening up the Southern Gas Corridor. In total, 16bcm of Shah Deniz Stage 2 gas will be delivered through more than 3,500 kilometres (2,175 miles) of pipelines through Azerbaijan, Georgia, Turkey, Greece, Bulgaria, Albania and under the Adriatic Sea to Italy.



US

Sochi 2014 support

BP America is to sponsor six US Olympic and Paralympic athletes training for the Sochi 2014 Olympic and Paralympic Winter Games, as part of the company's ongoing commitment to the US Olympic Committee (USOC) and Team USA. Two of the six BP-sponsored Athlete Ambassadors include 2012 Olympic hurdler Lolo Jones and 2012 Paralympic track and field athlete Tatyana McFadden – both of whom will continue in their roles as

BP-sponsored athletes, as they attempt to join the elite ranks of Olympians and Paralympians who have competed in both the winter and summer Games.

India

Gas condensate discovery

Reliance Industries Limited (RIL) and BP have discovered gas condensate off the east coast of India in the Cauvery Basin. The discovery is situated 62 kilometres (39 miles) from the coast, and is the second gas discovery in the block. RIL is the operator, with 70% equity, and BP has a 30% share. The well was drilled in a water depth of 1,743 metres (5,718 feet), to a total depth of 5,731 metres (18,802 feet), with the primary objective of exploring Mesozoic-aged reservoirs.

Egypt

Gas discovery

BP Egypt has made a significant gas discovery in the East Nile Delta. The deepwater exploration well, named Salamat, is the deepest well ever drilled in the Nile Delta. It is the first well in the North Damietta Offshore concession, granted in February 2010 and operated by BP. The well was drilled in a water depth of 649 metres (2,129 feet) and reached a total depth of around 7,000 metres (22,965 feet).

Global

Petrochemicals technology

BP has announced two new technologies for the production of key petrochemical feedstocks. SaaBre™ is a new route for the production of acetic acid by converting synthesis gas (carbon monoxide and hydrogen derived from hydrocarbons such as natural gas) directly to acetic acid in a proprietary, integrated three-step process.

This avoids the need to purify carbon monoxide or purchase methanol. BP's second technology Hummingbird® is a newly developed proprietary process, by which ethanol is dehydrated to produce ethylene, a fundamental building block for the plastics and other petrochemical industries. The new technology is lower cost and simpler compared to existing ethanol to ethylene technologies.

Brazil

Farm-in deal

BP has completed a deal with Petróleo Brasileiro SA (Petrobras) to farm-in to five deepwater exploration and production concessions operated by Petrobras in the Potiguar Basin, located in the Brazilian Equatorial Margin. Together, the blocks cover a total area of 3,837 square kilometres (1,480 square miles). BP Brazil president Guillermo Quintero said: "This is another step in building our presence in Brazil. Since first gaining interests in 10 blocks, with our purchase of Devon Energy do Brasil in 2011, we have now expanded our upstream portfolio to interests in

27 blocks in seven basins, which includes the largest deepwater exploration portfolio held by an international oil company in Brazil."

UK

Jacket installation

BP and its partners, ConocoPhillips, Chevron and Shell have safely installed the Clair Ridge platform jackets (below), a major milestone in the Clair Ridge project. Clair Ridge is a £4.5-billion investment in the second phase of development on the Clair field, which lies 75 kilometres (46 miles) to the west of the Shetland Islands. The project will comprise two new bridge-linked platforms, as well as new pipeline infrastructure to connect to processing facilities on Shetland. The next major milestone is the installation of the topsides, scheduled in 2015, with production expected to commence in late 2016. The development will have the capability to produce an estimated 640 million barrels of oil over a 40-year period, with peak production expected to be up to 120,000 barrels of oil per day.

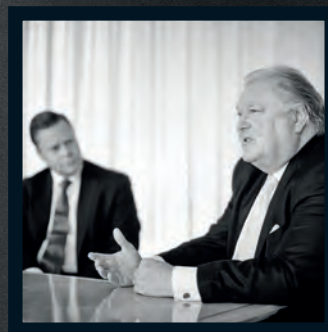




Iain Conn & Digby Jones

What does it take to run a successful and sustainable global company in such an uncertain world? Five years after the onset of the financial crisis, there are shifting geopolitical threats, mixed signs of recovery and new opportunities. Iain Conn, BP managing director and chief executive, Refining and Marketing, and Digby Jones – Lord Jones of Birmingham, the former CBI director general and trade minister, who now advises BP – met *The Spectator's* business editor, **Martin Vander Weyer**, to discuss the challenges facing today's corporate leaders.

Photography > Graham Trott/Giles Barnard/Stuart Conway/Corbis



Head to head: Iain Conn (top left) joined BP in 1986 and was appointed managing director and chief executive, Refining and Marketing, in June 2007. Lord Jones of Birmingham is the former CBI director general and trade minister, and took up a role as an advisor to BP in 2012.



“The reality is BP is German in Germany and Chinese in China...To be truly global, you’ve got to be resident in multiple countries, and residency doesn’t just come with arrival, it comes with relationships and commitment and partnership.”

Iain Conn



Martin Vander Weyer: Let's start on a note of optimism. We're coming to the end of a traumatic period for the global economy: most of us think we can see light at the end of the tunnel. If that's the case, how does it reshape priorities – not just for BP, but for multinationals generally?

Iain Conn: Well, the world is always changing and we've just seen one very big shift – the worst recession for 80 years. It caught a lot of people off guard because they thought growth was guaranteed in a globalised world, and they confused growth with consumption. We used to believe growth equalled production, but, latterly, consumption growth was presumed to equal wealth creation, and, in effect, we consumed all the wealth we'd created since the Second World War. One result of that depletion is that the capacity of developed countries to project, economically and militarily, is more limited than it used to be. Europe and the US have turned introspective, just as certain other countries, notably China, are becoming more international in their dealings. So, there's another big shift in who's present in the new opportunities around the world. And, in parallel with this retraction of Western power, we've seen the Middle East and North Africa becoming more unstable. Yes, the risk profile of the world has changed materially – but that's a challenge a global company like BP always has to face.

MVW: If the political underpinnings have weakened in the way you describe, does that make operating conditions even more difficult?

IC: It changes the tapestry, but it doesn't necessarily make life more difficult. It's trickier if you're tied to one political domicile, and your home nation has lost its ability to project. But the reality is BP is German in Germany and Chinese in China; of course, we have strong British links, but we're not solely British or, indeed, solely Anglo-American. To be truly global, you've got to be resident in multiple countries, and residency doesn't just come with arrival, it comes with relationships and commitment and partnership. If you have

multiple domiciles, your ability to hold on to opportunities as they move around the globe is considerably greater.

MVW: Digby, you're a great cheerleader for British business – I see you're wearing Union Jack cufflinks. Does what Iain's saying offend your patriotic viewpoint?

Digby Jones: Not at all, because I maintain that we're the most globalised of societies, in an unacknowledged way. Let me take you back to 1983, when Nissan opened its first factory outside Japan, in Sunderland. France, Germany or America would all have said no. But, Britain said yes, come and do it. And, within a few years, we had Toyota at Burnaston and Honda at Swindon, and this successful product called Mini, owned by BMW, and now Jaguar Land Rover – a British engineering brand with German managers and Indian money. I'm proud we have that in our DNA: if there was a nation made for globalisation, it's us. And, there's something else we have to offer, which is that business can be a force for good in the world, helping to break down barriers of religious difference and problems of urbanisation and demographic change. Of course, business has its faults and it needs good governance, but I can't think of a nation better suited to sort that out than Britain.

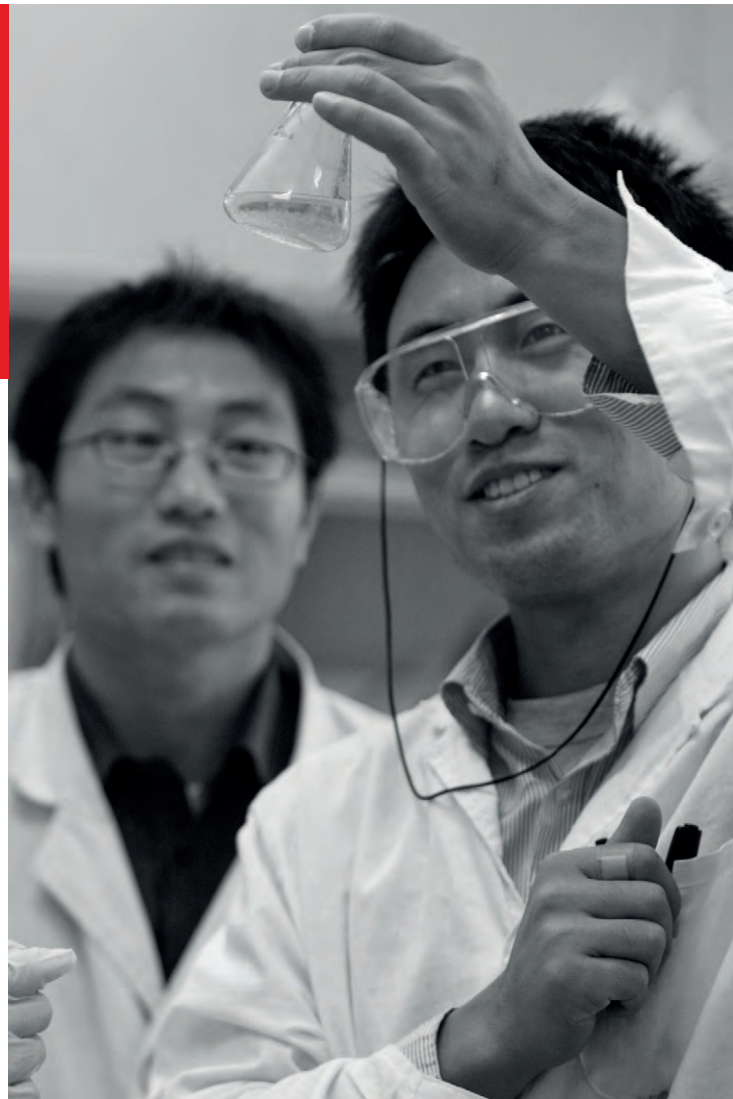
MVW: Iain, does Digby's concept of the benevolent role of big business weigh heavier on you than it used to?

IC: I think there was a period when many countries revered multinationals because they wanted to learn from their skills. Then, the reverence disappeared as the host nations started to build skills of their own – to a point where multinationals found their businesses being confiscated. To be a successful global company today, above all, you need to be trusted: the role of the company in each place where it operates has become much more mutual and co-dependent, and the factors for success are as much intangible as they are tangible. It's no longer good enough just to bring your balance sheet, you need to bring your brand values and reputation, »



“We need the local community to want us to stay, and local talent to be developed. As a result, an industry like ours naturally makes longer-term commitments to education, infrastructure and relationships of mutual benefit with governments.”

Iain Conn



Global economy: (top) in 2002, BP bought Veba Oel and with it, the market-leading retail brand, Aral. It chose not to rebrand the network and, today, is the largest player in the domestic petroleum industry. Below left, at work at Nissan's manufacturing plant in Sunderland, UK. Nissan's move to the UK in 1983 opened up the British car manufacturing industry to a host of other international brands. Below right, scientists at work at the Dalian Institute of Chemical Physics. The institute is developing hi-tech technologies in the fields of chemistry and catalysis that could benefit the sustainable development of China.

the ingredients that are the most difficult to copy.

As part of this trust equation, society puts more and more burdens on us, expecting the highest standards of ethical behaviour, wherever we are – and if we have a failing anywhere, the power of social media means it's known everywhere immediately. Multinationals are expected to contribute far beyond their business remit – to civil society, to education, and, of course, to address environmental concerns. So, yes, those responsibilities weigh heavier, but if you do it right and project your values consistently, it's a bigger world.

DJ: I've always believed in what I call socially inclusive wealth creation. Business creates employment and generates taxation – everything flows from the wealth that business creates. I think that gives business every right to say to governments: just provide the facilities we need and let us get on with it. But, you can't operate unless you come to the table of political requests with clean hands. You've got to make it easy for politicians to say 'Yes, I'll help you'. Business has to be seen to be socially inclusive. Its role in raising the level of society through education can be enormous, for example. That's a big thing for me, and one of the reasons I'm so proud to be part of BP is the amazing relationship the company has with schools and universities. If you're going to make the most of the global picture that Iain

has painted, you're not going to win with commodities, because someone is always going to sell those cheaper. But, if you can exploit knowledge, develop it and transfer it, then you'll always have something that will sell around the world.

IC: There's an issue here about the nature of heavy industries, not just oil and gas, but chemicals or mining, too. When we make big investments, with big capital assets, we tend to be there for a long time. We need to collaborate with local and national government for several decades, through changing political complexions. We need the local community to want us to stay, and local talent to be developed. As a result, an industry like ours naturally makes longer-term commitments to education, infrastructure and relationships of mutual benefit with governments. Service industries tend to move more quickly, but heavy industries have a bigger role to play in the 'stickiness' of the economy – by which I mean the elements that are difficult to move and have qualities that are difficult to replicate. Partnership between governments and heavy industry is really important for the stickiness of skills and capabilities.

MVW: Give us an example of where all these elements of local engagement work well in the BP world...

IC: Everywhere has challenges and everywhere has opportunities, but

"I've always believed in what I call socially inclusive wealth creation. Business creates employment and generates taxation – everything flows from the wealth that business creates."

Lord Jones

Germany is a very interesting case. We were a small petroleum retailer and manufacturer in Germany until 2002, when we bought a major national oil company, Veba Oel, which had the Aral petrol brand. It was the market leader and we chose not to rebrand it as BP. Our leadership was sufficiently trusted that the German Government let us effectively become the largest player in the domestic petroleum industry. With that, we inherited apprenticeship schemes that are very strong, good relationships with organised labour, and good relationships with schools and universities.

DJ: If I can broaden this out again, governments have a responsibility to provide a successful business environment too, because multinationals have choices. Companies bring this 'stickiness' that Iain describes, but governments have to provide an environment that's beneficial for companies. That doesn't mean bribing them to come; it means providing skilled labour, a transport infrastructure that lets them get their goods to market and their people to work, and a tax regime that's competitive. And, it means allowing constructive criticism. Otherwise, companies will say: why should I invest in your country? If I want to be in this region, why shouldn't I go to your neighbour?

IC: Digby's right, it's a two-way thing. Companies have choices about where they »

go and governments have choices about who they invite in. What matters most is what you stand for – that can mean child welfare standards for companies such as Nike, just as it means environmental and safety standards for BP – and the capabilities you bring.

MVW: Let's apply these parameters to Europe. You've described the long-term nature of BP's commitments and the kind of relationships with government that work best – but it must be tough to make that work in a Europe crippled by short-term uncertainties and financial weakness. Do you just take a pragmatic view that you have to be in these markets whatever happens?

IC: At the end of the day, it all comes down to competitiveness. Europe is a hugely important economic bloc and, of course, it's difficult to see why a global company wouldn't be there. But, over decades, we tend to migrate away from places that are uncompetitive, and what's really worrying is the slow pace at which Europe is driving towards being more competitive. That means completing the internal market, and it means gas-on-gas competition, conventional versus unconventional sources, such as shale. There's a very simple equation: the US today has some growth, plus cheap energy; China has high growth and expensive energy; Europe has no growth and expensive energy. That should worry everyone, because energy is 10% of the cost of production and if you are uncompetitive in energy, you have a real problem, especially if you don't have growth. I believe strongly that Europe can be much more competitive than it is, and I think it would be a very poor decision for the UK to decide to leave; I don't believe we can go it alone. The problem is Europe's track record in relation to the two most useful things for business, competitiveness and geopolitical influence, is not good. In a referendum, the public would be asked to vote for something that seems like a good idea but doesn't have a good track record. But, I think business needs to stand up and explain that the future of jobs and growth in Britain is dependent on access to the world's largest marketplaces, and that includes Europe.

DJ: As a nation, because of our history of exposure to markets, we understand this quest for global competitiveness that Iain's describing. We're not nationalistic in the way we look at our business engagements and I don't want this to become an argument about Britain wanting exceptional treatment in Europe. It should be about Europe reforming itself, not concessions for us. I mean major reforms in terms of markets and investment, not just getting rid of the Working Time Directive. And, I think British industry needs to come together with Dutch and Scandinavian and German business to make sure it happens.

MVW: One last factor in this global tour d'horizon – the energy map. Iain, you referred to gas-on-gas competition as a good thing, but is shale really going to be a game-changer on this side of the Atlantic?

IC: The technology to drill long wells and fracture them, combined with a high oil price, has made shale economic in the US, and the technology is transferable – so why isn't it working in Europe and everywhere else? Because the US has three things: it has 2,000 land drilling rigs that were already there, it's criss-crossed with pipelines, and if you own the land, you own the mineral rights. In Europe, we don't have the drilling rigs or the pipelines and, other than in Latvia, the landowner doesn't own the mineral rights.

So, this is going to be slower everywhere other than the US, and what should worry Europe is that China may actually be the place where it happens next. Why this is so important is because it's a potentially huge source of competitive advantage: in the US, they've cut gas-based energy costs by two thirds. The search for unconventional hydrocarbons, whether it's shale gas or shale oil, should be encouraged in Europe,

but it may take longer than people think to make a material impact. And another energy factor for Europe is the high freight cost of importing liquefied natural gas by tanker. Countries importing it that way will be an awful lot worse off than countries that either produce it locally or access it by pipeline. Therefore, Europe should try to do two things: produce as much as possible locally, including shale gas, and connect itself by pipeline to as many countries as it can. That way, Europe can have a competitive gas-based economy.

MVW: We've talked about BP and its ilk in Europe and around the world, but not at home. How has the role of the UK-based multinational evolved?

“If we really want globally competitive businesses like this one to be agents for good, we have to stop the anti-business feeling that's out there.”

Lord Jones



IC: We invest in the UK, financially and in education; we're a good corporate citizen, supporting many things beyond education, such as the arts, and being involved in corporate governance work; and we work around the world to bring wealth and the sustainability of high-end jobs to the UK. That's the role of the modern global company wherever it happens to be domiciled.

MVW: And a last word from you, Digby?

DJ: Iain asked me a year ago to work with BP and since I came onboard, my eyes have been opened to what this company can do, particularly the ways in which it promotes social inclusion through education and through its sponsorship work. It's a real

privilege to be part of it. But, if we really want globally competitive businesses like this one to be agents for good, we have to stop the anti-business feeling that's out there, which really distresses me. You see it in the media, you see it in politics – it's such an easy win for politicians – and what

effect does it have on a 16-year-old with all the choices of the world in front of her, who's trying to decide what to do with her life? I want her to have a good feeling about what business can do, and to get engaged with wealth creation. I want her to think: I could be an engineer with BP. ■

“Europe should try to do two things: produce as much as possible locally, including shale gas, and connect itself by pipeline to as many countries as it can. That way, Europe can have a competitive gas-based economy.”

Iain Conn



→ bp shipping

Training > Oil spill response



With its vessels travelling around the world every day, training for a potential incident is a key part of life in BP Shipping. Eric Hanson observes a 'worst case' regulatory drill to see how BP and external organisations work together to test the company's ability to respond.

KNOWING THE DRILL



E

very day, BP Shipping vessels travel the world delivering cargoes of oil and gas. Given the contents, it's vital that the organisation be fully prepared should an accident occur, which is why oil spill training is a regular occurrence across the business. One such major drill took place in July this year, when 300 people gathered in a San Francisco-area hotel ballroom to take part in a BP-run drill to simulate a major oil spill off the California coast.

For BP Shipping, these drills serve two main purposes: to fulfil regulatory requirements, ensuring that BP is aligned with federal and state laws; and to test the business's ability to respond to crisis situations.

"The drills ensure that we continue to learn lessons from a multitude of different situations," says Mike Baccigalopi, BP Shipping's HSSE and emergency response advisor, based in Houston, US. "That can be anything from this drill, which is a 'worst case' regulatory drill, or it could be something as simple as the loss of propulsion on one of our vessels off the coast."

THE DRILL BEGINS

The premise behind the exercise was fairly straightforward. At 3:30am the *Arctic Dancer*, a hypothetical Alaska class tanker, travelling north from Long Beach and heading to Richmond, California, collided with an eastbound ore carrier around 50 kilometres (30 miles) southwest of Pillar Point, near San Francisco.

The collision ripped open the portside number 5 cargo oil tank, leaving a 4.5 by six-metre (15 by 20-foot) opening in the tanker's hull plating, and releasing around 35,000 barrels of Alaska crude oil into the water. The crew reported seeing a growing slick heading east-southeast.

The drill scenario included a shipboard fire that was extinguished by the crew. There were no injuries.

But, *Arctic Dancer*, carrying 600,000 barrels of crude, was adrift in an area of the ocean where wind and current conditions would drive the oil onto the coast, near Monterey Bay.

The Monterey Bay region is home to some of the most picturesque sites on the

US Pacific Coast, where extensive wildlife flourishes at places such as Half Moon Bay State Beach and the Fitzgerald Marine Reserve.

Beyond the beauty of the scenery, however, this scenic stretch of California coastline has been the site of real shipping disasters dating back to the 19th century. The Monterey Bay National Marine Sanctuary database lists 436 vessels lost in these waters.

The details of the simulated accident were worked out in advance by BP employees and regulatory officials, says Baccigalopi. He adds that the planners had to find a way to create a challenging oil spill scenario that would drift towards the beaches south of San Francisco. "How the oil leaves the tanker is something that is left to the imagination. The more important thing was to understand how the hypothetical oil might spread and what impact would that have?" he says.

Before the drill began, the players spent two days in training sessions, which included presentations from BP experts and state and federal officials. The participants also spent half a day on buses touring beaches that would be affected in the drill.

"The tour gave the drill team a chance to see for themselves the actual terrain and the beaches that would be affected in this scenario," says Baccigalopi.

THE DRILL RESPONSE TEAM

Around 150 BP employees, 100 government officials, and approximately 50 contractors teamed up to contend with a host of issues in the drill, which lasted two days.

The exercise officially began at 8am, as participants were presented with an evolving event that had already been under way for several hours.

The various teams in the operations centre immediately went to work. Salvage vessels were dispatched to the scene, the US Coast Guard established a safety zone around the ship, a damage-assessment fly-over was scheduled, and BP employees in the joint information centre responded to simulated calls from the news media and the public. BP team members also began moving additional resources into the area.

Jeff Johnson, environmental and

external affairs manager for BP Shipping in the US, says the first few minutes of a response are a very active time, as people assess their roles, the situation and then sit down to work. "We have folks from state and federal government, from BP, from a variety of organisations who are sorting themselves into forming a team."

Johnson says the work carried out during the exercise is similar to what athletes go through when preparing for competition. "It is kind of a muscle memory activity, where we repeatedly train ourselves so that we are always ready for an incident."

And, he says, people get an opportunity to cross-train in different jobs. "That helps us so we can broaden our access to all the different skill sets in BP."



“It is kind of a muscle memory activity, where we repeatedly train ourselves so that we are always ready for an incident.”

Jeff Johnson

Baccigalopi echoes that sentiment, saying drills provide opportunities to draw on varied abilities and experiences from the many BP people participating.

“It’s about shared learning, it’s about pulling in the same direction, it’s about best practices,” he says. “It’s being open and being willing to challenge yourself and say, ‘Well, we have done it this way, but this is something I picked up from somebody in another business. Let’s see how it can be applicable to the systems we operate.’”

Over the course of the exercise, the

response team dealt with dozens of other hypothetical problems, ranging from a crewman’s broken arm on a relief ship to a small earthquake that rattled the San Francisco area.

The drill also featured a fairly realistic news conference, with the Unified Command team answering questions from BP employees pretending to be reporters.

Incident commander Jim Ellis, president of BP Shipping USA, and other members of the Unified Command, were given a briefing by the joint information centre team, in

preparation for the news conference, which was held in a hotel conference room.

Ellis, Commander Donald Montoro of the US Coast Guard, Mitchell Goode of the California Department of Fish and Wildlife, and Anil Mathur, president and chief executive of Alaska Tanker Company, took the podium to answer questions from the ‘media’.

At the conclusion of the drill, Ellis said the exercise proved to be a valuable learning tool. “This drill gives everybody experience, so that, if we have to do the real thing, people are current in their training and knowledge of the systems and processes. This reinforces a one-team approach, so that we can effectively deal with a potential incident.”

From a personal perspective, Ellis found the drill to be very useful. “You appreciate how much stuff is thrown at you at the very beginning. And, you learn how to differentiate the items you need to manage and the things you can allow other people to manage for you,” he says. ■






Successful topsides installation

BP's Chirag Oil Project has reached another milestone, with the installation of the 19,500-tonne topsides structure (pictured here) onto the West Chirag jacket, offshore Azerbaijan. The gigantic structure sailed from Baku's AMEC-Tekfen-Azfen (ATA) yard on 12 September 2013. First oil from the project is expected by the end of 2013. The topsides structure is an integrated deck, incorporating the accommodation, drilling and oil and gas processing facilities. It is the heaviest structure ever installed in the Caspian Sea. The Chirag Oil Project is a \$6 billion investment that will increase oil production and recovery from the Azeri-Chirag-Guneshli (ACG) field in the Azerbaijani sector of the Caspian Sea, via the new West Chirag offshore facility. Around 4,000 people, including sub-contractors and specialist vendors, were involved in the construction works, with up to 90% of that workforce made up of Azerbaijani nationals. The West Chirag platform is located in approximately 170 metres (560 feet) of water and installed between the Deepwater Gunashli (DWG) offshore complex and the Chirag platform. ■







Midnight sun: view from the bridge of the MV Island Chieftain, a supply vessel, as it sails out to the Skarv FPSO from a loading dock in Sandnessjøen, northern Norway. This shot was taken at 10pm on a summer night when the sun never fully sets.

THE NORTH FACE

In the final hours of 2012, gas began to flow at the Skarv field – one of BP’s major new Upstream projects. Oil production followed three months later. As well as marking a significant milestone for the company, production at Skarv represents a new era for the town of Sandnessjøen, where contracts for the project are helping local businesses to thrive.

Report> Amanda Breen **Photography**> Stuart Conway

N

ature has been kind to the Helgeland region in northern Norway, with its fjords, islands and crystal waters. For those patient enough to sit through the take-offs and touch-downs in small propeller planes at the handful of local airports that dot the journey to the coastal town of Sandnessjøen, the final destination is worth the time and effort.

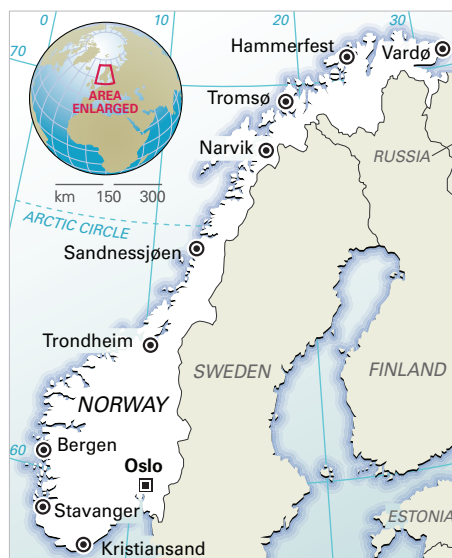
Glancing across the short runway and over the small airport terminal, the Seven Sisters mountain range lies in view, with its seven summits lining the horizon. Locals say they hike – or, more alarmingly, run – all seven in a day. But then again, the definition of ‘a day’ here is flexible.

Lying less than 70 kilometres (45 miles) south of the Arctic Circle, in summer, daylight lingers. In late June, the sun never really sets – it rather bobs on the horizon and then rises again. Winter, of course, brings the opposite – hours of darkness, illuminated only by the glare of white snow under a community’s artificial lights.

Local events

While the area’s natural assets may seem top of the list for visitors venturing 66 degrees north, there are two events in the calendar that see Sandnessjøen’s small population swell. Both are linked to offshore activities: crab-catching and the oil industry. The former is a serious pastime here, with a long history, while the latter is a much newer arrival.

Crabs actually win people medals each autumn, during the town’s world championship event, Krabbefiske. Now in its eighth year, some 150 participants sail out to a predetermined location to see



if their chosen bait will attract the largest haul of red claws. The weekend-long festival puts the Helgeland coastline firmly in the spotlight, much to the delight of the championship’s president, Terje Johansen.

“We have the most beautiful coast in the world,” he boldly declares, “and people come from all over the country each September to compete. The championships take over the town.”

BP is there as well. The company has become the main supporter of this curious sporting event, among its efforts to build lasting relationships in the northern region since the Norwegian Government approved a significant offshore development in 2007. Discovered in 1998, the Skarv field lies 210 kilometres (130 miles) west of Sandnessjøen, and holds an estimated 100 million barrels

of recoverable oil and condensate, plus more than 1.5 trillion cubic feet of gas.

First gas came onstream from the field minutes before the dawn of 2013, with oil production starting three months later. As BP Norge’s first greenfield project since 2001 and its first in the Norwegian Sea, this represented a milestone for the company and the wider BP group, with around 165,000 barrels of oil equivalent a day (boe/d) now in production.

Mutual respect

Locals such as Johansen have been keenly aware of the project since the days it was merely on paper, though. “Originally, people in the community were a little sceptical about oil and gas production activities in the area,” he says. “We asked ‘what’s in it for us?’ and ‘how can we be part of it?’ I’ve followed the project from the start and felt informed every step of the way. As a result, I believe, there is a sense of mutual respect between BP, on behalf of the licensees, and the town.”

Business owners at Sandnessjøen’s other recently-inaugurated annual event, the oil and gas conference, agree. Arnt Jakobsen and his family have run the Slipen Mekaniske shipyard in the town since 1909. In 2003, they stopped constructing vessels, due to competition from the Asian markets.

“Since then, we’ve conducted repair and maintenance only,” he says. “BP gave us the opportunity to tender for contracts on the Skarv project, by joining forces with three other local companies. Together, we worked to raise standards, establish rigorous processes and supply detailed documentation – and won a contract. We now have five employees based on the FPSO »



Rapid response: (above) the MV Island Chieftain's fast response vessel undertakes a drill exercise around the Skarv FPSO; (below) peaks, islands and fjords of Nordland county, just south of the Arctic Circle.







Local community: (main image) Sandnessjøen waterfront, where the crane marks the town's building activity – a result of increased demand for accommodation and facilities in the area; (left) a mechanic works on board the MV Island Chieftain, as it sails out to the Skarv FPSO to deliver supplies; (right) mealtimes on board the Skarv FPSO.



full-time and more than 60 others at the yard on the town's waterfront.

"Sandnessjøen was once a sleepy town – now, there are other oil and gas companies showing an interest in the area, while cranes point to the building activity with two new hotels, a swimming pool and a culture house under way."

This physical evidence of economic growth and anecdotes from locals have now been given academic support in the shape of a three-year study by the Bodø Graduate School of Business at the University of Nordland, which confirms that the development of Skarv has had a positive impact on the region.

The so-called ripple effect is worth an estimated 4.5 billion Norwegian kroner (NOK) (\$750 million), according to authors Jan-Oddvar Sørnes and Jan Terje Henriksen. Of that total, Skarv contracts awarded to local businesses have been worth around NOK 1 billion (\$170 million). To reach that achievement, both BP, as operator, and the region's companies approached the Skarv opportunities with a new lens.

For BP Norge, that meant adapting its established purchase and supply chain

policy to devise a more pragmatic strategy that took account of local conditions. From the outset, the company aimed to facilitate local business activity by offering decentralised contracts and supplier development opportunities, at the same time as working closely with the municipality and public policy and funding agencies.

Collaborative approach

Meanwhile, Helgeland vendors and suppliers also rethought their own business structures, often entering into collaboration, to position themselves to win contracts. For example, eight companies established a joint venture, Helgeland V&M, to provide maintenance and modification services to Skarv. Managing director Øystein Barth-Heyerdaahl says: "In this part of Norway, the companies are traditionally small. In 2008, a group of owners sat around a table together for the first time and decided to work together.

"Three years later, as a joint venture, we signed a five-year contract with BP worth NOK 20 million per annum (\$3.3 million). In 2012 alone, our turnover was more than

NOK 120 million (\$20 million). We have 660 people employed across the eight companies now. With the Skarv project, there's a sense in the community that everyone is part of it, because they've been included and that's very special."

A new production asset, such as an FPSO, requires more than technical support. With 100 beds onboard, the vessel is akin to a floating hotel, where people both live and work. As such, while food is, of course, prepared at sea, dirty laundry is returned to shore on a weekly basis.

While no company in northern Norway had the capacity to take on all the cleaning, catering and laundry services in one contract, BP again decided to split the requirements so as not to exclude local bidders. Situated 300 metres (985 feet) from the onshore supply base, Helgeland Industrier AS (or Hias) won the contract to wash and iron the tonnes of sheets, towels and workwear from the vessel.

Stig Toven, Hias operating manager in Sandnessjøen, says the decision to establish a new location for the business back in 2007 has paid off. "We wanted to position ourselves to take advantage of the



upcoming oil and gas activity, so secured some farmland to build an operating centre here, very close to the port.”

Today, as giant industrial washing machines churn through up to 100 kilogrammes of soiled coveralls in one cycle, some 120 staff are employed at the site, including people with a range of disabilities from a local training programme.

Turning point

According to the town's mayor, Bård Anders Langø, BP's decision in 2006 to locate Skarv's extended operating base in Sandnessjøen – to include supply services, logistics, drilling support, light maintenance and procurement – was a turning point for the entire municipality.

“There had been some decline in the area, in population and economic terms – we'd even lost the post office, which is a fundamental service in any community,” he says. “Immediately, at city hall, we started to make plans and took the decision to invest and build a new quay. Soon after it was completed, warehouses started rising there and we needed another quay, and then another.

“For me, the development is almost personal, as we've spent millions of kroner from the municipal budget. I drive around the quays now and count the number of vessels docked, checking on our investment.”

The mayor needn't worry; the university study also revealed that oil and gas activity in the region has had indirect effects on other industries. For example, the Alstahaug Port Authority has tripled its turnover in the past five years. Air travel has also significantly increased: in Sandnessjøen, passenger numbers have risen from 49,000 in 2006 to 79,000 in 2012, while in Brønnøysund – the base where helicopters fly out to Skarv – numbers have also grown from 70,000 to 105,000 in the same period.

These increases have also had a knock-on effect on demand for hotel accommodation, with projects now under way to triple capacity in Sandnessjøen and increase the length of the airport's runway to receive larger aircraft. More people are choosing to make the area their home, as well, prompting plans for 600 new homes.

The growing population includes 16 BP staff who work at the onshore operations

office, directly supporting colleagues on the FPSO. Many of the team joined the project while the 295-metre-long (970-foot-long) vessel was under construction – the hull and topsides at the Samsung Heavy Industries yard in South Korea, while the turret and mooring system was built at the Keppel Shipyard in Singapore.

Deep understanding

Tove Ormevik, site manager at Sandnessjøen, joined BP Norge in 2010 with 18 years' industry experience. Along with other team members, she lived in South Korea for a year to prepare for the sail-out to Norway and her role involved preparing for operations, by ensuring that the right people gained a deep understanding of the vessel's systems.

“We did the handover process with the commissioning and operations teams, after verifying that all the systems were ready to go,” she says. “Once the vessel was manned, we left the yard in November 2010 and I sailed away on the first leg of the voyage, bound for Singapore. That was an amazing experience; the whole project team stood on the quayside and waved us goodbye.” »



Thriving business: (clockwise from left) laundry from Skarv is washed and ironed at Helgeland Industrier AS; clapperboard houses in Sandnessjøen; BP chemist takes samples for testing; and a helicopter bringing a change of crew lands on the Skarv FPSO's helideck.

“With the Skarv project, there's a sense in the community that everyone is part of it, because they've been included and that's very special.”

Øystein Barth-Heyerdahl





Some 90 days later, the vessel arrived at Stord Island, Norway, for some additional preparation work, and was on location at the field by mid-August 2011 for the all-important hook-up to the pre-installed subsea risers. Although the FPSO appears to be the star of the Skarv show, around half of the development lies beneath the waves.

“We have an 80-kilometre [50-mile] pipeline, more than 40 kilometres [25 miles] of flowlines, 13 risers, five drilling centres and 16 wells, control umbilicals running all the control systems and numerous structures on the seabed,” says Pat McHugh, Skarv project director. “Our nearest drilling centre is about four kilometres [2.5 miles] away and the farthest 14 kilometres [nine miles] away. The architecture associated with all of that kit and the tie-in of our pipeline to the main trunkline that runs through the Norwegian Sea required considerable work and represented half the project.”

Safety considerations

The FPSO is moored by a geo-stationary turret, a very large circular structure anchored to the seabed, with 15 lines and suction cans, allowing the vessel to weathervane around it. “For safety reasons, we positioned the turret part-way along the hull and downwind of the accommodation block,” adds McHugh. “This, however, decreases the vessel’s ability to weathervane naturally, so we added five large thrusters to the hull. These are used by the control room operators to move the hull around the turret to the optimum position with respect to the environment.”

Conditions in this part of the Norwegian Sea can become rather wild in the winter months – so much so that the vessel is designed to withstand three combined potential eventualities: a total loss of power and 100-year storm conditions, while the FPSO is not in the optimal position for the prevailing weather. These factors demanded

the highest-strength mooring systems ever installed.

The first winter at the field exposed the vessel and its team to a taster of the harsh meteorological conditions. “The weather is not particularly cold, but rather stormy with high winds,” says Ormevik. “In 2011, we had waves up to 30 metres [100 feet] and big movements of the vessel. It performed well, though; onboard, you have to think all the time how you can modify activities to deal with that movement and where you’re storing items.”

Although the crew had to become accustomed to the moored vessel in motion, the FPSO’s systems and processes were already familiar since they had been in effect since the sail-out from South Korea. “To prioritise safety and risk management immediately, we ran an extensive training programme on the equipment and facilities and initiated all the systems on a cold [hydrocarbon-free] vessel since the departure from the yard,” adds Ormevik.

That included carrying out the same procedures to obtain a work permit, for example to isolate a piece of equipment, as would be necessary once the vessel was in production. This long period of acclimatisation meant that by the time hydrocarbons were introduced onto the vessel, effective routines were already established.

Knowing the vessel’s systems inside out is also vital for the BP staff onshore at Sandnessjøen, where today’s technology allows the team to see exactly what is happening onboard the vessel, in real time. Field instrument engineer Halvard Benjaminsen also spent time offshore during the hook-up phase. “We’re in daily contact with Skarv, as well as technical authorities in Stavanger, so we have a truly integrated operation,” he says. “Working on the vessel was an invaluable experience as it allowed familiarisation with the equipment – I’ve seen all these parts in

reality and met my offshore colleagues face-to-face.”

With a similar goal in mind, BP Norge’s new managing director, Jan Norheim, paid a visit to both Skarv and Sandnessjøen within a month of taking on the role earlier this year. “My first impression of the vessel at sea – aside from its scale, which I’d already witnessed at Stord Island – was the energy from the crew, who are very determined in what they want to achieve and where improvements can still be made.

“Our priorities for Skarv are clear: to perform safe and efficient operations and deliver our production promises to reach our target of 165,000 boe/d by the end of this year. The field is an important high-margin hub for us, contributing significantly to our production growth from Norway and representing a significant new source of gas to Europe.”

Field life

The expected field life is 25 years, with future potential tie-ins to the FPSO, depending on processing and export capacity. Nearby, the Snadd North discovery, made in 2010, is already in test production, while another smaller discovery from 2012, Snadd Outer, is under review. There is still further production potential under consideration from the Snadd South and Gråsel structures, while exploration will also continue in the area.

In the meantime, Norway’s overall oil production figures reached their highest in July since May 2012, with crude output at 1.576 million barrels a day, 8% above the forecast from the nation’s petroleum directorate. The Skarv field will make a steady contribution to the country’s hydrocarbon output for many years to come. But, it’s on a local level that people are most vocal about its significance: “Skarv has meant everything really,” says Mayor Langø, “it represents a new age, not just for our town, but for the whole region.” ■

SKARV IN NUMBERS

Vessel length = 295 metres (970 feet). The equivalent of four jumbo jets nose to tail

Vessel width = 51 metres (170 feet)

Water depths of field = 350-450 metres (1,150-1,480 feet)

Hull weight = 49,000 tonnes

Production facilities weight = 18,000 tonnes

Mooring turret weight = 7,500 tonnes

Oil production capacity = 85,000 barrels/day

Gas production capacity = 19 million cubic metres/day

Number of wells = 16

Licensees:

BP Norge AS (operator) = 23.84%

Statoil Petroleum AS = 36.17%

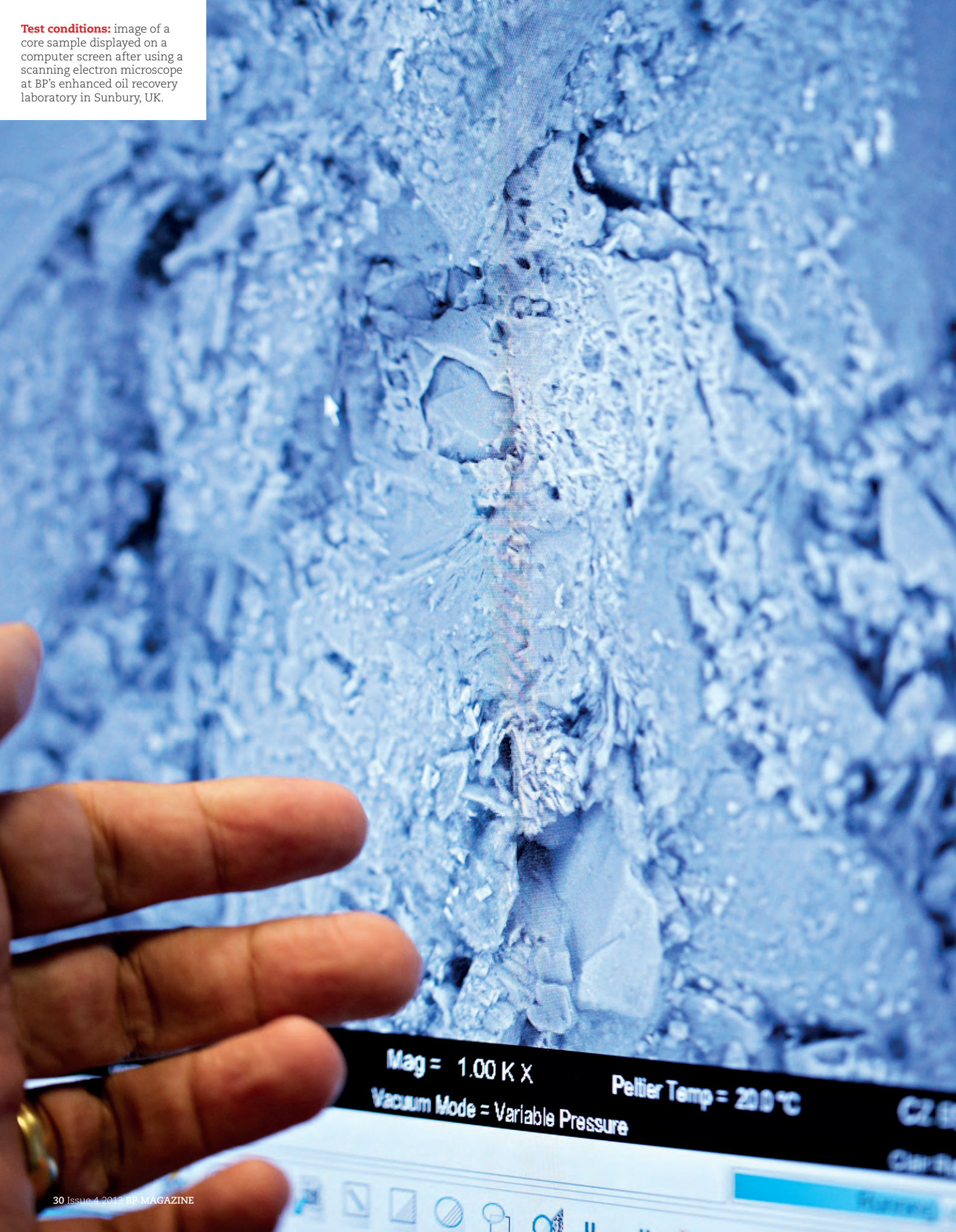
E.ON E&P Norge AS = 28.08%

PGNiG Norway AS = 11.92%

Operational activity: (left) pilots in a helicopter cockpit on approach to the Skarv FPSO, while the vessel loads a tanker with cargo; (main) and a Skarv worker conducts integrity/vibration testing on pipework onboard the FPSO.



Test conditions: image of a core sample displayed on a computer screen after using a scanning electron microscope at BP's enhanced oil recovery laboratory in Sunbury, UK.



ENHANCED PRODUCTION

Global demand for oil and gas keeps climbing, and seems set to continue to do so for many years. According to BP's *Energy Outlook 2030*, the company's annual projection of energy industry trends, by 2030, there will be 8.3 billion people in the world needing energy for light, heat and transport. Energy consumption is projected to grow by 1.6% every year on average from 2011 to 2030, adding 36% to global consumption by 2030. There are three main ways to meet the growing demand for oil: finding new resources; continuing to develop unconventional resources, such as shale and oil sands; and increasing the amount recovered from existing resources. The third of these might not enjoy the high profile of the first two, but it could make a huge contribution.

BP's *Statistical Review of World Energy 2013* revealed that the world's proved oil reserves at the end of 2012 reached 1,668.9 billion barrels, sufficient to meet 52.9 years of global production. But this is based on current recovery rates – even a small improvement in these rates would make a dramatic difference to the size of overall reserves.

In 2011, then-president of the Society of Petroleum Engineers Alain Labastie wrote: "The current ultimate average recovery factor for oilfields, on a worldwide basis, is

about 35%. This means that about two-thirds of the oil that has been discovered is left within the reservoir. We have under our feet, in well-known locations, enormous prospects for booking new reserves. Increasing the average ultimate recovery factor from 35% to 45% would bring about 1 trillion barrels of oil!"

If you drill a well into a reservoir and rely on natural pressure to force the oil to the surface, you will typically recover around 10% of the available volume in place. Unless other forces act on the oil,

pressure in the reservoir will naturally fall as it empties, until, eventually, there isn't enough to force up oil.

It's possible to go some way towards maintaining pressure, by injecting water or gas into another (injection) well. The injected substance is forced through the pores in the reservoir rock, pushing some of the oil ahead of it. This process is known as secondary recovery.

Water injection – or waterflooding – is almost as old as the oil and gas industry itself. It's been used since the late 19th century, although it didn't become standard until the second half of the 20th century. It continues to be very important for BP, still accounting, on its own, for around 60% of the oil that the company expects to recover.

Adding waterflooding increases the amount of oil that can be recovered, with a typical value being 35%, although this can vary significantly depending on fluid properties and reservoir parameters.

Injecting gas to maintain reservoir pressure is not as common as water injection, both because gas is a valuable – and marketable – commodity in its own right, and because more sophisticated machinery is needed to inject it. But it, too, is a technique that BP has used at large scale since the 1980s.

Recovery improvements

Enhanced oil recovery (EOR) is the generic term for techniques used to improve the amount of oil recovered from reservoirs – it is generally used to denote those that go beyond simple injection of water or gas to maintain pressure. The most widely used method is thermal EOR, which involves heating up the oil – usually using steam – to make it less viscous and, thus, easier to



recover. Around two thirds of the world's EOR oil production can be attributed to this technique. But it is exclusively used to recover heavy or very viscous oil, such as that found in oil sands, rather than conventional oil. So, BP's efforts are predominantly focused on other methods, such as gas or chemical EOR.

Enhanced oil recovery makes a real difference for BP's production. The company's massive Prudhoe Bay oilfield in Alaska is on track to achieve recovery of 60%, due, in part, to various EOR projects. At its Ula field in the Norwegian North Sea, essentially all the current production is due to EOR, as Bharat Jhaveri, BP senior advisor, gas EOR, explains: "The Ula field is now essentially only producing EOR oil, so without EOR, there would be no Ula. To my knowledge, this is the only offshore platform in the world that is just producing EOR oil. Some people consider EOR to be something that's nice to have – the icing on the cake – but, in fact, it's Ula's lifeblood now."

Some of the most widely used forms of EOR build on basic gas injection to push the oil through reservoirs. At Prudhoe Bay, for example, BP processes the natural gas that is produced, along with the oil, into two EOR-optimised streams. Jhaveri says: "We take the enormous quantities of gas produced from the field, almost as much gas as Britain uses every day, and put it through an enormous refrigeration plant – effectively a \$1 billion fridge – which takes it to -40 °C (-40 °F). This enables us to isolate components in the gas,

such as propane and butane. Then, we create one stream of 'lean' gas that's virtually all methane, and another stream of what's called miscible gas – because it mixes with the oil, unlike water – which includes propane, butane and carbon dioxide."

The miscible gas is injected into the wells in the oil zone to push more oil from the rock. "Initially, the gas and the oil are in two different states – or phases – but, then, some of the heavier components in the oil transfer into the gas, and some of the intermediate components in the gas transfer into the oil

"The Ula field is now essentially only producing EOR oil, so without EOR, there would be no Ula. To my knowledge, this is the only offshore platform in the world that is just producing EOR oil."

Bharat Jhaveri

until, at the interface, oil and gas begin to look like each other. You can't tell where the boundary is any more; they're the same thing – and that makes it possible to push much more oil out of the rock with the injected gas."

Effective technique

This technique is extremely effective – typically displacing 95% of the oil in the rock it reaches compared with typically 65% for water – but the sweep factor (the amount it spreads through the rock) is limited. So, the gas is alternated with injections of water to improve its sweep.

The lean gas is used for something a little more specific to Prudhoe, as Jhaveri explains: "The whole structure of the field was originally full of oil, then, at some time in the geological past, the field tipped and a gas cap formed at the top of the reservoir. But the space taken by the gas had previously been full of oil. As the gas moved in, the oil drained down over the sand grains and some of it got stuck.

"A good analogy would be tomato ketchup, which leaves isolated blobs on the side of the bottle as it flows. It's the same in an oil reservoir – you end up with what's called 'relic oil' coating sand grains in the gas cap. Only 8% of the oil sticks like this, so who cares? Well, we do actually, because there are 1 billion barrels of it at Prudhoe Bay.

"You can pump water through the well forever, but this relic oil will never shift because it's broken into patches – like the



“There is no substitute for the lessons obtained through field trials and one of the other things that differentiates BP is that we have been prepared to commit to large-scale trials.”

John Peak

Long-term recovery: (far left) BP's Ula field in Norway relies on enhanced oil recovery techniques to continue producing; (right to left) the company's giant Prudhoe Bay field in Alaska is on track to achieve recovery of 60%, due, in part, to EOR projects; (right) a technician at BP's enhanced oil recovery laboratory in Sunbury loads a core sample into the CT scanner.



ketchup – and has lost its continuity, so it can't flow. But, when you inject methane gas, components in the oil transfer to the gas. It's analogous to having moisture on a surface and blowing warm air over it – the moisture vaporises. Then, we put the gas through the processing facilities, followed by the fridge again, which separates the vaporised oil, before recycling the gas to pick up some more oil. We've been doing this since 1987 and, eventually, it will help us to recover several hundred million barrels of extra oil.”

There are several other enhanced oil recovery techniques, all with their own strengths and weaknesses. Which is used will depend largely on local conditions. Gas injection is perfect for Prudhoe Bay, for example, because of the natural gas produced at the field – but it would clearly be less desirable at a field where gas would have to be imported.

John Peak, vice president for BP's Pushing Reservoir Limits technology programme, explains: “New ideas for improving recovery rates are constantly being developed. BP has deployed two advanced EOR techniques in recent years. The first, called *LoSal*[®] EOR, exploits the discovery that low salinity water displaces more oil from rock pores than saltier seawater. The second, called *Bright Water*[™], uses micro-particles that expand in the injection water when they warm up, thus blocking pores in freer-flowing rock zones and forcing the water through zones that were previously poorly swept.” (See *BP Magazine* Issue 3 2012 for more information.)

As EOR techniques become increasingly sophisticated, so does BP's understanding of what it takes to make EOR programmes work. Peak says: “Our experience has taught us that three important factors need to be in place: internal capability, external relationships, and focused deployment.

“Reservoir rock structures are massively complicated, so the only way to be certain about whether an EOR method is going to work is to carry out proper tests in the lab and then in the field. You need world-class laboratories and inhouse expertise to do that and the fact that we have these at BP is one of the things that sets us apart.

“However good your inhouse resources may be, scientific understanding is advancing quickly, so it's important to have relationships with key universities and other research institutions. We're working with the University of Cambridge to improve our understanding of low salinity water, for instance. The *ExploRe* programme is another example of the type of relationships BP has established with universities.”

ExploRe, running since 2009, comprises three projects – at the University of Copenhagen, University of Twente in the Netherlands, and the Max Planck Institute in Germany. BP funding enables these universities to assign teams of physicists, chemists, mineralogists, geochemists, geologists, engineers, mathematicians and biologists to various EOR research projects, the findings of which are shared with the industry.

Peak continues: “When it comes to deployment, we know that to see a return on EOR investment, we must deploy at scale. There is no substitute for the lessons obtained through field trials and one of the other things that differentiates BP is that we have been prepared to commit to large-scale trials.”

BP's pre-eminence in the field of EOR was reflected in the invitation the company received to write a paper on the subject as part of a bigger piece of work on the topic of peak oil, for The Royal Society – the UK fellowship of leading figures in the fields of science, engineering and medicine.

Leading academics

The lead author of the paper is one of the world's leading academics in EOR, Ann Muggerridge, professor of reservoir physics and EOR at Imperial College, London. Professor Muggerridge was also on the team that decided which universities to approach for the *ExploRe* programme, and what the research areas should be.

She says: “If you think about all the technology we use to recover oil – the exploration, the platforms, all the hardware, the various EOR techniques and so on – it's amazing that a cup of oil is still cheaper than a latte you'd buy from a café!” ■

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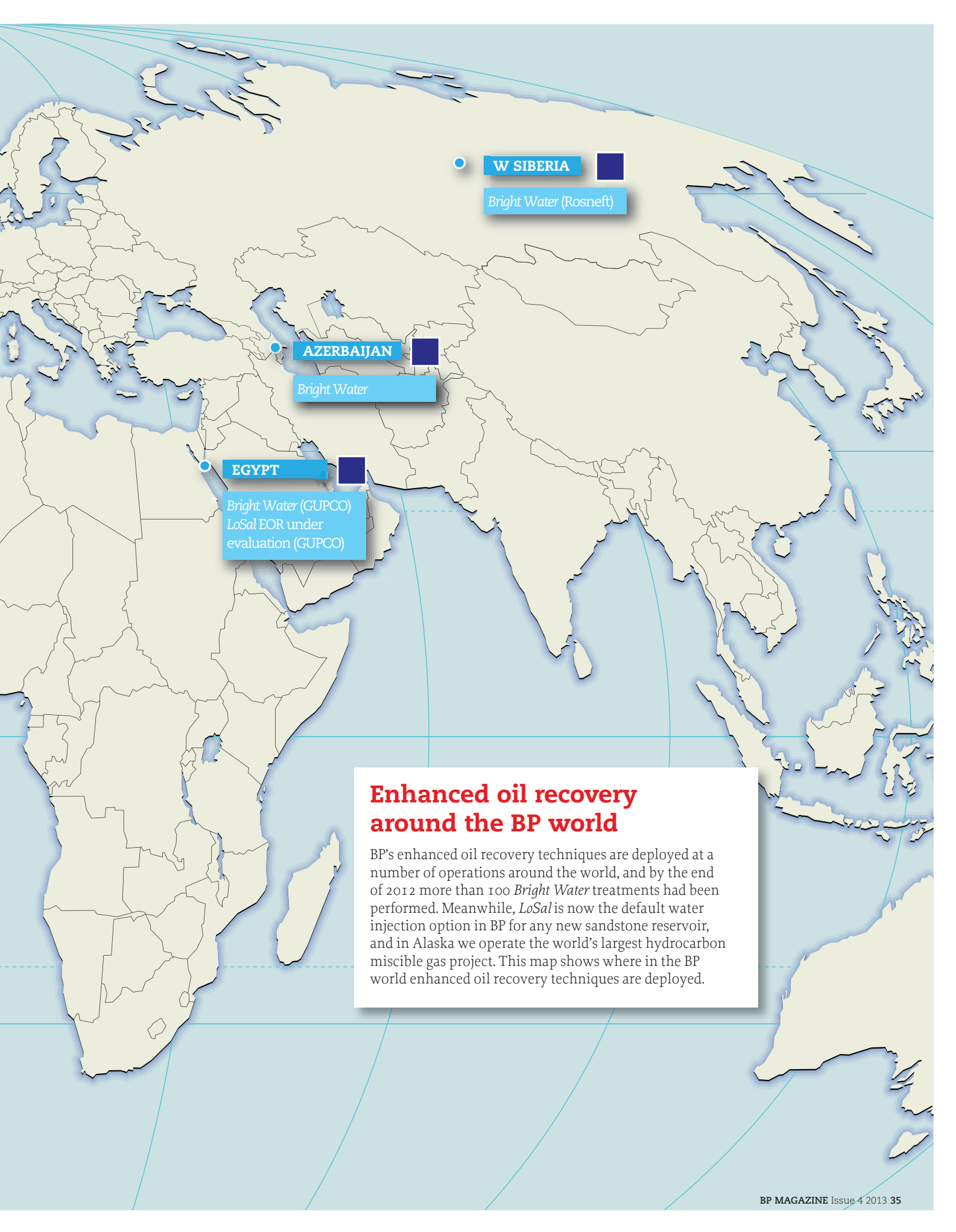
LoSal® EOR
Bright Water™
Polymer

Designer Gas®

Miscible gas
Immiscible gas

ARGENTINA

Bright Water (PAE)



W SIBERIA
Bright Water (Rosneft)

AZERBAIJAN
Bright Water

EGYPT
Bright Water (GUPCO)
LoSal EOR under evaluation (GUPCO)

Enhanced oil recovery around the BP world

BP's enhanced oil recovery techniques are deployed at a number of operations around the world, and by the end of 2012 more than 100 *Bright Water* treatments had been performed. Meanwhile, *LoSal* is now the default water injection option in BP for any new sandstone reservoir, and in Alaska we operate the world's largest hydrocarbon miscible gas project. This map shows where in the BP world enhanced oil recovery techniques are deployed.

Report > Lisa Davison

Photography > Richard Davies/Mehmet Binay/
Graham Trott/Jon Challicom

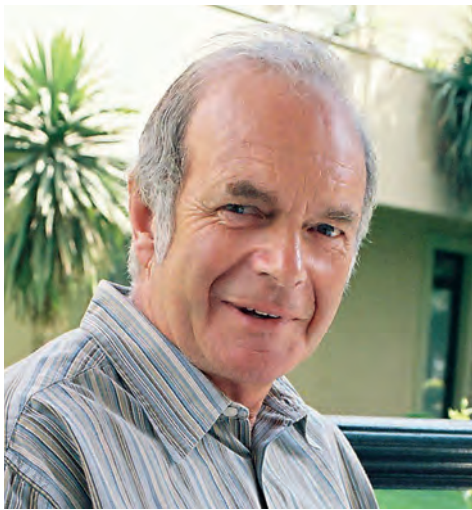
UP FOR THE CHALLENGE

Twenty years is a long time in business and BP is not the same organisation that it was in 1993. Nevertheless, the Upstream graduates who joined the company that year share one thing in common with today's new recruits: they've all been through BP's Challenge development programme.

Graduate life: many of the photographs over the following pages show BP Challenge graduates (from the Upstream business as well as colleagues from the relatively new downstream Challenge programme) taking part in development events in both the UK and Azerbaijan. The Challengers in the green t-shirts are seen here taking part in a Young Scientist Challenge at BP's offices in Sunbury, south England. Below and on page 41, BP's chief operating officer for Production Bernard Looney, took time out to talk with recent graduate Tom Bond and *BP Magazine* at London's Natural History Museum. BP is a corporate partner of the museum.







In 1993, Bryan Lovell, then BP exploration manager for the Middle East and a former university lecturer, posed a question to some of the most senior people in the company. The question was this: “How do you know when a company is moribund?” His answer: “When it stops recruiting new graduates.”



Lovell (far left) had strong reasons for asking the question. BP was facing some serious challenges, including a dramatic drop in its share price and a sharp reduction in the size of its workforce. At the same time, graduate recruitment had almost completely dried up, with the numbers dropping by around 90% in the UK alone. This unplanned cut in recruitment shocked Lovell and his peers.

He says: “It became apparent to those of us in the ‘engine room’ of the company that we were not getting the potential renewal we needed. If you miss even one year in graduate recruitment, then you face a hole in the company that can last a generation.”

So, Lovell proposed a new process of recruitment and development that brought together all of Upstream’s professional disciplines into a single, integrated, international programme. He called it Challenge. Twenty years on, it’s still going strong.

Lovell’s background in developing general science courses – he taught at Harvard and Edinburgh before joining BP – helped him to develop ideas for the programme. As well as practical, on-the-job training, Challengers joined onsite induction events, where they were encouraged to adopt a self-led style of learning on field-based projects.

“The rule was no-one who knew the answer was allowed to give it initially,” says Lovell. “Challengers would work in diverse groups. If there was a geology question, a non-geologist Challenger would be encouraged to attempt an answer before an



expert Challenger weighed in. The idea was that the Challengers would teach each other the basic principles of their own subjects.”

Peter Duff, then the Challenge programme manager and now chief of staff to BP’s chief scientists, says: “BP was very good at training people in their own disciplines. But, Bryan recognised that having connections between the disciplines right from the start adds greater value to your business. In other words, you can do your job much more effectively if you understand the context of what others around you are doing.”

At the time, the Challenge team was acutely aware of the risk of a talent drain farther down the line: “The idea was that we wanted to hire the people who could see the potential of a long-term career in BP across a range of fields and would perhaps one day lead the company.”

Bernard Looney is one such leader. Now BP’s chief operating officer for Production, Looney joined the company just over 20 years ago and was part of Challenge’s predecessor – the Early Development Programme. “When I joined, there were 13 graduates: eight in petroleum engineering and five in drilling engineering. The Early Development Programme was very focused on a single discipline. So, when Challenge was created, that focus switched to creating more structure, being more systematic

and helping new recruits to manage their careers for the first three years.”

Two decades later, Looney remains a supporter of Challenge and mentors a small number of graduates each year. “I think one of the reasons I feel so fortunate is because of the people I have met over the years in our company. The people I’ve worked with, and each boss I have worked for, have been hugely supportive. That continues to this day. But as I look back to the early days, I remember people such as Jerry Gilbert who had a huge influence on my career. He told me the future is unknowable and I should ”

“It became apparent to those of us in the ‘engine room’ of the company that we were not getting the potential renewal we needed. If you miss even one year in graduate recruitment, then you face a hole in the company that can last a generation.”

Bryan Lovell

“I think the way the company is going with its functional model, we are really trying to focus on technical excellence and technical capability in particular fields, and the Challenge programme really promotes that.”

Tom Bond

always concentrate on the job at hand. It was absolutely the best advice. Opportunities will arise that you cannot imagine today. If you do your current job really well, take care of, and respect people, then opportunities will come your way. That is BP.”

Today, BP recruits around 800 graduates every year (many of them into the Upstream business) in more than a dozen countries. Challenge remains a key part of BP’s Upstream recruitment offer, according to Simon Drysdale, head of HR for Upstream: “Hiring and developing graduates is a fundamental part of our people strategy to build deep technical capability. It is one of the most important levers in ensuring the company’s long-term success.”

Each Challenge graduate undertakes two to three job rotations over a period of around three years, with each rotation providing appropriate field or operational experience where needed. Graduates also receive up to 20 days of formal training every year, along with support, coaching, assessments and feedback. Once the three years are complete, graduates can go on to pursue a range of career opportunities, from technical specialists, to leadership roles. There are now more than 3,000 Challengers, past and present.

One such graduate is drilling engineer and current Challenger Tom Bond. He says he became aware of BP’s development programme while at university and believes it sets new recruits on the right path for a career in BP: “I think the way the company is going with its functional model, we are really trying to focus on technical excellence and technical capability in particular fields, and the Challenge programme really promotes that. It looks at the competencies that are relevant to your particular field, lets you focus on those and make sure that you get the opportunities you need to fill them or to progress within them.”

One of those opportunities for many Challenge graduates like Bond is the



chance to experience offshore life as one of the job rotations. It provides vital, practical experience that makes all the difference when it comes to planning the next project.

“It is a very awe-inspiring experience going offshore,” says Bond. “You can learn a lot from technical drawings and books, but it is not the same as seeing it in real life. I used to be a civil engineer and I remember doing my first design of a steel beam for a building, working really hard and then checking it again and again and making sure it was perfect before handing it over to the guy who was supervising me. He brought it back to me with red marks everywhere and said, ‘This is terrible.’ I was really disappointed. He said, ‘Well, this may well fit the loads, it may well do the job exactly, but how are they going to put this in place? It is an eight-tonne steel beam, there is no way they can lift it.’ It is that sort of practical understanding that the offshore experience gives you.”

Looney agrees: “I believe it is fundamental to spend time at a site, with our site teams, to gain experience of our operations and understand the challenges that teams face. It is about learning by doing. I think we want to have an emphasis on delivery and development.”

Naturally, something that has endured for 20 years has had to adapt with the times, but Looney believes Challenge is playing a key role in BP’s offer to new recruits: “We’ve just been voted the top Graduate Employer of Choice for Engineering by students in the UK. This is a great piece of recognition for BP. This says much about our company, but it also speaks to Challenge. As Tom said, it is a significant part of our offer. Challenge is vital and it will evolve as our industry changes. But, the core principles of putting development at the heart of what we do, making sure there is structure, that people get to experience first-hand real operations, that they are given real assessment to help them hone their skills – these foundational principles will endure.” ■

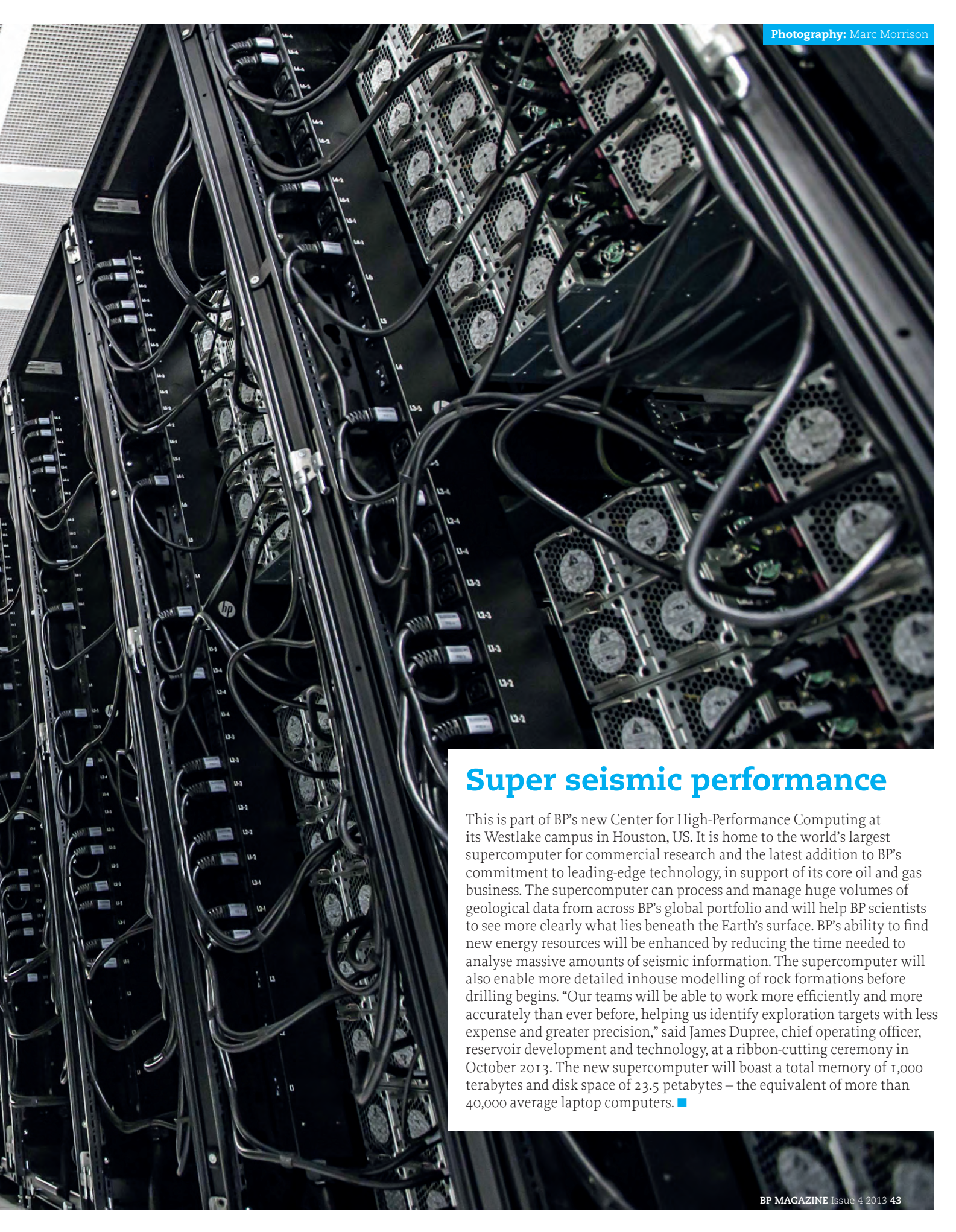


“The core principles of putting development at the heart of what we do, making sure there is structure, that people get to experience first-hand real operations, that they are given real assessment to help them hone their skills – these foundational principles will endure.”

Bernard Looney







Super seismic performance

This is part of BP's new Center for High-Performance Computing at its Westlake campus in Houston, US. It is home to the world's largest supercomputer for commercial research and the latest addition to BP's commitment to leading-edge technology, in support of its core oil and gas business. The supercomputer can process and manage huge volumes of geological data from across BP's global portfolio and will help BP scientists to see more clearly what lies beneath the Earth's surface. BP's ability to find new energy resources will be enhanced by reducing the time needed to analyse massive amounts of seismic information. The supercomputer will also enable more detailed inhouse modelling of rock formations before drilling begins. "Our teams will be able to work more efficiently and more accurately than ever before, helping us identify exploration targets with less expense and greater precision," said James Dupree, chief operating officer, reservoir development and technology, at a ribbon-cutting ceremony in October 2013. The new supercomputer will boast a total memory of 1,000 terabytes and disk space of 23.5 petabytes – the equivalent of more than 40,000 average laptop computers. ■

New and old: Many of the images over the next few pages show current daily life onboard the Magnus platform. A number of them, however, are from BP's archives and show parts of the installation being floated out to site or the full platform in situ.



STEEL IN BUSINESS

BP is refurbishing some of its most mature, but also most valuable, North Sea hardware, starting with its 30-year-old Magnus platform – the largest single-piece steel structure ever fabricated for the UK North Sea and still its most northerly. This investment is testament to the asset's crucial role in the region and the quality of its original construction.

Report> Helen Campbell **Photography**> Ray Smith/David Gold



Sometimes, a name just fits. Meaning ‘great’ in Latin and ‘house of power’ in Old Norse, BP’s Magnus platform could not be more worthy of its title. At the time of installation in the early 1980s, the Magnus platform – at 312 metres (1,023 feet) in height from the seabed to the tip of its flare stack, making it the equivalent of three Big Bens – was the largest, tallest and heaviest single-piece steel structure ever fabricated for the UK North Sea, and it is still its most northerly platform.

Those deployed to work there in the early days say Magnus was viewed as the ‘jewel in the crown’ of BP’s North Sea assets, and that the opportunity to work there was the most desirable Upstream job BP had to offer, even taking into account the long helicopter journey.

Now BP’s oldest UK asset, Magnus has been producing since 1983. The 1978 development submission envisaged the asset producing until the mid-1990s, so Magnus has already surpassed that original expectation by 18 years.

Magnus’s longevity has been due to the emergence of new technologies for increasing the rate of oil recovery. The technologies of water injection and, from 2003, water-alternating-gas enhanced

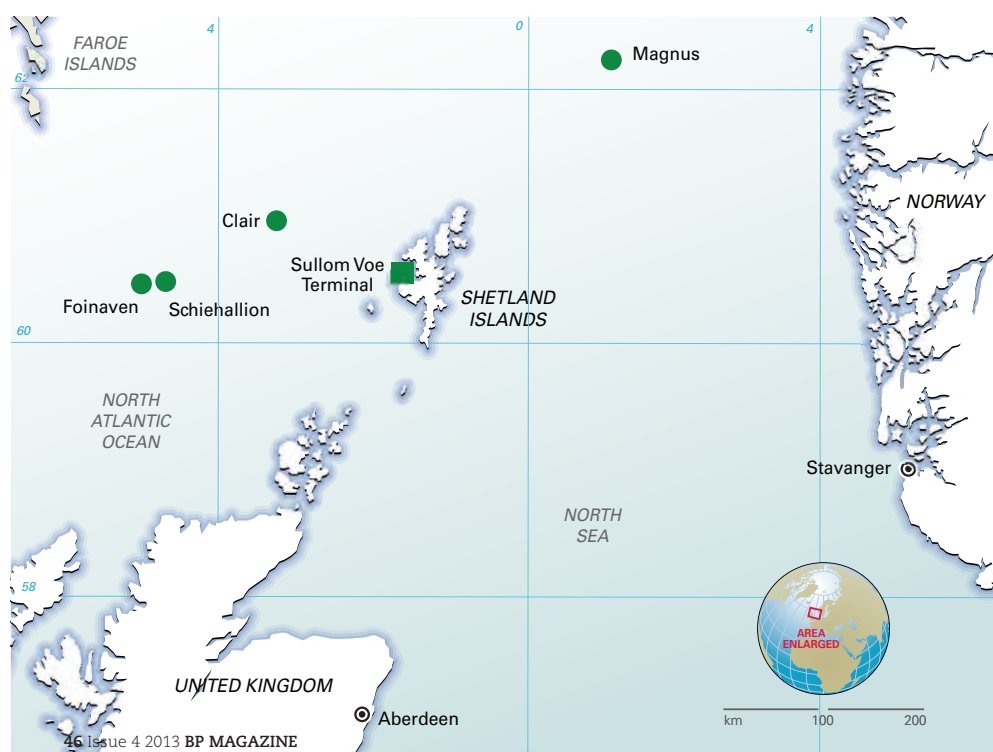
oil recovery (WAG-EOR) have been the cornerstones of the operation’s impressive production performance to date (see page 30 for more on enhanced oil recovery). At discovery, BP estimated original oil in place at between 845 million and 1.15 billion barrels of oil. As a result of enhanced oil recovery, the teams now estimate that 1 billion barrels may be recoverable – around 62% of the oil in place. The WAG-EOR programme accounts for a quarter of Magnus’s current production, making it one of the most successful globally.

The gas injected by Magnus is all imported from BP’s Schiehallion, Foinaven and Clair fields in the area west of Shetland (WoS), via the Sullom Voe terminal in the Shetland Islands. Schiehallion is being

re-developed as part of the Quad204 project (see page 51 for a map highlighting £1 billion of UK investment in Quad204), and Clair is the subject of one of BP North Sea’s largest-ever investments. The WoS area is a key part of BP’s North Sea strategy for the future, but the region’s remoteness means much of the group’s investment there would not have been feasible without Magnus’s ability to handle WoS gas.

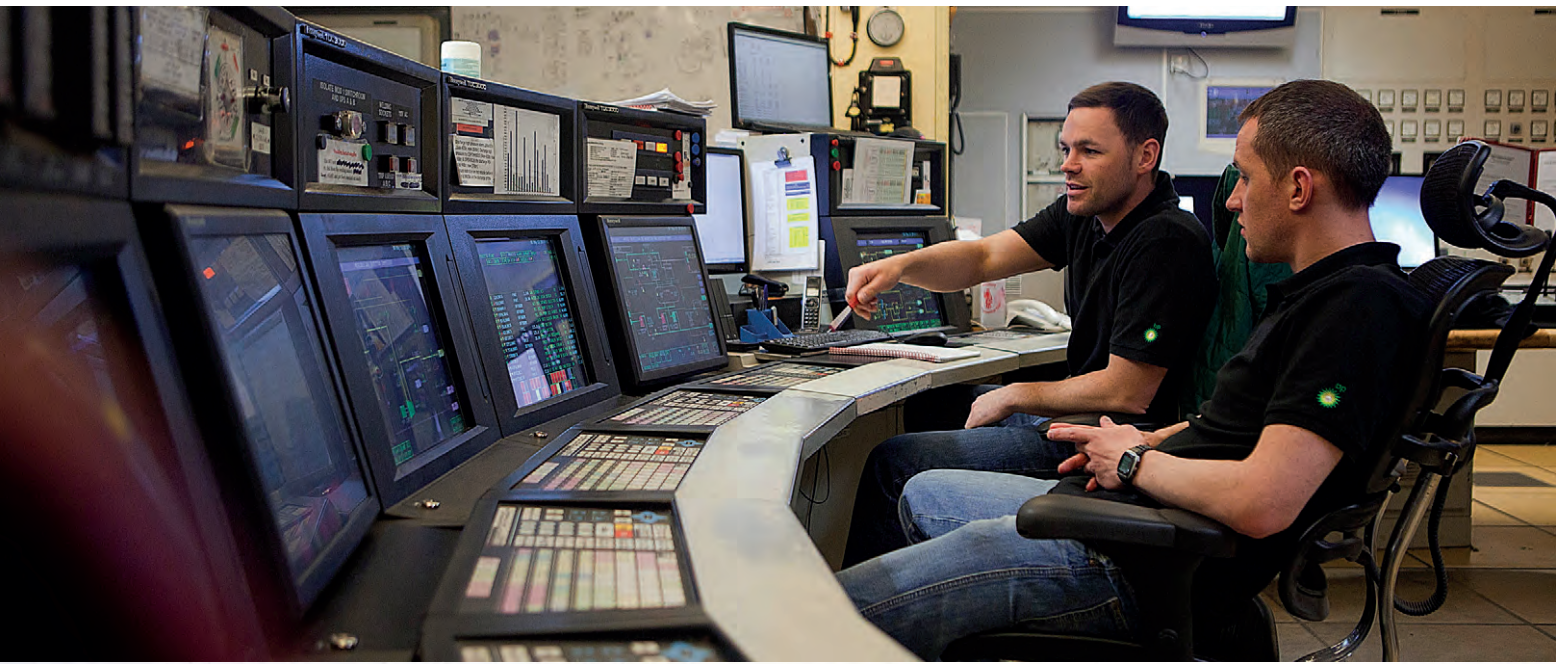
While enhancing recovery from producing areas is the backbone of Magnus’s extended life expectation, that future will also allow BP to continue producing from the deeper and more complex areas of the Magnus reservoir.

“Thirty years after it produced its first oil, Magnus is one of the most important assets BP has in its streamlined North Sea portfolio, for two key reasons,” says Dave Goodwill, vice president of operations, BP »



“Magnus is absolutely key strategically to the region and wider BP business. To be able to reliably produce the existing Clair Phase 1 and Foinaven fields, the new Clair Ridge field and Glen Lyon floating production, storage and offloading vessel, we need a reliable Magnus in order to handle gas from those assets.”

Dave Goodwill



“Magnus’s future is assured by its vital role as a hub for BP North Sea’s west of Shetland gas, but it is also underpinned by the remaining potential of the Magnus reservoir itself. To tap that potential, the asset has an active drilling programme, with wells planned out to 2018 and others under evaluation for later drilling phases beyond that.”

Matt Dunning



FUTURE ROLE

“Magnus’s future is assured by its vital role as a hub for BP North Sea’s WoS gas, but it is also underpinned by the remaining potential of the Magnus reservoir itself,” says Matt Dunning, senior petroleum engineer, North Sea. “To tap that potential, the asset has an active drilling programme, with wells planned out to 2018 and others under evaluation for later drilling phases beyond that.

“The future planned wells are WAG wells (injectors and producers), designed to target areas that have previously been waterflooded and which will now be injected with more gas to increase overall recovery,” Dunning says. “We also have ‘attic wells’ that will target higher areas of the field that BP believes may not have been reached by the original waterflooding and that could hold residual untapped oil.

“In addition, the reservoir team is employing the latest in four-dimensional seismic technology to identify areas of the reservoir that have not been swept and making interventions where appropriate, to continually identify new opportunities and maximise the recovery from Magnus’s wells.”

Daily life: Opposite, onboard Magnus. Below, North Sea conditions are rough and Magnus was designed to withstand waves of up to 31 metres (101 feet) and winds of up to 100 knots. Bottom, Dawson Hardiman, Magnus’s offshore installation manager in the onboard gym.



» North Sea. “Firstly, there are still significant reserves to be recovered from the reservoir, so Magnus still offers major value to the company.

“Secondly, Magnus is absolutely key strategically to the region and wider BP business. To be able to reliably produce the existing Clair Phase 1 and Foinaven fields, the new Clair Ridge field and Glen Lyon floating production, storage and offloading vessel, we need a reliable Magnus in order to handle gas from those assets.”

Magnus has stood the test of time – physically as well as commercially, successfully enduring the harsh and hostile waters of the northern North Sea for 30 years. It was designed, completed and fitted out to withstand 100-year storm conditions, meaning waves of up to 31 metres (101 feet) and winds of up to 100 knots.

Now, the North Sea business plans to equip Magnus for a further generation. It is about to undertake a major overhaul of the operation to set it up for the next 20 years. In what will be the most extensive offshore fabric maintenance programme ever carried out in the North Sea, BP will

“Magnus has changed with the times. From the 1980s to the present day it has adapted to its environment, taken advantage of advances in engineering to help overcome huge technological challenges and is shaping up for a new decade.”

Wissam Al Monthiry

progressively renew and refurbish much of the platform, from the asset’s 27-year-old nitrogen generation plant right down to its accommodation.

The programme will involve some 500,000 manhours and 12 months of near-continuous shifts. The North Sea business will then work systematically to renew and refresh the fabric of the asset on a large-scale-project basis, clearing the way to embark on new drilling and the value-adding work that will see Magnus maximise its potential.

“Magnus’s age means it has one of the world’s most extensive inspection programmes, and one of the world’s most extensive fabric maintenance programmes,” says Wissam Al Monthiry, one of Magnus’s offshore installation managers. “The renewal programme will enable us to do everything we need to do

to set up Magnus for the next part of its life and keep it operating safely.

“We are bringing in a lot of new people to help take it forward, while continuing to draw on the expertise and knowledge of people who have been part of Magnus for a long time, both on and offshore.

“Magnus has changed with the times. From the 1980s to the present day, it has adapted to its environment, taken advantage of advances in engineering to help overcome huge technological challenges and is shaping up for a new decade.”

A model of BP’s management of a valuable late-life asset, Magnus is now looking at a future well into the 2020s and beyond. The approach is likely to be replicated on other assets in the mature North Sea, in line with BP’s approach of focus on its core portfolio in the region. ■

AN EARLY GIANT

Located in the northern North Sea in blocks 211/12a and 211/7a, Magnus is approximately 160 kilometres (100 miles) northeast of the Shetland Islands. The UK’s most northerly-situated platform, it lies 480 kilometres (300 miles) south of the Arctic Circle and just a few kilometres from platforms over the maritime border with Norway. BP was awarded a licence to drill in the block in 1972 in what was only the UK’s fourth licensing round, and discovered oil in May 1974.

Magnus’s resources made sure it easily earned its place as one of the early ‘giants’ of the North Sea, but the field’s location so far north meant it was initially viewed as a ‘marginal’ field that required a financially compelling development solution. The reservoir’s long and narrow shape, delineated with BP’s seven appraisal wells, initially suggested nothing less than a two-platform development would work, but, two years of economic and engineering studies later, BP selected a single-platform development with subsea-completed wells,

and construction commenced in 1980. The project cost £1.3 billion.

Floated out of the construction yard at Nigg Bay, Scotland, in March 1982, the Magnus structure weighed 40,400 tonnes. More than 1,000 individuals worked on the operation to hook up the structure with its 31,000-tonne topsides, and Magnus produced its first oil on 15 August 1983, exporting via the Ninian Central pipeline. At its peak, from the mid-1980s to the mid-1990s, Magnus produced 156,000 barrels per day of oil, 12,000 b/d of gas condensate and 60 million cubic feet per day of gas.

In 1995, the limited number of well slots on the platform led BP to expand the subsea system. This allowed further injection wells to be drilled and the development of South Magnus field, which came onstream in 1996.

The Magnus Extension Project (MEP) in 2006 added an extra four well slots, serving eight new wells, to the platform, enabling further development of the WAG scheme. North West Magnus followed, coming onstream in 2009.

First oil: former British prime minister Margaret Thatcher at the inauguration of Magnus, 14 September 1983.



Quad204 project Contract awards

NORTH ATLANTIC OCEAN

ROSYTH

Oceaneering Umbilicals Solutions
Babcock Marine (Rosyth)

SHETLAND ISLANDS

Loyal
Schiehallion

LERWICK

Veolia Environmental Services

ORKNEY ISLANDS

EVANTON

Technip UK

ABERDEEN

Technip UK
WG Kenny
HPF Energy Service
Stork Technical Services
Subsea 7
Panalpina World Transport
Enermech
Aker Subsea
National Oilwell Varco
London Offshore Consultants
Petrofac Facilities Management
Offshore Design
Oceaneering International Services
Genesis Oil and Gas Consultants
Cape Industrial Services
Sparrows Offshore Services
Det Norske Veritas
WoodGroupPSN

SCOTLAND

NORTH SEA

Redevelopment gains pace

In September BP announced that it and its partners had awarded more than £1 billion (\$1.6 billion) in contracts to UK-based companies. The contracts are for the provision of services and equipment for the major redevelopment of the Schiehallion and Loyal oil fields, located to the west of Shetland. Known as Quad204, the redevelopment project involves two main elements: a brand new floating production, storage and offloading vessel and a major upgrade of the subsea infrastructure that will lie on the seabed. The two fields have already produced almost 400 million barrels of oil since production began in 1998. An estimated 450 million barrels are still available. In total, BP and its partners plan to invest around £3 billion (\$4.8 billion) in total to help extend production out to at least 2035. This map shows the UK-based companies that have won the latest contracts. ■

NORTHERN IRELAND

BROMBOROUGH

VerdErg Connectors

NEWCASTLE

BEL Valves

KNUTSFORD

Oliver Valvetek

HULL

Veolia Environmental Services

LEEDS

One Subsea

NOTTINGHAM

Earlytower

LEICESTER

Emerson Process Management

WALES

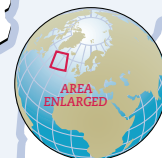
KNAPHILL

VerdErg Connectors

LONDON

Sumitomo Corporation Europe

ENGLISH CHANNEL



km 50 100



Getting the right balance

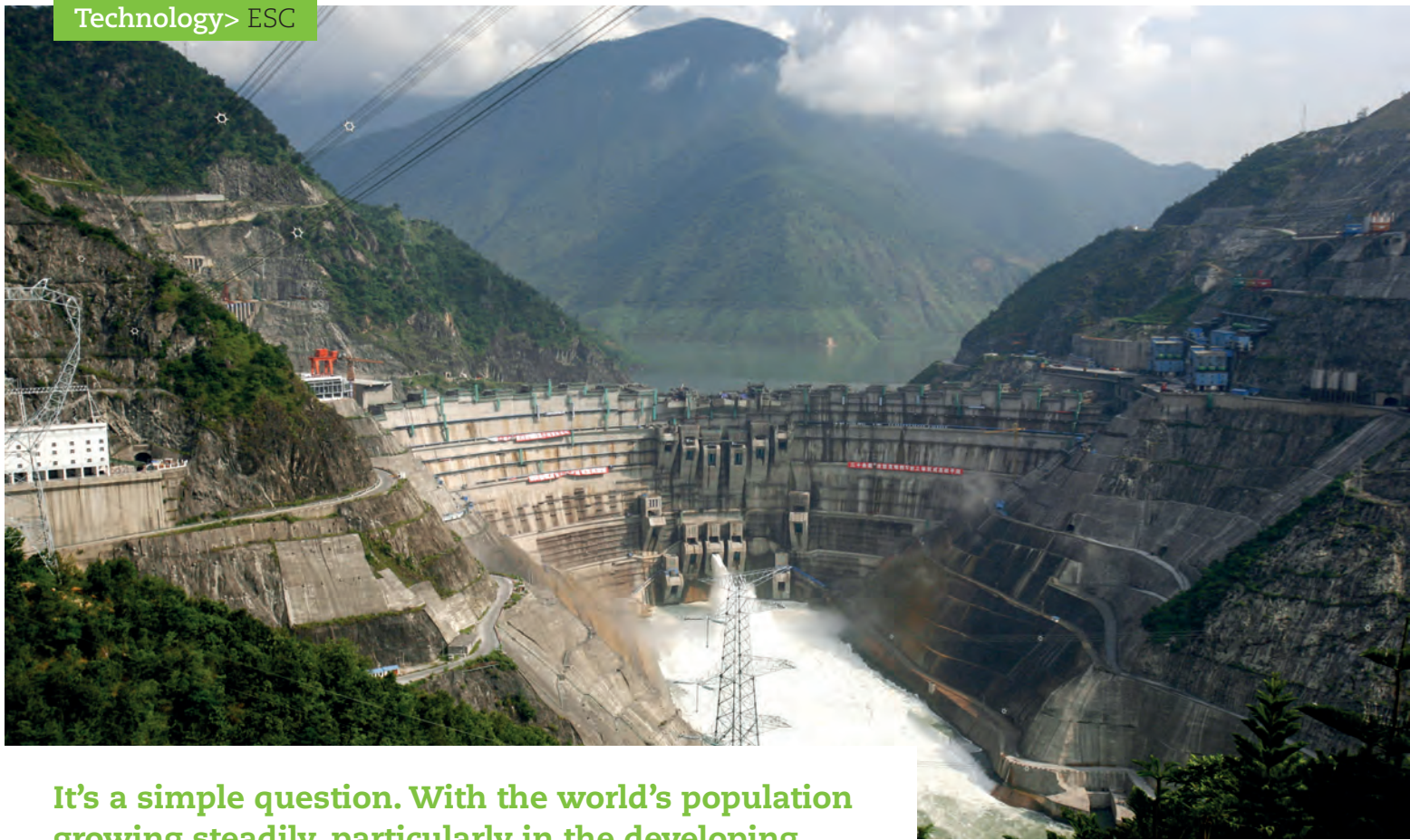
A BP-funded consortium of experts from 15 leading universities is examining the complex relationships between natural resources and the supply and use of energy. Called the Energy Sustainability Challenge, the research programme is investigating the effects of natural resource scarcities on patterns of energy supply and consumption, and has already produced some interesting findings.

Report > Nick Reed Photography > Richard Davies/Marc Morrison/Aaron Tait/Corbis



Natural resources: (clockwise from far left) wind turbines provide low-carbon energy, but their turbines require rare earth elements only found in a small number of locations around the world; a US coal-fired power plant; BP operations at the Khazzan field in Oman. Fresh water volumes are low and the team is looking at ways to minimise water use wherever possible; and crop fertilisation in progress. Further ESC research will combine regional information about land, agriculture, and hydrology within the context of future demand and policy choices.





It's a simple question. With the world's population growing steadily, particularly in the developing world where people are striving to improve their quality of life, too, can the planet's natural resources – water, land and minerals – cope with the consequent rise in demand for energy?

Understanding and responding constructively to these issues is vital for a global energy company such as BP, since they have a direct impact on its project planning and the relationships it develops around the world.

With that in mind, BP commissioned a research programme called the Energy Sustainability Challenge (ESC). Its initial findings suggest that the simple answer is 'yes': there is enough water, land and minerals to keep producing the energy the world needs now and into the immediate future. But inevitably, underpinning these initial findings are a complex web of provisos, ifs and buts that prove there is no room for complacency.

The main proviso is that the answer depends on how the natural resources are used and the balance of amounts used to produce energy against the larger demands for other human activities. Unless humankind learns how to manage these competing demands efficiently, and make the right decisions in areas such as policy and technology, it is in danger of actually

wasting these precious and often finite, reserves, so failing to strike the delicate balance needed to enable a sustainable future.

There's nothing particularly revealing about this as a theory, of course. The fragile nature of the resources that provide us with heat, power and mobility has been one of science's biggest talking points for decades. What is, perhaps, less well understood is how the constraints on natural resources might limit the way we produce and use energy.

Knowledge gap

This is a knowledge gap that the BP-funded ESC has been working to help fill. An international, independent and multi-disciplinary consortium of leading university researchers, its specific brief is to first understand the relationship between energy and natural resources, then use that insight to inform decision-making at the highest levels of government and industry.

The programme was established in 2010 and has explored the discrepancy between

public perception of the relationship between energy and natural resources, especially water, and how regionally varied and increasingly manageable the energy-resource linkages actually are. Initial findings have been published in peer-reviewed papers and summarised in three handbooks covering water, materials and land for biomass.

However, while that linkage is increasingly manageable with the right local governance in place, it does not mean that the world's overall sustainability issues are under control: "Energy sustainability is one of the biggest challenges of our age," explains Ellen Williams, BP's chief scientist. "And we need to increase our technical understanding of energy's relationships with the natural resources that directly maintain life in a systems context, supported by robust data, so that policy makers and businesses can make the right choices. As a responsible citizen of the world, with strong business experience in this specific area, the company is well placed to contribute to this process."

She continues: "The first phase of ESC has given us some high-quality data covering the main areas relevant to this challenge. A sound technical basis of understanding is essential for making decisions about both technology and policy.



Energy mix: (left) water is discharged from the dam at the Xiaowan hydropower station, in the Yunnan province in southwest China; (above) and harvesting energy cane in the US. Energy cane is suitable for growing on non-agricultural or marginal land.

Data drives BP's sustainability planning

BP needs to understand the long-term relationship between its operations and societal decisions on the management of the Earth's natural resources. That's why the Energy Sustainability Challenge research is central to the company's future planning.

"If we want to be competitive in the future we need to have the right technology and the right processes," says Alistair Wyness. "ESC's findings provide us with input to help us identify and implement them."

Wyness points to the physical and legislative constraints on water in certain regions as good examples. "There are very low quantities of fresh water at our Khazzan tight gas field in Oman, for example, so we are looking at new technologies to maximise recovery of fresh water from brackish water and to focus our efforts in minimising water use wherever possible.

"Good, robust scientific data from ESC is driving an innovative and sustainable approach to the use of natural resources."

"We want to get people thinking about these linkages between natural resources and energy in a structured, evidence-based manner. That is why we are making the results of the independent research freely available in a transparent manner," Williams says. "It also provides an opportunity to explode some of the myths in this area, which have been perpetuated through the reshuffling of old or erroneous data."

First results

Many of the results from the first phase of the ESC suggest that some popular misconceptions about energy and natural resources are unnecessarily pessimistic.

For example, research conducted with the University of Augsburg, Germany, and outlined in the ESC handbook, *Materials critical to the energy industry*, explored popular concerns about shortages of minerals, such as rare earth elements used in power turbines or lithium used in batteries. The research shows that, contrary to much commentary, there is an adequate physical supply of the mineral elements needed for energy production. Where problems occur, for instance in rare earth and platinum-group metals, as well as chromium – used in steel production – and cobalt, it is usually because the minerals are only produced in a small number of locations. This makes them

vulnerable to geopolitical forces and other potential disruption.

Another area of common concern is the impact of land use change on greenhouse gas (GHG) emissions, especially in the context of biofuels. The ESC explored this issue with a team from University of Illinois at Urbana-Champaign and discovered that many perceived problems are the result of only looking at the first year after a change in land use. In fact, once new land cover is established, the true results of the GHG impacts unfold over decades. As part of the work, the University of Illinois team created a GHG value calculator, which has a web-interface that allows a rapid comparison of the anticipated GHG effects of different land use types over the projected lifetime of a biofuels project.

The relationship between water and energy production is another area with significant implications for oil and gas industry operations. The perception, here, is that energy production can create large stresses on water resources. ESC research published in the BP handbook, *Water in the energy industry*, revealed much misunderstanding and unnecessary pessimism about water and energy. The biggest misunderstanding comes from the assumption that fuel production and electrical power generation are the same

"We want to get people thinking about these linkages between natural resources and energy in a structured, evidence-based manner. That is why we are making the results of the independent research freely available in a transparent manner."

Ellen Williams





Global issues: (left) an engineer tests forged steel. Chromium is used in steel production and, like rare earth elements, is found in a small number of locations around the world; (main) and BP's Kwinana refinery sits on the shore of Cockburn Sound. The refinery's water-minimisation initiative has seen dramatic reductions in fresh water usage and waste water flow.

thing. Electrical power generation has a large cooling requirement, which is responsible for around 10% of human withdrawals of fresh water. Water withdrawals for fuel production and refining together are much smaller – less than 2% of the world total. In both cases, technical advances over the past decades have demonstrated that it's possible to use a lot less fresh water. BP's water-use-minimisation initiative at Kwinana refinery, Australia, is a good example. The initiative ran between 1996 and 2009 and was responsible for a 48% reduction in fresh water use, 92% reduction in potable water use and lowered waste water flow by 47%. As demonstrated at Kwinana and other refineries, there is room in the future to effectively manage water demands for energy and power, even as the amount of energy and power the world requires increases.

Complex web

Understanding the web of interactions among the different resources, energy, and climate issues is a complex one and to help unravel this complexity, one ESC project, based at the University of Cambridge, UK, has developed a tool called Foreseer. The tool helps inform decisions about managing natural resources by visualising the factors involved along the entire path, from source to end use. With this tool, further ESC work will combine regional information about land, agriculture, and hydrology within the context of future demand and policy choices.

Overall, the ESC research shows that pressures on water, land and minerals need not constrain continued growth in the use and production of energy, but confirms that this positive conclusion depends entirely

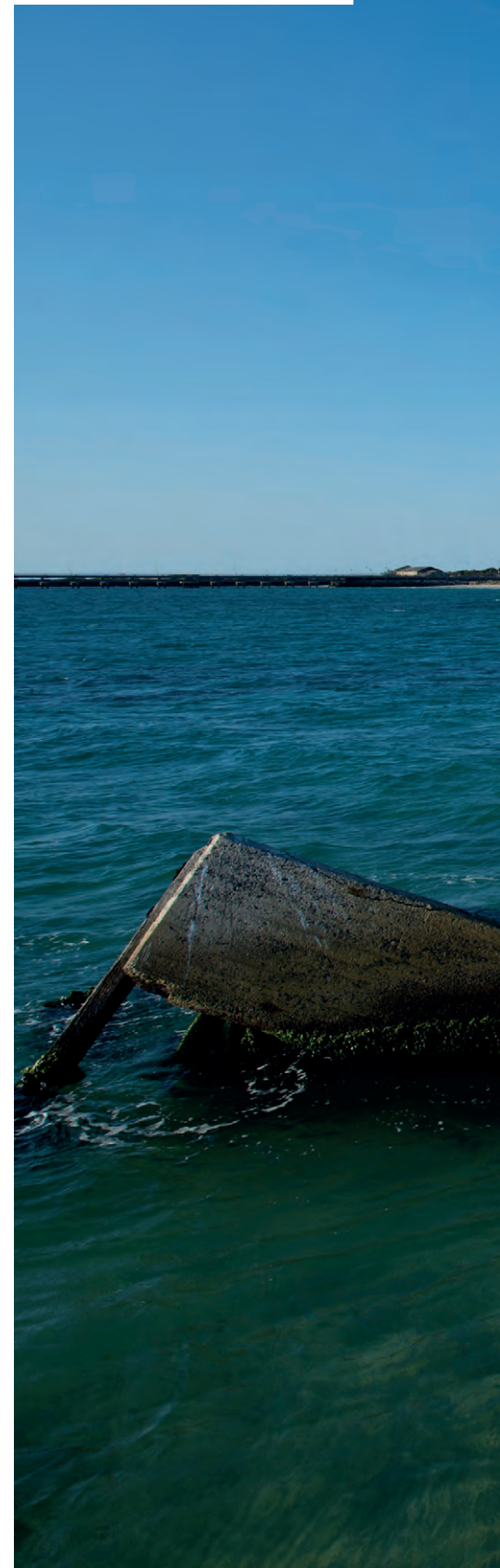
on sensible policies and using the most effective technologies.

A number of projects under way in the current, second phase of ESC research are in areas and regions of direct interest to BP operations. BP Biofuels is funding the upgrade of a model at MIT to improve understanding of the global economic potential for biomass in the presence of water constraints, for example. Local BP operations are working with Harvard University to research the allocation and use of water in the UAE, Jordan and Oman. And BP China is investigating how it can use the Foreseer tool to choose sustainable business options, while also demonstrating BP's commitment to science-based planning. In particular, since coal remains a preferred feedstock in China, an ability to understand its water needs is paramount.

Resource management

"The ESC research supports the view that natural resources for energy production can be managed sustainably, but doing so depends on the right policy framework and adoption of the right technologies, and it won't be easy given the wider natural resource issues," Williams concludes. "It's clear that there could be dire consequences if the world doesn't make the right decisions on resource management and usage. But I am optimistic about the future, because there are many times in my life when the world has been made aware of a growing crisis and responded to it.

"That's what ESC is all about. The findings of its participating universities are helping today's leaders respond to an increasingly challenging issue and make the right choices about the future. And I'm delighted that BP can play a role in that process." ■



“The ESC research supports the view that natural resources for energy production can be managed sustainably, but doing so depends on the right policy framework and adoption of the right technologies, and it won’t be easy given the wider natural resource issues.”

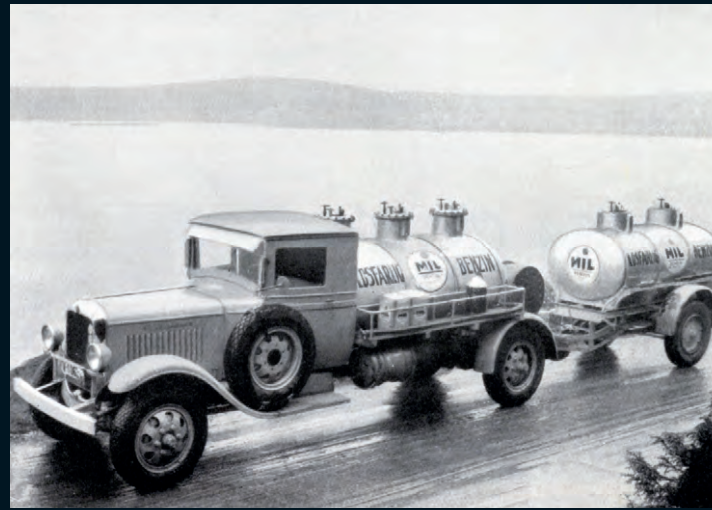
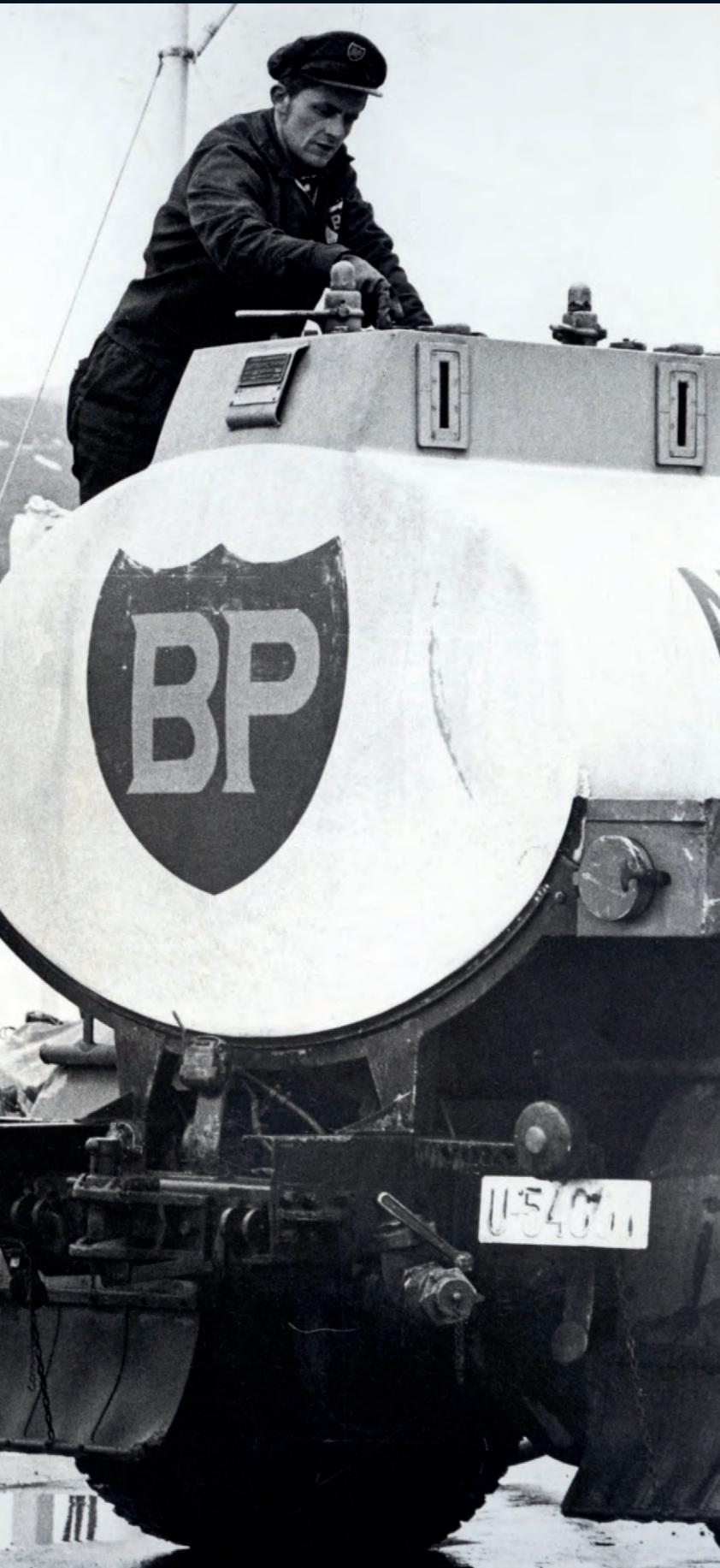
Ellen Williams



Main: marine fuels were big business for BP in Norway. This photo was taken in July 1970.

Inset: a road tank car with trailer, each vehicle holding 2,000 litres of Mil BP Motor Spirit, March 1932.





NORWEGIAN NOSTALGIA

BP has had a presence in Norway since 1920. While much of the focus today is on offshore exploration and production, the company has a distinguished history of supplying fuels up and down the land of the midnight sun.

BP
FOR T-O-TAKTERE
BP-ZOOM





Opposite: a motorcycle cross-country steeplechase at Hønefoss, 65 kilometres (40 miles) northwest of Oslo. The rider is Norway's champion, Jan Gjestrum Larsen passing under the BP Zoom banner, September 1961. **Top left:** the small motor tanker Mil, used for replenishing supplies at the large branch installations around the Norwegian coast. The Mil is seen here leaving the installation at Svolvær, in the Lofoten Islands, March 1932. **Above:** Sjursøya, near Oslo, where BP Norway has its largest distribution installation with laboratory and offices, September 1961. **Left:** AirBP fuels a SAS aeroplane, July 1970. **Bottom:** a BP seismic survey team at work in Spitsbergen, Norway, 1986.





Crab season

Photographer Stuart Conway took this portrait photograph of Terje Johansen, organiser and president of the world championships in crab-catching, while visiting the small coastal town of Sandnessjøen in northern Norway. The curious sporting competition Krabbefiske takes place every year in the waters off Nordland county, and 2013 saw more participants than ever. The crab-catching season runs from August until December and it's an activity that locals take seriously. "We're fully subscribed each September and the weekend-long festival attracts visitors from around the region," he says. "We take over the town and BP Norge has been our main supporter for the past six years."

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Our chief geophysicist.



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