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GL Group
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energize

energy. efficiency. engineering.

oil & gas

Safety First!

market trends Tough Operating Conditions
stricter regulations Lower Risk, Higher Costs
mooring systems Going Through The Ropes

GL Noble Denton

Complex marine engineering's a breeze when John is on the case

Registered with the Association of Professional Engineers and Geoscientists of Newfoundland

Operates a wide range of vessel stability and marine engineering software packages

Applies his skills both at his desk and out on the high seas

Rides a Kawasaki KLR650 trail bike around the Newfoundland wilderness

John brings 15 years of naval architectural engineering experience to GL Noble Denton's team of expert technical advisors in St John's, Canada. As one of our Principal Engineers, he's trusted to provide guidance on a multitude of industry challenges from high-value marine warranties to asset structural design and analysis.

Our clients rely on John when time's tight and there's a window in the weather to get an asset moved and secured. One particular project team knew they had the right man for the job when a semi-submersible that John had meticulously moored emerged unscathed from an encounter with Hurricane Bill.

John is one of the thousands of dedicated experts our clients count on every day

Learn more about him here **www.gl-nobledenton.com/John**

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GL Noble Denton is the independent technical advisor to the oil and gas industry

To Our Readers

Pekka Paasivaara

The next 50 years: The motto of this year's SPE Offshore Europe Conference and Exhibition reflects the optimism of an industry steeped in success; but while new technologies and resources seem to justify this mindset, the future will also bring challenges to our sector. The presentations and speeches given at this year's conference address this issue head-on and, as a major independent technical advisor to the sector, GL Noble Denton will participate actively (p. 8).

Safety and risk management has become a dominant issue for our industry. The Macondo incident in 2010 made it clear that the increasing complexity of offshore engineering projects calls for new concepts in risk assessment and mitigation. GL Noble Denton has developed a method to estimate the financial risks of lost well control (p. 40). Catastrophic events such as Macondo inevitably lead to tougher safety regulations. In a recent GL Noble Denton survey of senior oil and gas professionals, nearly 90 per cent of respondents expected US oil and gas regulations to become tougher over the coming months. And while a slowdown in investment is considered unlikely, operating overheads and the cost of compliance are expected to increase (p. 18).

But compliance with regulation is only the first step to safer operations. Hazard awareness training at our Spadeadam test site in northern England opens the eyes of industry professionals for technical risks by letting them experience the impact of a controlled hydrocarbon release incident in a controlled environment (p. 14).

Knowing what can happen helps managers make the right decisions. For offshore interventions, well-planned procedures, quality engineering and clear instructions are key to reducing risks and minimising schedule delays. Read on page 38 how a storm-damaged FPSO was successfully restored thanks to technical and operational support by GL Noble Denton.

Safety always comes first – but asset downtime is costly, and it is vital that operators achieve good balance between unplanned downtime and optimised production. Maximising uptime without surprises (p. 22) explains how Galiom, GL Noble Denton's advanced risk-based inspection and maintenance software, helps clients identify, predict and address asset-specific operational issues.

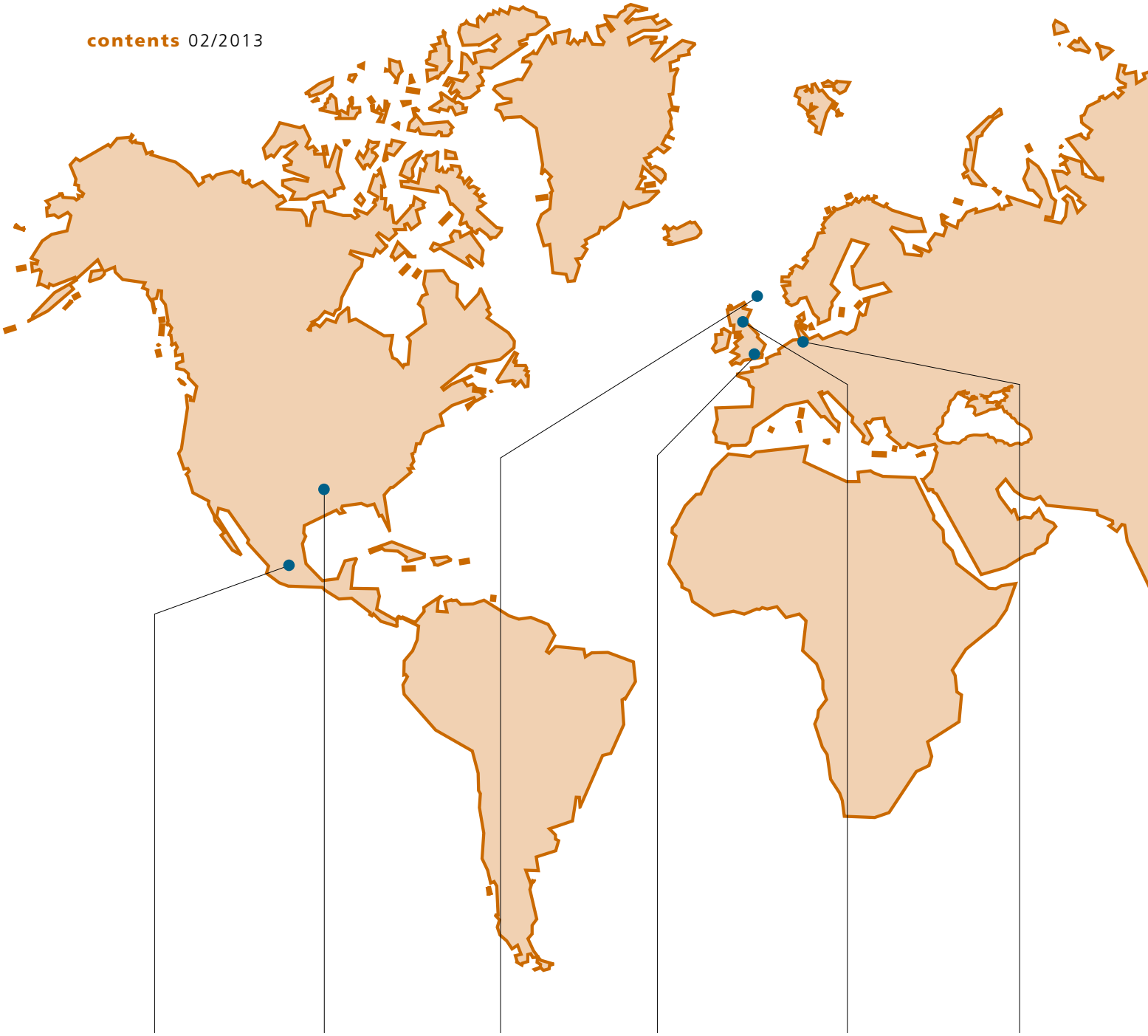
As we get ready for the next 50 years of oil and gas operations, we must seize new opportunities to brace ourselves for new challenges. The proposed merger of DNV and GL Group creates a tremendous opportunity to build a powerhouse of global expertise and an unmatched portfolio of services for the benefit of our clients.

Enjoy reading! We look forward to providing you with our services.

Yours sincerely,

Pekka Paasivaara

Member of the Executive Board, GL Group



SOFTWARE
Galiom enables risk mitigation and inspection

AUSTRALIA
Vast operational challenges lying ahead

GL Noble Denton in Brief

- GL Noble Denton is a **TECHNICAL ADVISOR AND TRUSTED PARTNER** for the oil and gas industry.
- The Oil & Gas business segment of the GL Group helps to design, build, install and operate onshore, maritime and offshore oil and gas assets to ensure **SAFETY, SUSTAINABILITY AND SUPERIOR VALUE.**
- GL Noble Denton is the **MERGER BETWEEN GERMANISCHER LLOYD'S OIL & GAS BUSINESS AND NOBLE DENTON**, a premier provider of life-cycle marine and offshore engineering services. Since January 2010, they have been offering their services as GL Noble Denton.

GL Noble Denton is a full-service provider with broad upstream and midstream competence **FOR THE COMPLETE ASSET LIFECYCLE.**

GL Noble Denton combines excellent engineering and analytical skills with operational experience of offshore, maritime and onshore oil and gas assets. The Oil & Gas business segment of GL employs **MORE THAN 3,000 ENGINEERS AND EXPERTS IN 79 COUNTRIES.**

We have strong expertise in complex oil and gas assets such as MODUs, FPSOs, pipelines, subsea systems, OSVs – and assurance, asset integrity, safety and risk, marine operations, project management and software services to match. The scope of technical services includes safety, integrity, reliability and performance management.
GL Noble Denton is **A TRULY INDEPENDENT ADVISOR** without any vested interest in selling a design, installation, fabrication or equipment.

GL Noble Denton services oil and gas clients in onshore production, onshore pipelines, storage, import terminals, LNG, refineries and petrochemicals, distribution networks as well as mobile offshore drilling units, mobile offshore production units, fixed platforms, subsea, risers and flow lines, offshore support vessels, tankers and shipping, and offshore pipelines. We oversee and support the full lifecycle of an asset from project concept to decommissioning. The business segment has **A GLOBAL REACH IN THE OIL AND GAS CENTRES** of the world.

GL Noble Denton
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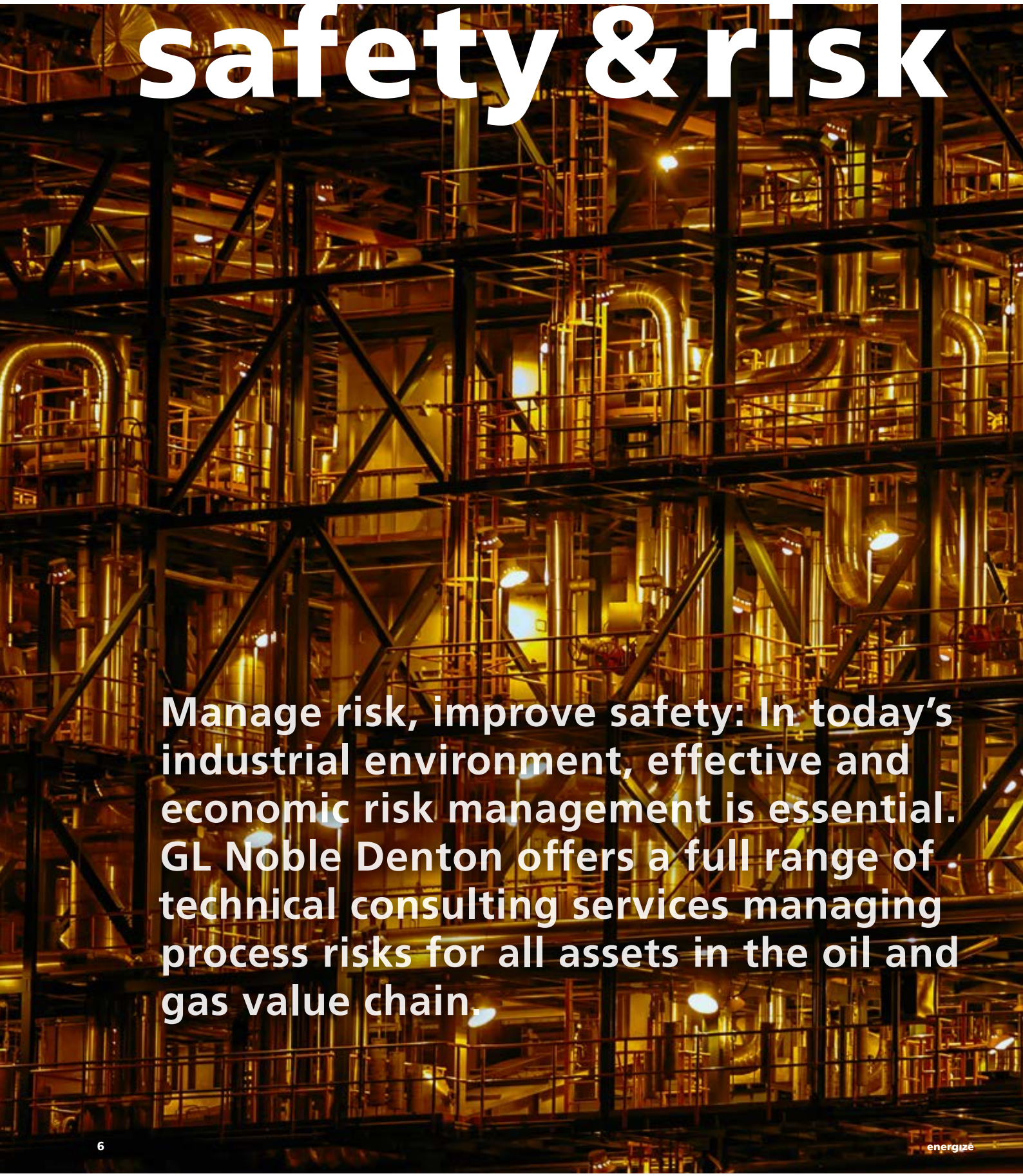
safety & risk



Manage risk, improve safety: In today's industrial environment, effective and economic risk management is essential. GL Noble Denton offers a full range of technical consulting services managing process risks for all assets in the oil and gas value chain.

Photo: Pat138241 | Dreamstime.com

Offshore. GL Noble Denton has served North Sea clients for more than 50 years.

Photo: Bombaman | Dreamstime.com

“We Face an Acute Shortage of Skilled Professionals”

GL Noble Denton reinforces its strong commitment to the North Sea oil and gas industry, says Executive Vice President Europe Lutz Wittenberg

ENERGIZE: This year’s Offshore Europe is being held in Aberdeen. Why is this an important event for GL Noble Denton? What makes it relevant for customers?

LUTZ WITTENBERG: Offshore Europe provides the North Sea oil and gas industry with an opportunity to come together to discuss key opportunities and challenges it faces in a period of exciting growth in this region. GL Noble Denton has provided valuable technical advice to North Sea clients for more than 50 years now. We have contributed to the development of a number of „industry firsts“ over that period, and our presence at Offshore Europe reinforces that commitment to the North Sea oil and gas industry.

The great thing about this event is that it serves as a platform for industry professionals to share their ideas and technical knowledge. The oil and gas industry is built upon collaboration, and as an independent technical advisor to the sector, GL Noble Denton has an important role to play in that network.

During this year’s Offshore Europe, GL Noble Denton will be working with Offshore Engineer magazine to host a series of technical briefing sessions on technical, environmental, regulatory, inspection and maintenance strategies for floating production. The event, which will include presentations from a range of GL Noble Denton experts in this field, aims to share industry best practice and to profile our experience in this important area of operations. ▷

ABSTRACT

- Offshore Europe is the industry’s leading conference and exhibition
- Safety and risk, and the lack of skilled personnel are key issues this year

Our industry will see continued expansion into more challenging operating environments.

Lutz Wittenberg, Executive Vice President Europe

Aberdeen. **Offshore Europe 2013 attracts a global audience of oil and gas professionals.**

PIPER ALPHA. Former North Sea oil production platform, later converted to gas production. An explosion and the resulting oil and gas fires destroyed it on 6 July 1988, killing 167 men, with only 61 survivors.

▷ **ENERGIZE: What main trends do you expect over the course of the next year?**

WITTENBERG: Over the next year, the oil and gas industry will see continued expansion into more challenging operating environments. In light of this, we will see an upward trend in capital investment, as the price of oil remains strong. Recent industry research conducted by GL Noble Denton also indicates that HSE and risk management will remain a top investment priority for the oil and gas industry. Indeed, in this area we have begun to see major operators undertake more focused and coordinated approaches to managing the safety and risk profiles of their operations worldwide. The sector's supply chain has not escaped the effect, as operators thoroughly reassess the way they procure and manage technical services such as third-party inspection, marine warranty and engineering consulting. Increasingly, major operators have recognised that, if they are to manage safety and risk consistently and on a global basis, they need to have a tighter control over quality and performance. For this reason, many operators have begun to consolidate and rationalise their technical advisors from hundreds of disparate companies to just six or seven global partners, via a robust and quality-focused global procurement process. GL Noble Denton has already been selected to conduct third-party inspections for BP and Shell on this basis, using our proven global operating model.

ENERGIZE: What are the challenges facing the industry?

WITTENBERG: Perhaps one of the greatest challenges facing the industry on a global scale is that of an acute shortage of skilled professionals, according to a survey amongst more than 400 senior oil and gas professionals published by GL

Photos: Bomboman/ Leofrancini/Sanuyufoto | Dreamstime.com, Offshore Europe

Noble Denton earlier this year. The oil and gas industry is struggling to mitigate the risk of seeing a raft of skilled oil and gas professionals approaching retirement, with fewer experienced colleagues to succeed them. Much of this trend is owing to a major fall in the price of oil in the early 90s, which rendered the industry unattractive to work in among young people at the time. The cost of sourcing staff and paying their wages is likely to increase as the best talent gains a premium price. This trend is particularly hard to swallow for an industry that already has to deal with the cost of tighter margins, greater overheads, higher risks, more rigorous regulation and tougher contract terms.

ENERGIZE: Could you highlight one of GL Noble Denton's projects in Europe and tell us more about its scope?

WITTENBERG: One outstanding example of GL Noble Denton's engagement in Europe is the Gryphon re-mooring project. This marine operation was a particularly challenging endeavour due to its complexity. Following a storm in the North Sea the Gryphon FPSO had suffered severe damages. GL Noble Denton provided Maersk Oil with technical and operational support, and successfully towed and eventually reconnected the vessel to its moorings. Not only did our experts work very closely with Maersk Oil giving engineering advice during the whole process of repairing and upgrading the vessel, but they also assisted in preparing the vessel for its return to operation. Thanks to our marine operations and engineering expertise we completed this major re-instatement project successfully despite sometimes adverse conditions in terms of weather or the ▷

Landing. Technical and operational support is a question of time, apart from quality.

Global Framework Agreements

One of the major industry trends that emerged in 2012 was the move by a number of major operators towards a more focused and coordinated approach to the procurement and management of third-party technical services. In an effort to manage the safety and risk profiles of their operations worldwide, many of GL Noble Denton's clients have begun to consolidate and rationalise their suppliers from hundreds of disparate companies to just six or seven global partners, through robust and quality-focused global procurement processes.

Recognising this shift, GL Noble Denton enhanced its approach to managing global client projects in 2012 by formalising its global operating model, thereby winning a number of key global contracts since last year. GL Noble Denton was awarded a four-year inspection services agreement by Shell, followed by an multi-million-dollar agreement with BP, to become one of a small number of prefered inspection vendors.

Norway. GL Noble Denton is well established in the world's largest offshore market.

▷ challenges resulting from the Gryphon's new mooring configuration.

ENERGIZE: We have recently marked the 25th anniversary of the Piper Alpha disaster. What is the current state in the industry regarding safety practices?

WITTENBERG: Ever since the Piper Alpha incident, safety and risk management has become a fundamental part of oil and gas operations. Research conducted by GL Noble Denton this year has revealed that industry spending on health and safety has risen to unprecedented levels, as companies continue to develop robust practices, technology and training that keep safety at the top of the agenda. Since Piper Alpha, the evolution of risk management technologies such as modelling software has allowed the oil and gas industry to take significant steps forward in managing risk by simulating the causes and effects of hazardous situations in a virtual environment.

Reported incidents of hydrocarbon releases also remind us of the high risks we continue to face in our industry. We have to keep working on continuous improvements and enhancements to safety and risk management processes. Constant awareness of the hazards of operations in the oil and gas sector remains a critical concern. Risk management needs to be accompanied by robust hazard awareness programmes, such as those offered by GL Noble Denton at our secure Spadeadam test site in northern England. In the wake of the Piper Alpha incident, the British Government acted swiftly to reform oil and gas regulation. Still, we need to step back again and again to examine whether the regulations are still fit for purpose and able to evolve with the industry's changing needs, technologies and practices.

Many countries look to goal-setting regimes – such as those of Norway and the UK – when establishing their own regulatory framework. GL Noble Denton is currently working with governments across Europe and the Middle East to help create new goal-setting legislation for their oil and gas industries. In Ireland, for example, we have been working with the Irish Commission for Energy Regulation (CER) to introduce new upstream safety regulations that cover onshore and offshore production. A team of safety and regulatory specialists has been working with the CER for a number of years to review different regulatory approaches being used around the world, to identify the ones most suitable for the Irish industry, and they are using these practices from the regimes in the UK and Norway, among others, as a basis for developing new regulations.

Support. GL Noble Denton offers customers comprehensive, top-quality marine and engineering expertise.

ENERGIZE: Considering the upcoming merger of DNV and the GL Group, what does this hold for the future of the new company DNV GL Group in your opinion?

WITTENBERG: The proposed merger will be a game changer for DNV, the GL Group and our clients. It provides us with an unprecedented opportunity to form a truly unique business that offers a greatly enhanced portfolio of complementary technical assurance and advisory services for the industries we serve.

In particular, the oil and gas business area of the proposed DNV GL Group will provide exceptional global coverage, with one of the industry's broadest networks. This will help us to deliver a fast and local response to client needs, with the support of enhanced service quality and technical competence. This merger is about bringing together two organisations, each with a strong heritage in the oil and gas industry, in addition to a reputation for outstanding quality and innovation. It will provide our clients with world-class engineers across a wide range of technical disciplines, supported by significant investment in R&D, and will create an authority in industry best practice. □ **RC**

GL GROUP EXPERT:
Lutz Wittenberg
Executive Vice President Europe
Phone: +49 40 36149-313
E-Mail: lutz.wittenberg@gl-group.com

The Training Challenge

Experiencing hazards first-hand could have a marked benefit throughout a company's safety culture

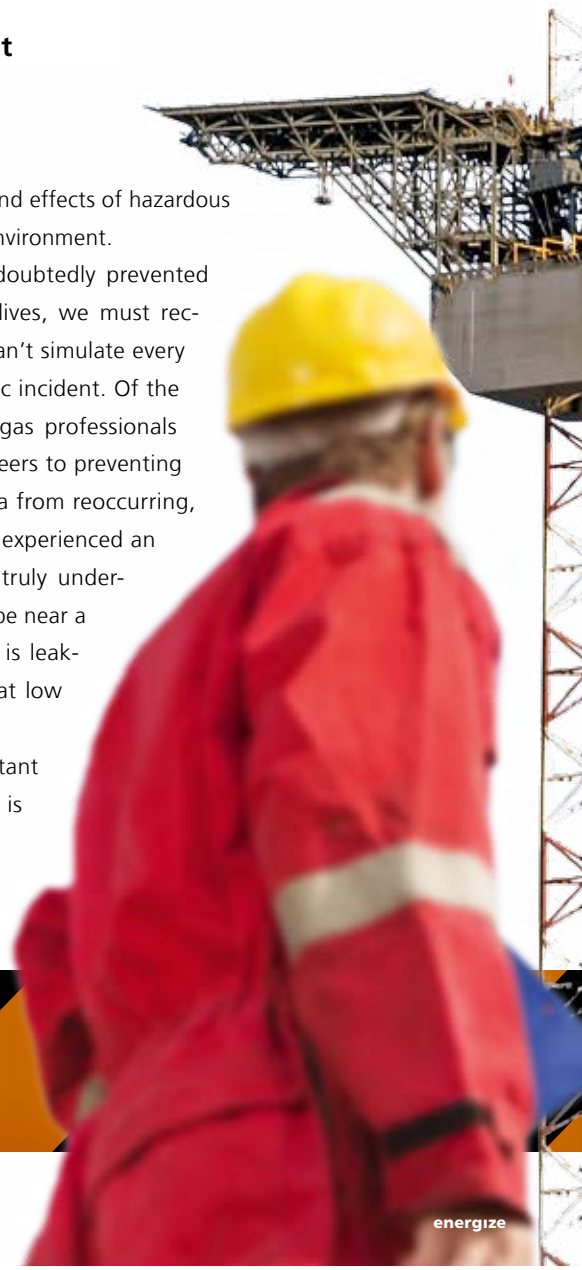
The oil and gas industry recently marked the 25th anniversary of one of the most devastating incidents in its history, when 167 people were killed in the UK's Piper Alpha disaster. In the wake of the tragedy, the British government acted swiftly to reform oil and gas regulation. Offshore operators were required to carry out immediate assessments of their systems and Lord Cullen's official public inquiry made 106 recommendations which were all accepted by the UK industry.

Fortunately, since the Piper Alpha incident, risk management has become a more fundamental part of oil and gas operations. Research conducted this year by GL Noble Denton has revealed that industry spending on health and safety has risen to unprecedented levels, as companies continue to develop robust practices, technology and training that keep safety at the top of the agenda.

Since Piper Alpha, the global evolution of technologies such as modelling software has allowed the oil and gas industry to take significant steps forward in managing risk by simulating the causes and effects of hazardous situations in a virtual environment.

While this has undoubtedly prevented the loss of countless lives, we must recognise that software can't simulate every aspect of a catastrophic incident. Of the thousands of oil and gas professionals who dedicate their careers to preventing the likes of Piper Alpha from reoccurring, for example, few have experienced an incident first-hand or truly understand what it is like to be near a ruptured pipeline that is leaking ignited gas, even at low pressure, for instance.

As such, it is important that risk management is accompanied by robust hazard awareness



ABSTRACT

- The Piper Alpha disaster 25 years ago prompted major safety regulation changes
- Hazard awareness training gives key personnel a sense of the impact of accidents

Sculpture. **Aberdeen memorial to the Piper Alpha disaster.**

Platform. **A potentially dangerous workplace requires a safety culture to minimise hazards and prevent major accidents.**

Photos: 36clicks | Dreamstime.com, Lizzie

programmes, such as those offered by GL Noble Denton at our secure Spadeadam Test Site in northern England. In addition to providing an opportunity to discuss the technical theory behind incidents, hazard awareness training allows industry professionals to see, hear and – most importantly – feel the impact of a hydrocarbon release incident through a set of controlled demonstrations. They give us the chance to put into perspective the simulations that we generate on computers.

Training across the Organisation

While it is standard practice for engineers in the field to go through rigorous and frequent safety training, the lasting lessons that can be learned from hazard awareness training should not only be taught to those at the coalface of a company's operations.

The real challenge is for companies to demonstrate the reality and impact of a major disaster to employees ▷

who don't work directly with oil and gas assets; perhaps members of a finance team, who could inadvertently contribute to an incident by making a simple budget cut hundreds or thousands of miles away from the project it affects. Indeed, a number of the major operators who undertake hazard awareness training at the Spadeadam Test Site include a cross-section of their workforce, from senior safety engineers to HR advisors to directors and CEOs.

SPADEADAM TEST SITE. GL Noble Denton's unique facility carrying out research and technical service work.

During the hazard awareness courses, GL Noble Denton carries out a number of large-scale fire and explosion demonstrations for these types of audiences – often with similar technical characteristics to real-life incidents. These are particularly important because they allow oil and gas professionals to appreciate the physical impact of a major hazard.

Leadership Involvement needed

For hazard awareness training to be effective, the lessons that it offers must be actively supported by a company's leadership team. During GL Noble Denton's recent conference just over half of the delegates said they believed that company leaders try but do not quite understand and engage with major-hazard safety, proving that there is still much work to be done within the industry to ensure it is a senior-level priority. Leaders must drive the company's focus on safety from the top and decide how much time and money should be dedicated to it. As one delegate explained: "The minimum attention that a leadership team can give is compliance with safety regulations, but in reality, that's a box-ticking exercise. Regulatory compliance might keep you out of jail but it won't keep you out of a morgue."

In a move to keep the fact that the unthinkable may happen front-of-mind, the board of one major operator frequently visits GL Noble Denton's Spadeadam Test Site to

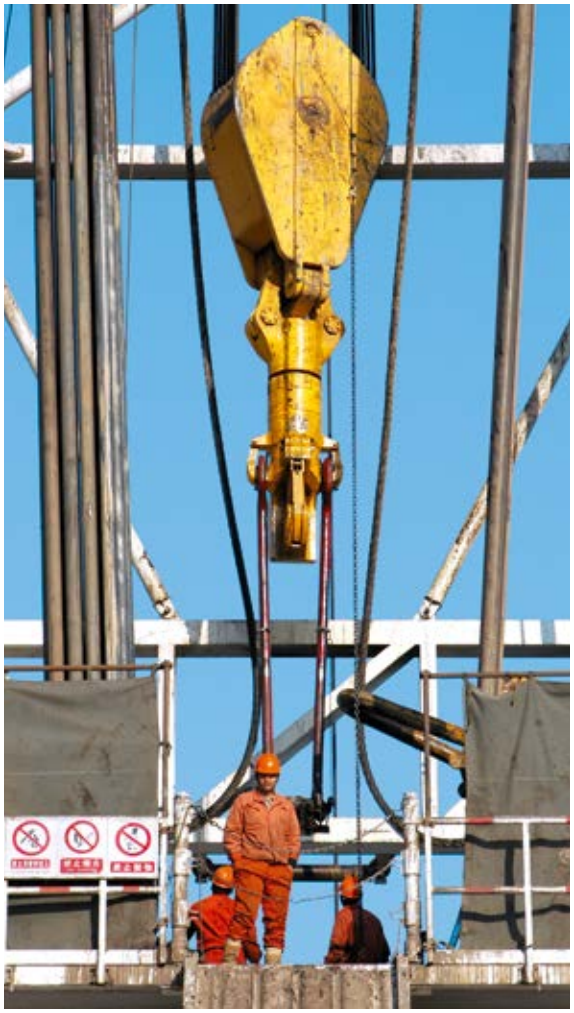


Photo: Seesea | Dreamstime.com

Production. **Compliance with safety regulations is only the first step in a comprehensive risk management approach.**

Spadeadam. **GL Noble Denton's world-leading test site is located in a remote region close to the Scottish border.**

witness the hydrocarbon leak demonstrations, and to discuss the company's safety culture and priorities.

On that note, only half of the safety and risk experts agreed with the notion that companies work on the basis that the unthinkable may happen. This figure could be much higher if employees were given a sense of how real and likely major incidents are. When someone sees a drip of oil coming from a flange, you want them to think it will turn into trickle; when everything seems to be running smoothly, you want people actively looking at how it will go wrong. Hazard awareness training can help to instil that culture of "curiosity" across a business by helping employees get a closer experience of what it feels like to be affected by a major incident.

Nurturing Curiosity

Major-accident hazard prevention requires a safety culture in which oil and gas professionals are constantly reminded of the potential impact of their daily decisions through frequent and meaningful training. It is part of the human condition that we have a natural tendency to avoid questioning widely ignored problems in an environment that we're used to. Company leadership teams need to nurture a sense of curiosity among their employees in order to challenge practices that they feel uncomfortable with and learn from past mistakes.

As oil and gas leaders drive the debate about safety within their businesses, small changes brought about by effective training that helps oil and gas professionals understand the physical and emotional impact of an incident could have a marked benefit throughout a company's safety culture. Coupled with simple process safety models and innovative risk management technologies, this approach is vital to helping oil and gas professionals make the right decisions and ask the right questions about their company's safety practices. □ **GT**

GL GROUP EXPERT:
Gary Tomlin
Principal Consultant Safety and Risk
Phone: +44 1509 282166
E-Mail: gary.tomlin@gl-group.com

Awareness. Large-scale fire and explosion demonstrations show the physical impact of a major hazard.

REGULATION

More than eight in ten (88%) oil and gas professionals expect the US regulatory regime to get much tougher over the next two years.

More than half (51%) said the regulatory authorities could have done a better job in preparing the industry for the regulatory changes being implemented in the US.

Almost eight in ten (78%) oil and gas professionals say they are either "highly" or "somewhat" prepared for the changes coming over the next two years.

Lower Risk, Higher Costs

New, stricter regulations for the US oil and gas industry are in the making. What are executives expecting? GL Noble Denton wanted to know – and asked around

ABSTRACT

- The US government is implementing stricter safety legislation for oil and gas
- Acceptance among the industry is divided

In the three years that followed the Macondo incident in the Gulf of Mexico, the US authorities embarked on one of the most comprehensive reforms to oil and gas regulation in the country's history. A strong reaction to the oil spill was inevitable. No government could fail to act in the aftermath of such an incident.

Research conducted by GL Noble Denton last year revealed concerns that legislation was being "rushed" through, and that compliance costs would increase as a result of the new regulatory regime. ***"Seismic Shifts: The outlook for the oil and gas industry in 2013"*** found that nearly four in ten (37%) respondents from North America thought that policymakers were rushing rules into place. Similarly, 39 per cent in North America cited the growing regulatory burden as a key barrier to growth.

New Study

It is against this backdrop that GL Noble Denton decided to undertake a further study of industry professionals to establish how the regulatory process was unfolding in the US. ***"Reinventing Regulation: The impact of US reform on the oil and gas industry"*** is a new report based on a survey of more than 100 senior oil and gas professionals

with operations in the US, providing a snapshot of industry sentiment towards the new regulations.

The research shows that US oil and gas professionals are losing their appetite for risk and are worried about rising operating costs as they grapple with the consequence of a tougher, post-Macondo regulatory regime. More than eight in ten (82%) of those questioned believe compliance costs will increase and nearly six in ten (57%) believe the changes will affect their appetite for risk-taking. An overwhelming majority – nearly nine in ten (85%) – say they expect the US regulatory regime to get tougher in the coming two years, even on top of the changes already implemented.

Worst Case in Focus

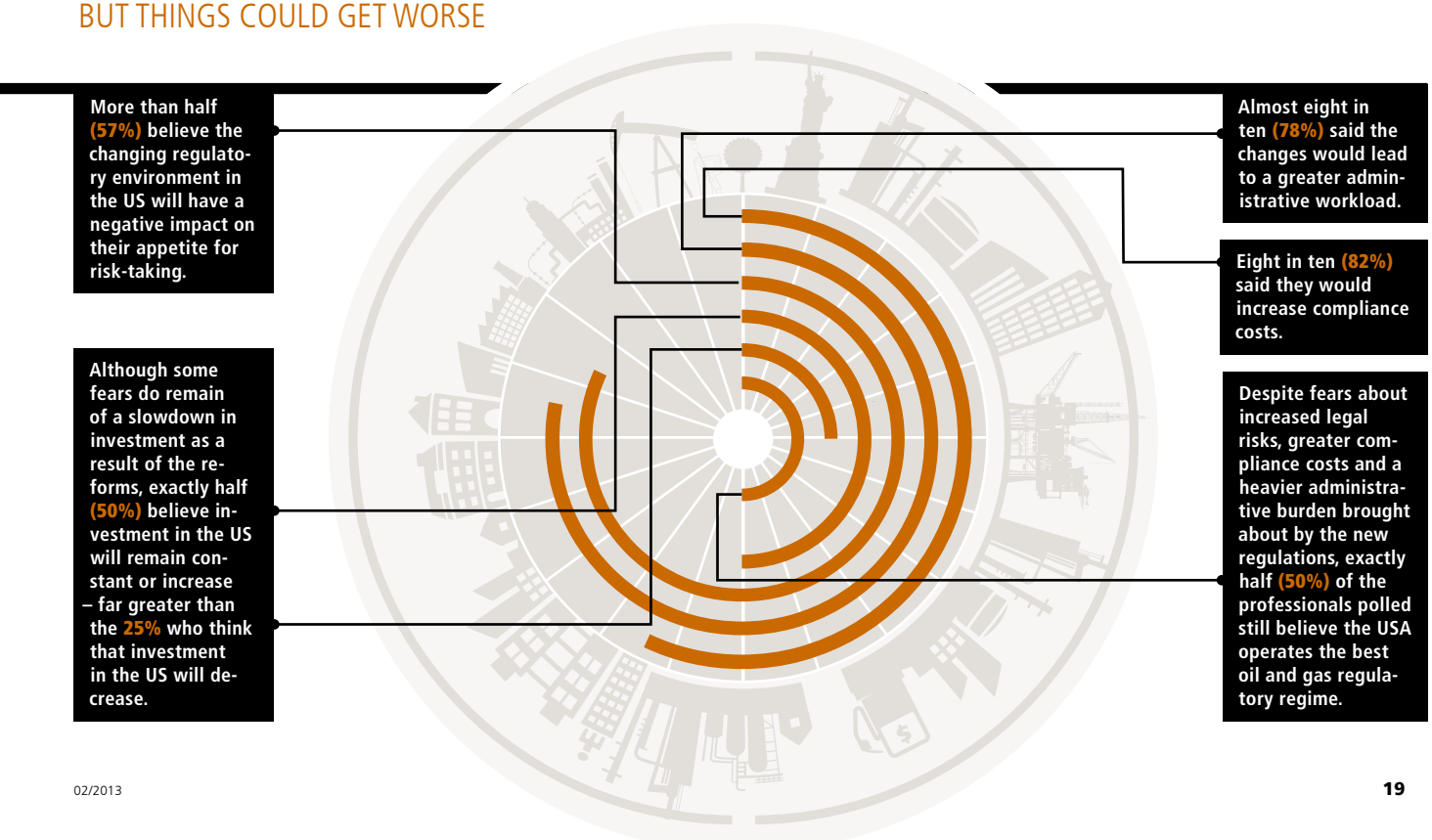
The US government is implementing a raft of regulatory measures in response to the Deepwater Horizon incident, with the aim of transforming the industry's safety culture. Oil and gas operators are now required, for example, to demonstrate that they are prepared to deal with a blowout and worst-case discharge, while revising their approaches to everything from well design and workplace safety to corporate accountability.

In May, President Obama published proposals for regulating hydraulic fracturing for oil and gas on public lands. Under the draft regulation, operators will be required to disclose the chemicals they use in fracking, improve assurances of well-bore integrity to ensure that the fluids used in fracking do not pollute ground water supplies, and confirm they have a water management plan in place for disposing of the water and other fluids used in the process. Widespread opposition to fracking ▷

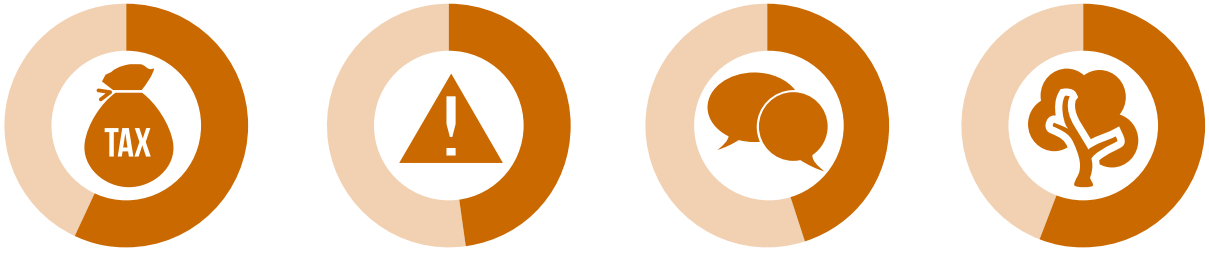
HYDRAULIC FRACTURING.

As one of the key methods of extracting unconventional oil and gas resources, this technique challenges the adequacy of existing regulatory regimes.

A STRONG REGULATORY HEADWIND IS EXPECTED, BUT THINGS COULD GET WORSE



TOP FOUR BENEFICIARIES OF THE NEW REGULATIONS IN THE USA, ACCORDING TO OIL AND GAS PROFESSIONALS:



Government tax revenues (57% agree)

Industry safety levels (48% agree)

Public perception of the oil and gas industry (45% agree)

The environment (44% agree)

▷ is creating an increasingly challenging operating environment for oil and gas companies. While some believe that tougher regulations could help to allay fears about the new technology, others feel that the stricter regulatory regime will have a detrimental impact on their business.

Of those surveyed, six in ten (61%) said that the impact of the new regulations on their business had been either "somewhat" or "highly" negative, especially for larger, publicly listed firms. Increased compliance costs and a greater administrative workload are cited as the two most significant impacts of the new regulations (81% and 75% respectively).

Game Changer

One likely consequence of the changes will be an increase in mergers and acquisitions (M&A) among oil and gas operators, as growing compliance costs accelerate consolidation. Almost six in ten (57%) US-based oil and gas professionals surveyed for the research believe M&A will increase as only larger players will be able to afford to compete for business under the new regulatory regime.

Despite rising costs and a loss of appetite for risk-taking, the US will continue to attract business from oil and gas operators, according to the survey. Less than one in five (17%) of those surveyed said they disagreed that the USA would remain a leading investment destination in 2013. In terms of spend, exactly half said they thought spending would either remain constant or increase. Only 25 per cent said they thought spending could drop.

Furthermore, many oil and gas professionals operating in the USA believe the changes will help to restore confidence in the industry. Almost half (47%) of those polled said the measures will improve overall safety compared with 35 per cent who did not (a further 18% were unde-

SCEPTICAL PROFESSIONALS

Only one in ten (10%) said they believed the USA authorities are effectively preparing the industry for upcoming regulatory changes.

MARKET CONSOLIDATION

More than half (57%) said rising compliance costs will force increased consolidation and M&A, as only large players will be able to afford to compete for business.

MAJOR INFLUENCE

Six in ten (60%) professionals believe the current regulatory trends will have an impact on oil and gas regulations outside the USA. This may help to bolster industry safety standards in other areas of the world.

GREATER SAFETY

Almost half (47%) said they believed that the regulatory changes expected over the next two years will increase the overall safety of the oil and gas industry – compared with about one in three (35%) who argue that they won't.

cided). The majority of professionals believe US regulators are getting it right when it comes to regulation. Overall, 53 per cent of respondents believe regulatory shifts are either going in the right direction, or are at least as good as before, compared to 46 per cent who do not think this is the case. One respondent to the GL Noble Denton survey claimed that the USA still provides "the best combination of required safety regulations to maintain a safe industry, and yet allow[s] for a free market economy... to thrive".

Asked how governments should approach regulation, nearly eight in ten (76%) said they favoured a performance or goal-orientated approach, where safety and environmental targets are clearly defined, over a more prescriptive approach. The latter is more typical in the US regulatory environment.

Download.
Get a copy of "Reinventing Regulation" from www.gl-nobledenton.com

DESIRED APPROACH

Almost eight in ten (78%) believe a "performance/goal-orientated" approach to regulatory compliance is best.

CLEAR PREFERENCE

Only one in five (21%) said a "prescriptive" appoach – the approach predominantly used in the USA – is the best way to enforce regulation.

Challenges for the Industry

As the new rules come into force over the next two years, the sector will need to adapt to survive in this new regulatory climate. Increasing compliance costs, burgeoning legal risks and a greater administrative workload are just some of the difficulties that industry professionals are likely to face this year.

Despite these challenges, there are clear opportunities for business growth in the USA, as evidenced by the sharp rise in the number of on and offshore drilling permits issued to operators over the past year. Many of GL Noble Denton's survey respondents agree that the US remains an extremely favourable, stable and certain place for oil and gas companies to do business, irrespective of industry ambivalence towards the new regulation itself. ◻ **AS**

GL GROUP EXPERT:
Arthur Stoddart
Executive Vice President Region Americas
Phone: +1 713 586-7000
E-Mail: arthur.stoddart@gl-group.com

Maximising Uptime without Surprises

Managing equipment downtime effectively is a core concern for plant operators. GL Noble Denton's software Galiom delivers comprehensive insight and decision support

Every hour an oil or petrochemical facility is shut down for scheduled maintenance or unplanned repairs, potentially costing the operator hundreds of thousands of dollars.

Achieving the most effective balance between unplanned downtime and optimised production is vital over the life of assets such as offshore production platforms, onshore oil and gas processing or water separation facilities, water treatment plants and refineries.

To understand and manage these risks, GL Noble Denton developed Galiom, an advanced risk-based suite of inspection and maintenance software applications. Through facilitating data collection, Galiom enables risk mitigation and inspection strategies to be developed and implemented with the aim of optimising maintenance planning whilst staying within acceptable risk levels.

Galiom is managed from GL Noble Denton's Malaysian office by a team led by Matthews Varkey, Programme Manager at the Kuala Lumpur Development Center. In *energize*, Varkey explains how operators use Galiom to optimise inspection policies to keep their oil, gas and petrochemical plants operating at high levels of safety and operational efficiency.

ENERGIZE: Galiom software is central to GL Noble Denton's Asset Integrity Management software toolbox. How does it fit into the group's integrity management offering?

ABSTRACT

- Reconciling efficient plant operation with effective risk management is a challenge
- A comprehensive, computer-based data collection and analysis toolset is essential

Assets. **Complex plant environments harbour numerous risks of costly shutdowns.**

VARKEY: Galiom follows the holistic approach GL Noble Denton takes to all our asset integrity management (AIM) solutions. The Galiom framework provides a platform that enables any asset or piece of equipment to be managed and maintained from within one central system. The software integrates with our clients' enterprise systems, for example within Computerised Maintenance Management Software (CMMS), Electronic Document Management System (EDMS), and Production and Laboratory Information systems, which are commonly found across oil and gas production, refining and petrochemical facilities. Galiom helps clients identify, predict and address an asset's operational challenges.

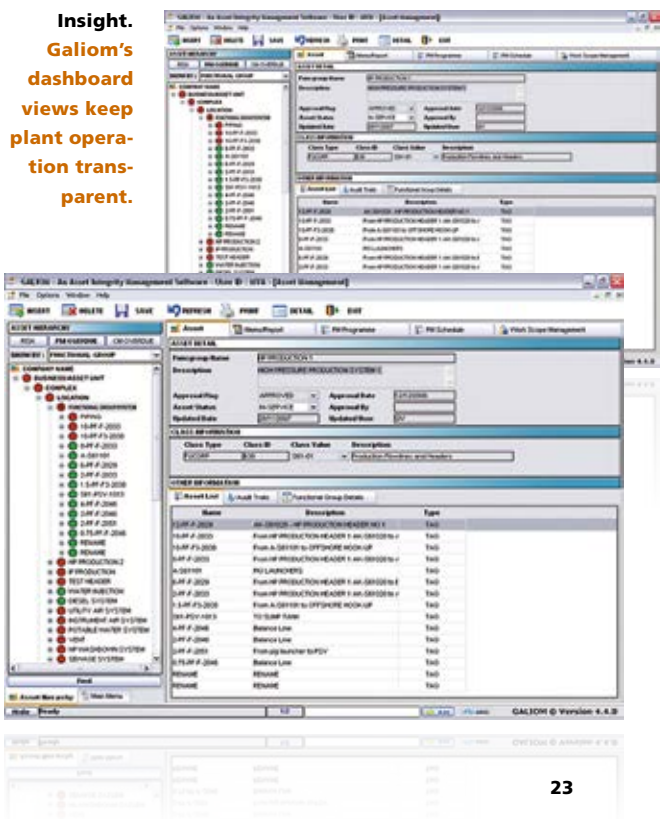
ENERGIZE: **Can you describe what advantages it brings to customers, with particular reference to safety, environmental protection and operational efficiency?**

VARKEY: Risk identification and mitigation is central to Galiom, with a host of standard industry analytical tools including risk-based inspection (RBI), reliability-centred maintenance (RCM) and safety integrity levels (SIL) built into the software. Each equipment type has a specific risk ranking based on its behaviour and purpose, wherever in a plant it is installed. The consequences of failure are analysed by looking into safety, health and environmental protection, economics of production loss and cost of damage, and loss of corporate reputation. The data allows engineers to assess and prioritise where inspection and repair work is needed, and informs operators whether their assets are performing safely and at optimum capacity.

ENERGIZE: **In which type of projects is Galiom most effective?**

VARKEY: Galiom has been deployed successfully in oil and gas offshore and onshore facilities, including FPSO and FSO, petrochemical plants and refineries. Companies utilise Galiom in scenarios such as inspection data management (IDMS) or corrosion and inspection management (CIMS), others as RBI software, RCM software or SIL software. Galiom is also deployed as risk and reliability management (RRM) ▷

Insight. **Galiom's dashboard views keep plant operation transparent.**



Photos: Bradengunem/Fred11 | Dreamstime.com

Control room. Galiom helps users to keep assets running safely and plan maintenance effectively.

▷ software, which includes RBI, RCM and SIL functionality. For structural integrity it is deployed as an SIMS solution.

ENERGIZE: Galiom was first developed to handle integrity management of piping, pressure containers and safety valves. What are its key uses today?

VARKEY: Galiom has evolved from a simple risk-based inspection software used to monitor fixed pieces of equipment into a fully fledged integrity management solution for facilities as varied as offshore structures, onshore and offshore pipelines, rotating equipment, instrumentation, lifting equipment and safety systems.

An easy-to-read dashboard and traffic light systems highlight risks as well as preventative maintenance work due and overdue for any item of monitored equipment.

Galiom integrates business and operational behaviours of various different departments including inspection, maintenance, operations, engineering and management by providing those day-to-day tools and utilities for informed engineering and practical decision-making.

Data from Galiom can be easily accessed, and sliced and diced for further analysis and use in management reports.

ENERGIZE: At what stage in an asset's life should, or can, Galiom be introduced?

VARKEY: Galiom is best introduced before the facility begins operations to allow for efficient integration with other software and engineering needs. Certain modules of Galiom, such as SIL (Safety Integrity Level), can be used during the design phase, but we suggest to incorporate Galiom into the design at an early stage, perhaps when as-built drawings and documents are available. This allows Galiom to be integrated with other computer-based management systems such as SAP and IBM's Maximo.

ENERGIZE: How does Galiom fit into the oil and gas sector's regulatory environment?

VARKEY: Galiom assists companies in ensuring compliance with host country regulatory requirements. In certain countries, regulatory bodies require all industrial companies to periodically open the pressure equipment for inspection, which requires shutting down the plant, unit or equipment.

ENERGIZE: A new Web-based version of Galiom is being launched. Which special features will it have, and when will it be available in the field?

VARKEY: The new, Web-based Galiom tool gives engineers, management and other advanced users the opportunity to mine information and create meaningful reports and graphs for day-to-day decision-making. Users can now access the Galiom dashboard through Web browsers such as Internet Explorer, Chrome or Safari, getting a one-shot view of modules within Galiom and any other linked software. The Safety integrity level (SIL) module is going to be available as a web application supporting the risk matrix, risk graph and LOPA methods for risk classification. Leak reporting, trending and analysis from the anomaly management module is now included and integrated with the system and module dashboards.

ENERGIZE: Looking to the longer term, how do you see Galiom developing?

VARKEY: We continue developing Galiom to allow our customers to meet their future needs. We are currently working on a fully Web-based system accessible from the full

Photos: Branex/Kikkerdirk | Dreamstime.com

Refinery. **Incorporating Galiom during the design phase ensures seamless system integration.**

range of platforms, including hand-held tablets using the iOS or Android operating system, and with data accessible in the cloud. Galiom will support Windows 2012 and Windows 8 platforms shortly.

ENERGIZE: **In which markets and sectors does GL Noble Denton see demand growing for Galiom?**

VARKEY: Interest in Galiom is growing fast from a variety of sectors, including national and international oil companies, FPSO operators and petrochemical plants. Demand from Asia-Pacific and the Middle East is showing strong signs of growth and these are likely to be the fastest-growing regions over the next few years. In the Americas, Mexico has been dominant in the past and will continue to grow in the medium term. In Europe, Galiom has been implemented in several pilot studies and we expect this market to grow strongly.

ENERGIZE: **Why would a GL client feel confident in using Galiom?**

VARKEY: Galiom has been used successfully by over 26 major engineering, energy and other clients and 50+ plants worldwide, and there are many engineers experienced in using the software. GL Noble Denton has deployed its implementation and support team strategically in three worldwide locations, including the UK, the US and Malaysia. Support is available 24/7. Galiom has been a true success story backed by the firm commitment of GL Noble Denton. I am certain this trend will continue, and we are looking forward to welcoming more clients and plants in the future. □ **BMM**

GL GROUP EXPERT:
Mathews Varkey
Galiom Programme Manager
Phone: +60 321610088-1059
E-Mail: mathews.varkey@gl-group.com

offshore

The demand for engineering services, technical assurance and consulting in the offshore sector is rising. GL Noble Denton supports oil and gas companies with its high-performance spectrum.

Photo: Numskyman | Dreamstime.com

The Next Big Shift

Australia is aspiring to become the world's leading exporter of natural gas. As the capital-intensive initial development phase comes to a close, the industry needs to begin contemplating the vast operational challenges lying ahead

As record-setting capital expenditure in new projects starts to give way to a more cost-centric operational focus, Australia's oil and gas industry is facing a new era of change. Nicholas Heyes, Managing Director for Resources in Australia at Accenture, discusses the challenges lying ahead for the sector, and how technology and collaborative management practices will help operators to overcome them. It's boom time in Australia's energy industry. And, not just any old boom: the sector is undergoing one of the most significant spurts of intensive capital investment that the entire world, let alone the country, has ever seen. Headlining the list is the Gorgon liquefied natural gas (LNG) project in Western Australia, which aims to produce 15.6 million tonnes of LNG per year when operational, but comes with an estimated price tag of 52 billion US dollars (USD). One of its key partners, Chevron, is also putting 29 billion USD into an LNG project at Wheatstone, also in Western Australia.

ABSTRACT

- Enormous amounts of capital have been invested in developing Australia's natural gas resources
- Now operators must focus on supporting their assets and optimising operational performance

All told, there are four major LNG projects currently under development, at an estimated total capital cost of 175 billion Australian dollars (AUD) or 160 billion USD – even before any likely cost blowouts are accounted for. By 2017, these combined investments are expected to make Australia the world's biggest exporter of LNG, overtaking Qatar.

New Focus Needed

Industry experts agree, however, that this incredible rate of capital expenditure (capex) will not be sustained for much longer. During 2014–15, capex rates are projected to fall, before coming back to "normal" levels in 2015–16, as key LNG trains come online and start to produce. But, as this change starts to take place, a major shift in focus will be needed within Australia's energy sector, argues Nicholas Heyes, Accenture's Managing Director for Resources in Australia. "Companies are going to need to start focusing on operational performance," he says.

Right now, however, with the focus squarely on capital projects, operational excellence isn't yet fully on the radar for most. "Operators have their capital project plans, and they're executing against those," says Heyes. But, he warns that "many don't yet have the organisation or local processes set up, nor the proper procedures, work instructions, tools and systems in place to support their assets once they begin to become operational. This will begin to change soon as operators begin to shift from the build-out wave to a focus on operating capability, which is often an afterthought."

ACCENTURE.
A leading multinational management consulting, technology services and outsourcing company.

This afterthought is soon going to become front of mind for many. Several LNG streams are projected to start coming online by mid-2014, such as BG Group's Queensland Curtis project (QCLNG), while the Gorgon mega-project is expected to start supplying in the first quarter of 2015. "We'll see first gases come online in the middle ▷

Photos: Chevron

"Solitaire". The pipe-laying vessel installed two production pipelines.

of 2014, which means operators have less than a year to set up the necessary operations, processes and systems to support them," says Heyes, suggesting that they'll need to start moving now if they're to avoid getting caught short once the projects are online. "They also need to hire the people to support these, train them to the right skill level, and figure out how to operate a robust value chain that has never really existed here before," he adds.

Heading for a Perfect Storm

Exacerbating this concern is the fact that local conditions also provide some additional challenges. For starters, many Australian LNG projects involve a number of firsts: innovative new projects or approaches that simply haven't been built or used before. Gorgon is unique in its size and complexity, while several other projects will occupy physically vast spaces: QCLNG, for example, will involve two sets of about 1,500 wells, linked by a 380-kilometre pipeline. Elsewhere, Australia will host the first floating LNG facility, Prelude, which is being run by Shell off Western Australia. Similarly, Queensland's LNG export plants may be a first for the state but will ramp up to several tens of millions of tonnes per annum.

Second is the issue of human capital. This is already a high-profile issue for the industry. After worries about vast cost overruns being incurred in most projects, the skills gap is seen as the second biggest barrier to growth for the year ahead in Australia, according to a 2013 survey of local oil and gas professionals conducted by GL Noble Denton*. Quite simply, across a physically huge country with many major projects, there are simply not enough skilled locals to fill the gaps. This issue persists not just at a technical level, but also at a senior management level, according to indus-

Curtis Island LNG

COMPANIES: BG, CNOOC
EST. START-UP: 2014
CAPACITY: 8.5 mtpa
CAPITAL COST ($B): 20.4

Pipe Pull. Queensland Curtis LNG will be the world's first project to turn coal seam gas into liquefied natural gas, or LNG.

CSG and LNG Projects

In Australia, seven major coal seam gas (CSG) and unconventional gas projects are under construction with capital costs totalling over 177 billion USD. Several smaller projects included, the domestic LNG production capacity will increase from 16.3 mtpa in 2008 to around 86 mtpa in 2016.

Project	Company	Location	Estimated start-up	Capacity	Capital cost ($b)
CSG/LNG PROJECTS					
Australia Pacific LNG	Origin, ConocoPhillips, Sinopec	Gladstone, Qld	2015	9.0 mtpa	23.0
Curtis Island LNG	BG, CNOOC	Gladstone, Qld	2014	8.5 mtpa	20.4
Gladstone LNG	Santos, Petronas, Total, Kogas	Gladstone, Qld	2015	7.8 mtpa	18.0
UNCONVENTIONAL LNG					
Gorgon	Chevron, Shell, ExxonMobil	Barrow Island, WA	2015	15.6 mtpa 300 TJ/d domgas	43.0
Wheatstone	Chevron, Apache, KUFPEC, Tokyo Electric, Shell	Onslow, WA	2016	8.9 mtpa 200 TJ/d domgas	29.0
Ichthys	Inpex, Total	Darwin	2016	8.4 mtpa	34.0
Prelude Floating LNG	Shell, Inpex, Korea Gas	Browse Basin	2016	3.6 mtpa	10.0

Source: APPAEA, DAE 2012, BREE 2012b

try body, the Australian Petroleum Production and Exploration Association (APPEA). It specifically highlights growing demand for technical personnel in oil and gas plant process operations, as well as supervisors with appropriate levels of management skills.

During a GL Noble Denton executive round table held in parallel with the 2013 APPEA Conference in Brisbane, it was clear that this skills issue is affecting all players in the sector. "Collaboration with specialist allies across the industry is becoming more necessary as access to deep skills in often remote locations is very difficult," said Heyes. "Specialist allies can deliver knowledge and insight and enable organisations to tap into deep skills in terms both of running operations and of providing software assets to support them." He cites as an example a recent project for a major operator in Queensland, which involved Accenture and GL Noble Denton working together to implement GL Noble Denton's pipeline integrity management software, Uptime, to help manage and control the operator's gas distribution network.

Rounding off this perfect storm of challenges is the issue that many of Australia's LNG projects are being derived from coal seam gas (CSG). CSG projects (see table above) are a comparatively low-margin business, in contrast to the typical LNG operations seen in countries such as Qatar, where gas can be extracted at a much lower cost.

Heyes adds that operators will also have to tackle the uncertainty surrounding the gas flows from these wells, given that they are often tapping unconventional reservoirs. "All this makes optimisation at scale the next key challenge," he explains. "Operators in Australia will have to focus far more on operational efficiency. Many will essentially have a continuous drilling programme. Because their wells have a short life cycle, they'll need to drill hundreds of them a year."

***SEISMIC SHIFTS.** Download your copy of GL Noble Denton's 2013 oil and gas survey.

Big Gas, Big Data

Advanced analytics technology is likely to play a key role in addressing many of these challenges. "We certainly believe that some of the leading-edge analytics tools can help operators understand how to increase performance across thousands of wells," agrees Heyes. ▷

Photos: QCG

Indeed, behind the scenes, there is a growing array of technology and services that can help operators to bolster operational performance. One of the related trends is so-called "big data" – this has long been a feature of the industry's exploration activity, where huge data sets of seismic scans and other exploration statistics are routinely digitised and visualised to aid discovery efforts. Now, however, this technology is moving down the value chain to help optimise the operational aspects of projects.

BIG DATA. Describes the growing volumes of information that companies collect and analyse for competitive advantage.

Related trends within the technology sector are helping too, from the rise of cloud-based computing through to the falling costs and increased capabilities of connected sensors. Equally, operators have been quick to adopt mobile technology to use automated data analysis and knowledge-sharing tools to deliver insights to the workforce as and when they need it.

All this is coming together to allow operators to monitor and increase gas flows from across a vast, complex field of wells. State-of-the-art systems are able to provide continuous updates and to automatically analyse the data using advanced analytics tools. "These fields are generating huge amounts of data," explains Heyes. "You simply can't have an engineer looking at each one individually to check how it's flowing, and whether it's right or not. You need tools to aggregate these trends for you, and to run diagnostics to highlight where improvements can be made," he says.

LNG tanks. The Curtis Island project has a production capacity of about 8.5 mtpa.

Photo: QCG

Advancements in technology are also helping to alleviate some of the staffing pressures faced by operators, as the number of people required to monitor individual wellheads is reduced. "We've got a remote drilling operation in place, where all the engineers and geologists are sat centrally, but with a live view over all drilling activity, with video feeds and in-built collaboration tools," says Heyes. "When there's a problem, normally an engineer would have to drive out to see what they can do, but now they can see all this information on a live feed – for example, where the drill bit is, what direction it's going, local site images – all of this can help them figure out why it's stopped or gone off track. It helps operators to leverage fewer engineers over more wells."

Sharing Insight

This is all part of what Heyes terms operational optimisation, which he says starts at the wellheads but stretches across the entire supply chains that lie behind them. He says this will be crucial in a market in which gas will need to be passed between multiple operators and their suppliers, each with complex commercial agreements, and varying ownership structures – navigating domestic off-takes and commercial agreements, with bypasses to local power stations, all while trying to keep the export LNG trains at the end of the lines full. "The optimisation of this value chain – from a cost and commercial perspective – will be key to the effectiveness of these new projects," explains Heyes. "When you've put in massive investment, you need to increase your potential by getting more throughput."

Heyes predicts that knowledge sharing will play a crucial role in this respect, especially given the tendency for Australian projects to involve multiple partners. "Of course, it is not always easy to achieve good collaboration and sharing of information across the extended ecosystem of

Carnavon Basin. Construction of the Wheatstone project started in December 2011.

Wheatstone LNG Project

The Chevron operated Wheatstone project is one of Australia's largest resource projects.

COMPANIES: Chevron, Apache, KUFPEC, Tokyo Electric, Shell

EST. START-UP: 2016

CAPACITY: 8.9 mtpa

CAPITAL COST ($B): 29.0

Photos: Chevron

a project," says Heyes. "But, companies are starting to see just how important that is. You can't have a purely transactional view in how you work with contractors. It's got to be an engaged relationship model."

He sees this in action in some of the projects on which Accenture and GL Noble Denton ally, as each party contributes specific experience, knowledge and tools to help deliver custom solutions. This is evident, for example, in the companies' recent collaboration to implement GL Noble Denton's software Uptime on behalf of a major oil and gas operator, the first such project within Queensland's CSG market. GL Noble Denton's Uptime solution is designed to help operators confirm gas distribution network integrity, assess risk and increase the return on investment from key network assets. To address the client's specific requirements, it needed to be fully customised and integrated with existing enterprise management systems, of the kind implemented by Accenture. As the country's gigantic build-out gives way to a more operational focus, Heyes believes that the ability of Australia's oil and gas industry to harness technology and collaborative management practices will be crucial to its ability to adapt to change. "Operators in Australia are facing a new future," he says, "one in which optimisation of the production environment will be a major driver of success." □

GL GROUP EXPERT:
Richard Bailey
Executive Vice President Asia Pacific
Phone: +603 2160 1088
E-Mail: Richard.Bailey@gl-group.com

Going Through The Ropes

While dynamic positioning has become the preferred station-keeping method for deep-water drilling vessels, mooring technology is indispensable in shallow waters

Attempting a comparison between the two technologies of conventional mooring and dynamic positioning (DP) is next to impossible. While mooring holds the best economics in relatively shallow water, DP offers better economics for exploratory drilling in ultra-deep water. This assumes importance since the global offshore mooring industry is confronted with significant logistical, cost and safety challenges arising from deeper, more remote and more complex installations.

A decade ago Marshall DeLuca stated: Traditionally, mooring has restricted vessels to maximum operating depths of 5,000 feet, whereas dynamic positioning allows a vessel to operate in water depths limited only by riser storage. The debate over mooring or DP for the optimal station-keeping scenario has been around since 1966 when Foramer first used DP for the Toucan drillship.

Of late, however, there has been an increased focus on dynamic-positioned rigs for deeper and more remote locations with benefits of greater flexibility and no need for mooring anchors. The disadvantage, if any, is the high cost

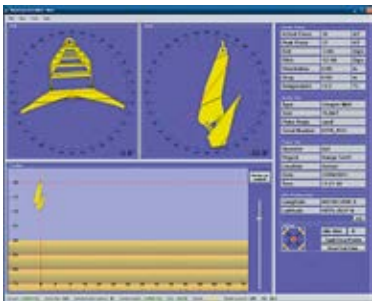
ABSTRACT

- Mooring is by no means an obsolete method
- Mooring technology must continue to advance to cope with harsh conditions

Station-keeping. Mooring is the only feasible technology for shallow waters.

Photo: mikeuk | iStockphoto.com

Foothold. **Suction pile anchor.**



Hi-tech. **Visualising anchor positioning using real-time data from an anchor data acquisition system.**

of operating rigs with fuel-guzzling, computer-controlled thrusters and the resulting NO_X and CO_2 taxes. In shallower waters, regulations over the angle of risers may cause many DP rigs to end up relying on mooring. It is evident, therefore, that DP, while cutting-edge technology, is not necessarily an alternative to conventional mooring. It is imperative that mooring continues to get patronage in terms of technological up-grades and also that it innovates and adapts to the demands of the industry.

The Challenge

According to Wolfgang Wandl, the global offshore mooring industry, faced with deeper, more remote and more complex installations, confronts increased complexity of mooring operations in addition to significant logistical, economic and safety challenges. In large-scale subsea deep-water infrastructures as seen in Africa or the mature fields of the Norwegian continental shelf, mooring operations happen in the vicinity of existing subsea facilities and pipelines.

Also, regulatory environments vary substantially around the world, stipulating provisions in relation to aspects such as, environmental statements, direction applications, oil pollution emergency plans and environmental reviews and Inspections. Operators are expected to adhere to all guidelines keeping in view the overall picture of the environmental requirements. The development of such regulatory scenarios has brought demands of safety into sharp focus.

In the Gulf of Mexico (GoM), in the past, hurricanes Ivan, Katrina and Rita caused several MODUs to break free of their moorings and go adrift. Other challenges included significant differences in water depths between the shallowest and deepest anchors, as well as uneven depths in the soft soils. Risks included tensioning the anchors and increased uplift mooring forces. Mooring operations today may call for a comprehensive portfolio of machinery and equipment, including ultra-high holding power (UHHP) anchors, the best in buoyancy units and mooring chains, synthetic fibre mooring ropes etc., that enable them to provide total mooring solutions.

Smart Anchors and Accessories

It is known that anchor handling can be as high as ten per cent of the total cost of an offshore exploration well. Challenges include deep-water seabeds and soil instability. Today, anchor data acquisition systems can monitor and visualise the anchor's behaviour during installation, embedment and final penetration with the help of a transponder unit on the anchor, displaying real-time data on board the AHV. They provide an overview of variables such as roll, pitch, drag length, penetration depth and pull-in force. Such a system is particularly valuable to harsh offshore conditions, such as in the North Sea. Acoustic-signal-coded buoys are another relatively recent development, which has eased the anchor deployment/retrieval activity. ▷

Loads. Typical Met-ocean conditions for mooring analysis.

Return period (yrs)	5	10	25	50	100
One-minute winds (knots)	58.7	79.8	99.4	111.7	122.1
Hs (ft)	23	31.8	41.3	45.9	48.9
Tp (sec)	9.70–12.7	11.0–14.0	12.4–15.4	13.0–16.0	13.4–16.4
Current (knots)	1.5	2.14	2.77	3.13	3.4

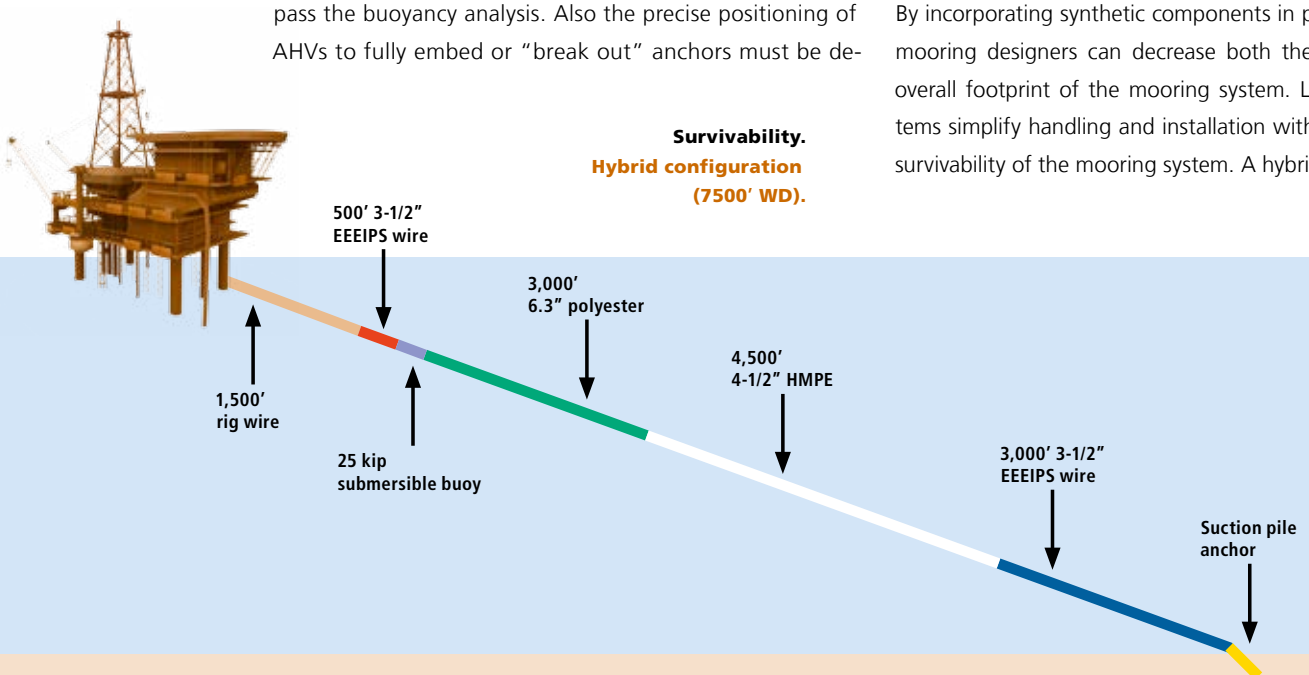
▷ Pre-Set Mooring

Another important development in offshore mooring technology is pre-set mooring. Benefits of pre-set mooring include greater precision and control over positioning the mooring around existing infrastructure, and reduced costs with fewer AHVs required for such operations and entailing less risk of AHVs being stuck in bad weather at a cost of some 500,000 US dollars per day.

Pre-set moorings can be placed months in advance of the rig arrival when weather is likely to be more favourable. Pre-laid mooring line must meet industry codes and must pass the buoyancy analysis. Also the precise positioning of AHVs to fully embed or "break out" anchors must be determined. The appropriate window of operations can then be identified.

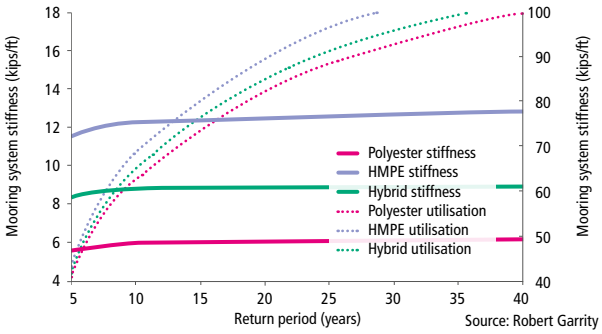
Hybrid Systems

After the hurricanes at GoM, great efforts were made to improve the survivability of MODU mooring systems including increased use of synthetic-fibre mooring systems for moored MODUs during the hurricane season. While polyester has been the most widely used synthetic fibre, high-modulus polyethylene (HMPE) components were also found to deliver increased survivability for deepwater MODU mooring systems. By incorporating synthetic components in place of steel wire, mooring designers can decrease both the weight and the overall footprint of the mooring system. Lighter-weight systems simplify handling and installation without reducing the survivability of the mooring system. A hybrid system wherein



Survivability. Hybrid configuration (7500′ WD).

Costs. **Anchor handling can account for as much as 10 per cent of the total cost of an offshore exploration well.**



Challenges. **Mooring system stiffness & utilisation for various systems including a hybrid system.**

a polyester segment is introduced offers a more cost-effective solution. The proportion of HMPE to polyester line lengths used in the hybrid mooring configurations changes as water depth increases. These ratios are shown below:

- Water depths up to 6,000' (1,829 m): 50% - 50%
- Water depths up to 7,500' (2,286 m): 60% - 40%
- Water depths up to 10,000' (3,048 m): 75% - 25%

A hybrid mooring system allows the designer to engineer the stiffness of the system. This provides the flexibility to balance the station-keeping advantages of a high-stiffness system with the lower peak loads experienced by a less stiff mooring system during an extreme loading event.

The Analysis

In all the above instances, whether pre-set or not, detailed mooring analysis is essential with quasistatic or dynamic analyses applied to minimise rig offsets and line tensions. Polar plots for the significant wave heights are arrived at, both for operational and survival conditions. Such a plot shows the maximum analysed significant wave height (H_{sig}). Minimum and maximum sea state periods are also indicated. T_{MIN} and T_{max} are picked up for stipulated tide current directions. Similar plots for wind and wave mean loads for the analysed conditions are prepared both for operational and survival conditions. Environmental mean loads and vessel dynamic motions are determined. The analysis is undertaken for various periods of return (years) accounting for the corresponding severity of winds and currents. The Metocean conditions considered in the mooring analyses can be treated as omni-directional, with collinear wind, wave, and current directions. The wave-induced first-order motions in all directions are applied to the mooring lines to determine the dynamic loads. Based on the performed frequency-domain motion analysis, the motion transfer functions are presented. Typical plots of motion transfer functions are depicted.

Conclusion

Conventional mooring is here to stay. Developments in the field of DP are not likely to replace or diminish the importance of mooring technology. It needs to innovate and adapt to the demands of the industry, which is getting more challenging by the day. Mooring equipment and accessories have to constantly evolve, keeping in view of the ever increasing challenge. Techniques such as pre-set mooring should be adopted to take advantage of favourable windows of operation and obtain cost offsets. Statutory bodies need to be realistic in stipulating criteria for mooring systems. The theory behind mooring should be in clear focus and material science will have to advance continuously so that harsher environments can be tackled without increasing risk levels. **BN**

GL GROUP EXPERT:
Cdr Balakrishnan G Nair
Structural & Naval
Phone: +91 22 4078 1000
E-Mail: balakrishnan.nair@nobledenton.com

Successful Reconnection

GL Noble Denton provided Maersk Oil with technical and operational support that has helped them return to production for the Gryphon FPSO

ABSTRACT

- A North Sea FPSO unit tore away from its moorings in a severe storm
- GL Noble Denton was instrumental in fully restoring the unit's functional integrity

Located 175 miles north-east of Aberdeen, the Maersk Oil Gryphon Floating Production, Storage and Offloading unit sustained damage in a major storm in 2011. Four anchor chains broke and the vessel moved partially off station causing serious damage to the subsea assets. Since this FPSO has thrusters to assist with heading control, although four mooring lines out of ten all from the same direction were lost, the unit did not completely break away from its moorings once thruster control was re-established.

The emergency response saw GL Noble Denton's team in Aberdeen provide Maersk Oil with engineering and offshore advice to temporarily reconnect the FPSO, recover the original moorings, and tow the vessel to the Netherlands for dry docking. Once the FPSO had been docked, the vessel went through a programme of repairs and upgrades while the original anchors were recovered from the seabed for inspection and complete refurbishment back on land.

GL Noble Denton assisted in the commissioning of Gryphon's marine systems as well as in the upgrade and placement of new moorings, making the vessel fit for its return to operations. The team also engineered and superintended the mooring pre-lay and hook-up operations, in addition to providing towmasters and marine representatives for the return towage and sea trials.

Return. **Gryphon FPSO on site during mooring line reconnection.**

New Mooring Spread

Earlier this year, Maersk Oil announced the successful reconnection of Gryphon FPSO. Martin Rune Pedersen, Managing Director at Maersk Oil UK, commented: "The sheer size of this major re-instatement project should not be underestimated; with significant overhauls and upgrades to tanks, positioning and mooring systems, process control, power management and the subsea infrastructure. Managing a major and challenging redevelopment like this in less than two and a half years with a first-rate safety record was a significant achievement by the project team."

The new mooring spread was pre-installed in February and March 2012. The unit was brought onto location and connected to its moorings during early September 2012,

Rotterdam. Tow-out of the FPSO following major refurbishment.

despite having to contend with less than optimal weather conditions. Gryphon's new mooring configuration made the reconnection operation a particular challenge, as the design consists of a triple parallel chain arrangement to help keep the FPSO within its excursion limits.

Tough Conditions

Gryphon's installation team had to ensure that the chain was spooled onto anchor-handling tug winches and subsequently laid down in the correct orientation, within tight tolerances. Permanent mooring systems are subject to tough operating conditions, and deviations from installation tolerances can have an adverse impact on their long-term operating integrity.

Installation. Spooling of the triple chain onto the anchor handling tug's work drum.

Commenting on the project, Martin Brown, GL Noble Denton's Project Manager for the Gryphon reconnection, said: "This was a complex and challenging marine operation. It required a close combination of GL Noble Denton's marine and engineering experience, a long-standing feature of the company's services. I am pleased that we have been able to bring this unique aspect of our capability to the service of the Gryphon Area Reinstatement project." □ **NR**

GL GROUP EXPERT:
Martin G. Brown
Consultant Naval Architect
Phone: +44 1224 289-108
E-Mail: martin.brown@nobledenton.com

Tough Job for Offshore Experts

OVER THE LAST TEN YEARS, much has been learned about the design, behaviour, integrity and durability of offshore moorings. When problems do develop offshore with moorings it has become very clear that they are difficult, expensive and potentially hazardous to fix.

For offshore interventions the key ingredients to reduce risk and to minimise schedule delays are well-planned procedures along with quality engineering and clear, easy-to-understand drawings. Experienced personnel need to follow the job all the way through from office develop procedures to offshore implementation. This needs to be backed up by good-quality intervention vessels with experienced crews plus quality services in terms of ROVs, divers, survey spreads, winch technicians, etc. Furthermore, adequate time is a crucial factor for the planning, preparation and procurement process.

Anchors. Pre-installation prior to FPSO arrival.

How to Insure a Deep-Water Borehole

The financial liabilities can be huge but putting a figure on the consequences of a potential catastrophic event is difficult. GL Noble Denton has developed a method

Producing oil and gas is a challenging, risky business. Extreme, unforeseeable events resulting in loss of life and property during exploration drilling are thankfully rare. Such occurrences can have wide-reaching effects on a company's ability to operate and can shift a whole industry's way of approaching challenges. Catastrophic events, such as the Indonesian 2004 Christmas tsunami or the Japanese earthquake and tsunami of 2011, caused extensive loss of life and property as well as severe pollution, as did the BP Macondo disaster in the Gulf of Mexico in 2010.

Estimates vary about how much BP will have to pay to settle with the US authorities and commercial and civilian claimants, but the amount could exceed the value of the oil in the reservoir, had it been successfully produced. The full amount of BP's total costs arising from the Macondo spill will not be fully known for several years but could exceed 50 billion US dollars.

Loss of Well Control

Offshore oil explorers across the world, from the Gulf of Mexico to Brazil and West Africa, are seeking and finding hydrocarbons in basins thousands of metres below sea level. Should an exploration well fail while being drilled, the results could be catastrophic to life and property. Deepwater wells must therefore be drilled with sufficient insurance to cover multiple claims.

ABSTRACT

- In the wake of the Macondo incident, offshore risk calculation must be rethought
- GL Noble Denton developed a statistical model to estimate the financial risks of lost well control

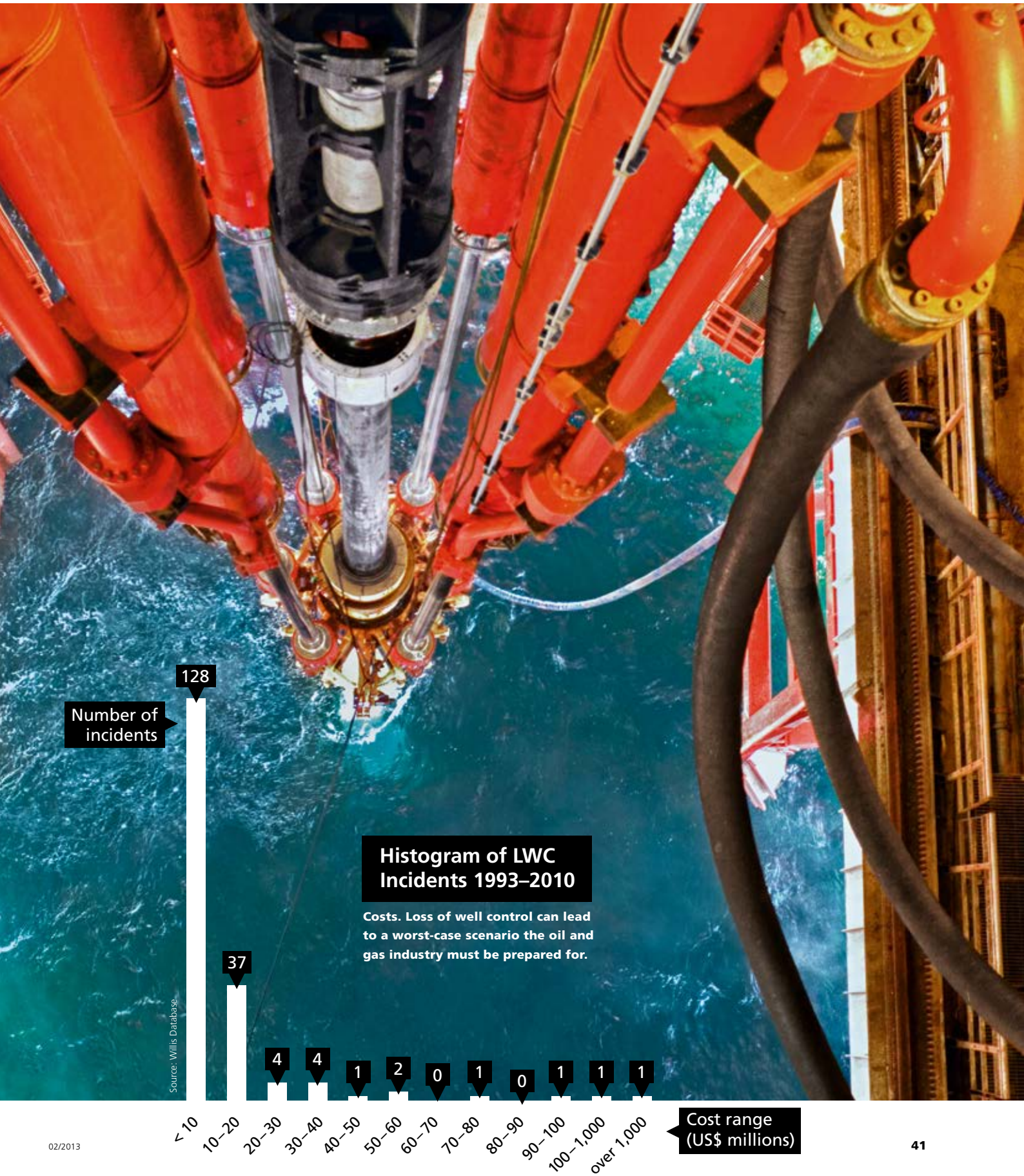
With this in mind, a national oil company commissioned GL Noble Denton to develop a statistical model for estimating the financial risks associated with losing control of a well (loss of well control, LWC) during a deep-water drilling programme the company was considering. The results of the analysis were made available to the oil company's risk management division to help determine how much insurance cover was needed for any singular exploration well.

To develop this methodology, a team was put together by Eckhard Hinrichsen, Country Manager Mexico for GL Noble Denton, with input from the company's Subsea, Umbilicals, Risers, Flowlines (SURF) division in Houston, Texas. The technique developed by the team allows risk managers to better understand the financial implications of lost well control and to develop more effective risk management plans.

Risk management is a vital component of operating such complex offshore engineering projects. Oil and gas companies' insurance policies must cover a range of potential risks from physical loss of property and damage to oil and gas plants to liability to third parties, workers' compensation and employer's liability, general liability, pollution and restoring well control. Risk management insurance should be incorporated into the early stages of planning. It is far more than a form-filling exercise rushed through when a claim is submitted to an insurance company in the aftermath of an accident.

The main potential loss arises from LWC. Incidents like the 2010 explosion and subsequent fire on the BP ▷

Photo: mikeuk | dreamstime.com



Histogram of LWC Incidents 1993–2010

Costs. Loss of well control can lead to a worst-case scenario the oil and gas industry must be prepared for.

Macondo. A catastrophic sequence of events caused the sinking of the platform.

▷ Macondo offshore field in the US Gulf of Mexico are likely to result in billions of dollars being paid out by insurance companies. Insurance will cover costs such as paying the contractor retained to bring the well under control, pollution clean-up, loss of equipment and property damage. Without sufficient coverage, loss of well control and the subsequent remediation costs and fines could bankrupt a small or medium-sized oil company.

Robust Methodology

Government authorities charged with licensing offshore operations need to be satisfied that sufficient insurance cover is in place before drilling operations begin. GL Noble Denton's risk assessment methodology is sufficiently robust to produce conclusions suitable for negotiating and confirming insurance coverage.

The GL Noble Denton Deepwater groups in Houston and Mexico City developed a unique methodology to estimate costs associated with a serious, worst-case accident during deep-water drilling. Using advanced statistical analysis including the Monte Carlo simulation and distribution theory, a lost-well-control incident case was elaborated assuming various potential cost drivers. These included fire fighting, search and rescue (by vessel and helicopter), regaining well control (by ship), well capping, relief well drilling, use of flow control fluids, debris removal, pollution control, loss of hydrocarbon, loss of blow-out preventer (BOP), drilling costs (pre-accident), rig loss, operator fatalities, and operator costs (environmental).

The GL Noble Denton methodology focused on incidents involving the loss of assets ranging from the drilling rig itself to expensive, state-of-the-art equipment such as blow-out preventers (BOP) and marine risers. The team looked at historical records of lost-well incidents, collecting data from organisations including the US government's Bureau of Ocean Energy Management (BOEM) and Sintef, a Norwegian-based research organisation. Hinrichsen's team had to develop a unique methodology to estimate the financial risk of an LWC accident in deep-water drilling to overcome a lack of publicly available statistical LWC data.

In addition, data from the Willis Energy Loss Database (WELD) gave the team access to over 180 lost-well-control incidents recorded in the US Gulf of Mexico and 210 blow-out incidents between 1993 and 2010. The Willis database also listed 150 oil and gas wells that suffered an LWC incident. Of the 150 incidents, 128 cost less than 10 million US dollars. Only two cases had costs exceeding 100 million US dollars, including BP's Macondo and another, 130-million-dollar incident. The study found that there was a 1-in-1,000 chance that an LWC incident could reach or exceed a cost of 2.16 billion US dollars.

50,000,000,000 USD

estimated losses following the 2010 Macondo incident

For each well that is analysed a workshop takes place with key GL Noble Denton executives alongside experienced oil company engineers and planners. Issues including the type and range of possible events were identified, and the financial impact of such an event was assessed.

Insurance Coverage

Costs that might need to be covered include firefighting, capping the wellhead, drilling a relief well and cleaning up environmental pollution. Predicted environmental costs ranged from containing and collecting spilt oil from the surface of the sea and the sea floor, cleaning up coastlines and paying for clean-up vessels, personnel and equipment.

Blow-out Preventer. The specialised valve used to seal, control and monitor oil and gas wells.

Photos: Bomboman | Dreamstime.com, US Coast Guard

By using such statistical analyses oil companies and drillers can, with a good degree of accuracy, forecast what necessary insurance coverage they require to fulfil both government and permitting authorities' needs and internal corporate requirements. The data can also be used when agreeing insurance premiums, adding solid statistical support to an oil company's negotiating position.

Furthermore, these numbers can be very useful to planners comparing the financial risks of drilling and developing deep-water wells under various circumstances, considering criteria such as the region or field, which drilling contractor to employ, and how to decide in terms of logistics and scheduling. Any time an oil company makes a major decision it must perform a detailed risk analysis to assess the implications of each available choice.

Using GL Noble Denton's methodology to forecast the insurance coverage required in the event of a deep-water loss of well control provides operating companies with a usable financial basis for managing insurance needs, both internal ones and those made by government and licensing authorities. Fortunately unforeseeable events are rare, but by using GL Noble Denton's methodology to simulate the financial cost of a deep-water LWC, operating companies can systematically address the financial risks inherent in a deep-water exploration drilling programme on a well-by-well basis. □ **BMM**

GL GROUP EXPERT:
Eckhard Hinrichsen
Country Manager Mexico
Phone: +52 55 5245 0193
E-Mail: eckhard.hinrichsen@gl-group.com

projects in brief

BG Group Long-Term Co-Operation to be Continued

London GL Noble Denton has successfully renewed and expanded its contract to provide structural integrity management services to BG Group's North Sea assets following a competitive tender. BG Group, UK, is a world leader in natural gas. The three-year deal will see the independent technical advisor continue its 13-year tenure as structural integrity management provider for BG Group's North Sea Armada platform.

Under the expanded contract, GL Noble Denton will provide a range of structural integrity management activities to BG Group, including the preparation and maintenance of a structural integrity management system; routine and advanced structural analysis; weight control; condition and anomaly assessments; repair identification; emergency response to incidents; and support for new projects as well as major modifications to assets.

Such services are crucial to the safety, upkeep and future performance of oil and gas assets, which require ongoing inspections, condition evaluations, repairs and upgrades, as well as emergency response support. The services will be delivered by GL Noble Denton's expert team of engineers in Aberdeen, UK, with assistance from its global competency centres in Slough, UK, Houston, USA, and Kuala Lumpur, Malaysia.

Buzzard. BG Group operates the Armada complex in the North Sea.

Photo: BG Group

EUA/IGEM GL Noble Denton Wins International Award

London GL Noble Denton's contribution to developing and implementing safety regulations in hydrocarbon-rich countries has been recognised at the UK Gas Industry Awards. The independent technical advisor won the International Business Development category. The ceremony was hosted by the Energy and Utilities Alliance (EUA) and the Institution of Gas Engineers and Managers (IGEM).

GL Noble Denton was awarded for the role it plays internationally at the forefront of regulatory development. In particular, the judging panel identified the company's ability to draw upon its global knowledge of gas and petroleum safety legislation to help international markets create and apply safety regulation to their energy industries for the first time. In the past 12 months, GL Noble Denton's international team of safety and risk experts has assisted major jurisdictions in Europe, the Middle East and South East Asia, to develop their safety regimes in line with industry best practice.

GL Noble Denton is currently providing technical guidance to the Irish Commission for Energy Regulation to design and implement a new petroleum safety framework. It is also working extensively with a major Middle Eastern gas-producing nation to develop the country's first regulatory regime.

Cups. 14 prizes were presented at this year's UK Gas Industry Awards.

Photo: IGEM

IGEM GL Noble Denton Expert Recognised for Lecture

Expert. Awardee Arthur Stoddart.

London GL Noble Denton's Executive Vice President for the Americas, Arthur Stoddart, has been recognised with a gold medal by the Institution for Gas Engineers and Managers (IGEM). The medal was awarded for the Sir Denis Rooke Memorial Lecture that he presented in March 2012. In his engaging lecture ("Gas in a Low-Carbon World"), Stoddart outlined why carbon capture and storage techniques will become imperative to UK energy generation as gas continues to gain importance as a fuel in the country.

GL Noble Denton "Innovation Company of The Year"

harrisburg The Technology Council of Pennsylvania recognised GL Noble Denton with their "Innovation Company of the Year" award, which honours companies with unique products and services that are breaking new ground in the technology industry. GL Noble Denton was nominated for its recent advancements in gas transient optimisation in the SynerGEE Gas product, and the real-time simulation & publishing of large water systems in the SynerGEE Water product. GL Noble Denton has deep roots in the state, with a large portion of the software organisation residing in Mechanicsburg, PA, going back to the 1970s.

The Technology Council of PA helps its members develop new business, connections, and industry knowledge. It builds coalitions to advance technology and innovation, represent the industry's interests in the political arena, and offer programmes and services to grow their membership's expertise. The Mechanicsburg site is one of the many locations globally where GL Noble Denton develops software products to support the needs of oil and gas, electric and water clients worldwide.

Ceremony. Representatives from GL Noble Denton's software organisation.

GL Noble Denton Advancing Best Practice in Marine Warranty and Consulting

london GL Noble Denton has issued three new technical guidelines for assessing and approving energy industry marine operations. These set the standard to which GL Noble Denton will conduct its marine warranty survey and marine consultancy services globally, ensuring that clients are provided with best practice for offshore oil, gas and wind operations. The new guidelines incorporate:

- **GENERAL GUIDELINES FOR MARINE PROJECTS** outlining the processes that GL Noble Denton will use to assess and approve offshore marine operations as well as requirements for approving operations using vessels equipped with dynamic positioning systems, and for asset decommissioning.
- **GUIDELINES FOR SUBMARINE PIPELINE INSTALLATION** specifying the company's approval process for pipeline installation by laying, pulling or towing. In particular, they demonstrate the standards to which the company will adhere when assessing and approving marine activities involved in pipeline installations.
- **GUIDELINES FOR OFFSHORE WIND FARM INFRASTRUCTURE INSTALLATION** outlining alternative or further guidance that the independent technical advisor will use to assess and approve the installation of offshore wind farms of various types.

The documents form part of a portfolio of 13 guidelines for offshore operations, which has been updated by GL Noble Denton following a comprehensive review of its guidelines for the marine assurance sector.

Wind farm. GL Noble Denton issued new guidelines for offshore infrastructure installations.

Photo: Voennyylmasterfile

dates

Conferences & Fairs

SEPTEMBER

16. – 19.09.2013
14th Annual FPSO Asia 2013
Singapore

23. – 25.09.2013
Floating LNG 2013
Houston, USA

FLNG. Leading players in the market are expected.

FPSO. Discussing the latest developments.

OCTOBER

07. – 10.10.2013
KOGS 2013
Kuwait

10. – 12.10.2013
CIOTC 2013
Beijng, China

Beijing. China's global offshore spectale.

16. – 17.10.2013
OSV World 2013
Shanghai, China

22. – 25.10.2013
31st International North Sea Flow Measurement Workshop
Tønsberg, Norway

Harbour. Focus on the practical application.

Forum. Covering the latest changes in the OSV industry.

NOVEMBER

10. – 13.11.2013
16th ADIPEC 2013
Abu Dhabi, UAE

ADIPEC. Abu Dhabi National Exhibition Centre.

IMPRINT

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Enquiries to: Germanischer Lloyd SE, Group Communications & Branding, Brooktorkai 18, 20457 Hamburg, Germany, Phone: +49 40 36149-7959, Fax: +49 40 36149-250, E-Mail: pr@gl-group.com

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Oil & Gas

GL Noble Denton

Think your assets are safe? Ask Debrin first

Debrin is a key member of our Houston offshore engineering team. Her detailed marine warranty experience keeps oil and gas assets safe and compliant, and she specialises in putting our clients' minds at rest.

Debrin double-checks our clients' calculations against ever-changing codes of practice, and ensures the viability of lifting and shipping operations around the world. Thanks to her keen eye for detail, some of the industry's leading operators know that their assets adhere to the highest standards of safety, integrity and performance.

Has run hundreds of marine warranty projects worldwide

Helped drill holes in a Gulf of Mexico spar to correct ballasting

Has assisted the move of an FPSO from the UAE to Brazil

Is up for a black belt in Kung Fu

Debrin is one of the thousands of dedicated experts our clients count on every day

Learn more about her here **www.gl-nobledenton.com/Debrin**

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GL Noble Denton is the independent technical advisor to the oil and gas industry

GL Group

Head Office

Brooktorkai 18
20457 Hamburg
Germany

Phone: +49 40 36149-0
Fax: +49 40 36149-200
E-Mail: headoffice@gl-group.com

www.gl-group.com

The global independent technical advisor

GL Noble Denton

Region Americas

1155 Dairy Ashford
Suite 315
Houston, TX 77079
United States of America

Phone: +1 713 586 7000
Fax: +1 713 586 7007
E-Mail: info.us@gl-group.com

Region Europe

Brooktorkai 18
20457 Hamburg
Germany

Phone: +49 40 36149-7700
Fax: +49 40 36149-1781
E-Mail: glis@gl-group.com

Region Middle East/Africa

Zahret El-Maadi Tower
66 Cornich El-Nile, El-Maadi
35th Floor, Apartment 2
11431 Cairo
Arab Republic of Egypt

Phone: +20 2 25287295
Fax: +20 2 25287294
E-Mail: glnobledenton@gl-group.com

Region Asia/Pacific

Level 39, Menara Ambank
No. 8, Jalan Yap Kwan Seng
50450 Kuala Lumpur
Malaysia

Phone: +60 3 2160-1088
Fax: +60 3 2160-1099
E-Mail: glnobledenton@gl-group.com

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