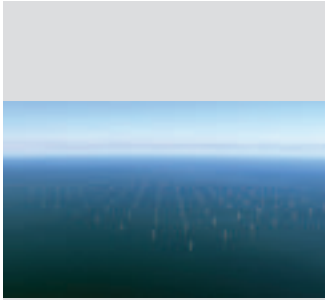


DNV Energy News

News from DNV to the energy industries No. 2 2008

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- Tackling weather conditions and ageing platforms
- Integrated operations in harsh environments
- Developing standard on CO₂ transportation



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The energy industry has entered a period of major changes. Possible profit is very high but the investment opportunities are also more challenging. Long-term sustainable growth can be secured by making the right decisions – however, intensified scrutiny of corporate

conduct, technical challenges and poor operations performance can reduce and overshadow otherwise excellent financial results. More than ever it is important to manage risks in order to take the right opportunities and avoid the pitfalls.

In this issue of *DNV Energy News* we look at wind power and how this clean energy can take a bigger share of the world's energy mix. DNV has acquired Global Energy Concepts in order to strengthen its impact and become a global leader in the field of wind consultancy. DNV is also assisting StatoilHydro in its work of developing offshore floating wind farms by using its extensive knowledge of oil and gas installations.

As climate change affects weather and wave loads, the offshore and technology standards must be adjusted. To meet these challenges of severe weather conditions and ageing platforms, DNV is now developing a new NORSOK standard.

Each year, DNV leads several joint industry projects researching core technical and operational challenges to the energy industry. Many of these projects result in new standards and recommended practices. Thus the entire industry can benefit from the research. For example, we are now leading a project which will lead to a standard reference guideline for onshore and submarine pipeline transmission of dense, high-pressure CO₂.

The offshore industry is working on improved ways of applying information and communications technology for running offshore installations. DNV is Together with the major Norwegian stakeholders, DNV is defining a standard on how information and communication technology should be best used for field operations in the extremely remote Arctic areas.

This handful of cases proves that we continuously work to fulfil our vision of making a global impact for a safe and sustainable future.

Magne Tørhaug
Director of Operations
DNV Energy

Front cover photo:
Getty Images

Adding software and expertise

London: DNV acquires the leading asset performance optimisation software company Jardine Technology Limited (JTL). Its market-leading performance forecasting and optimisation products will be added to DNV's software portfolio.

This acquisition follows on from DNV's successful acquisition and integration of the consultancy company Jardine & Associates Limited (JAL) in 2005 – completing DNV's offering of software and services in the market for performance forecasting.

Broadening portfolio

DNV will focus the software towards the oil and gas, refining, chemical, petrochemical and rail industries. The acquired software products include MAROS for the upstream oil and gas industry, TARO for the downstream refining, petrochemical and chemicals industries and TRAIL for the rail industry.

These new products complement DNV's existing market-leading Safeti software for quantitative risk assessment, consequence modelling and management systems assessment. Along with DNV's global base of highly qualified engineers, this software gives DNV a unique capacity to provide tailored solutions for improved financial performance and enhanced risk management – whether for a local operator or a company operating across the globe.

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JARDINE



USA leading research efforts for ethanol transportation

USA: The use of ethanol-blended gasoline is rapidly increasing, and existing pipelines are considered the most cost-effective method of transportation. However, issues regarding the reliable and safe transportation of ethanol through these pipelines have led the Pipeline Research Council International to select DNV CCT to conduct a research study on the topic.

The scope of the project is to determine the requirements for existing pipeline, tank and terminal systems to transport ethanol without Stress Corrosion Cracking (SCC). The project will research which ethanol-gasoline blends can be safely transported, the timeframe at which SCC occurs, and safe operating practices that mitigate the initiation and growth of SCC. Additional phases of the project will address corrosion of pipeline steels, as well as the compatibility of seals, gaskets, and other rubber materials currently in use.

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Risks in the hydropower industry

Sacramento: At the world's largest gathering of hydropower professionals, HydroVision 2008, DNV pointed out the necessity of risk management.

The conference, which took place from 14–18 July, attracted more than 2,500 hydropower professionals from 67 countries. This year's conference was arranged during a boom in hydro development, with more than 900 international projects under construction to create additional clean energy resources.

"Companies today are facing an increasingly complex risk picture. Requirements on transparency from media and NGOs are rising, there is a strong focus on environmental risks among the public, and there are demands for higher ethical standards in business. It is therefore necessary to understand the different risks, systematically identify the most important ones and manage these. The risk management culture must be developed from the top of the organization," says Wenche Grønbrekk at DNV.



Coal quality

Amsterdam: Rietlanden Stevedores BV has asked DNV to set up and implement an integrated Health Safety Environment and Quality (HSEQ) management system.

The company is operating three coal terminals in the port of Amsterdam, with a total capacity up to 15 million tons per year. It was recently acquired by EDF Trading (Electricité de France).

DNV has been working with Rietlanden for several years and was also involved in the conversations with EDF about further improvements on HSEQ. This resulted in the decision to use isrs7 as a framework for the future HSEQ management system.

EDF Trading began its coal trading operations in 2000 and is now one of the largest coal traders globally. As a significant importer of coal into Europe, it also plays an important role in arranging the EDF Group's coal supply requirements in France and the UK.

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DNV's services to the energy industry

The new risk agenda entails new challenges and opportunities for all players across the energy value chain. The **demand for energy** is increasing faster than ever before. At the same time, the access to energy sources is getting increasingly difficult. With unprecedented **concerns for energy supplies**, energy companies must venture into uncharted territories. Mounting local and global **environmental challenges** add to this already complex picture. All this spurs an unparalleled need for **new technologies, work processes and business practices**. This new risk reality belongs only to those who can master risk in all dimensions.

DNV offers the **whole range** of energy and process-related services, and provides world-class expertise in **technology, operations, management and risk**. But even more importantly,

DNV combines its know-how into a professional service concept designed to safeguard and improve the performance of your business. Through its worldwide organisation DNV provides **global impact**, supporting you **all the way** from **strategic considerations** to **decommissioning**.

■ Enterprise Risk Management

DNV provides a complete understanding of your organisation's total risk exposure and suggests how to manage these risks in an integrated way.

■ SHE Risk Management

DNV helps you develop, implement, maintain and continually improve best practices in SHE management.

■ Technology Qualification

DNV helps you ensure that new technology will function within specified limits and with an acceptable level of confidence.

■ Verification

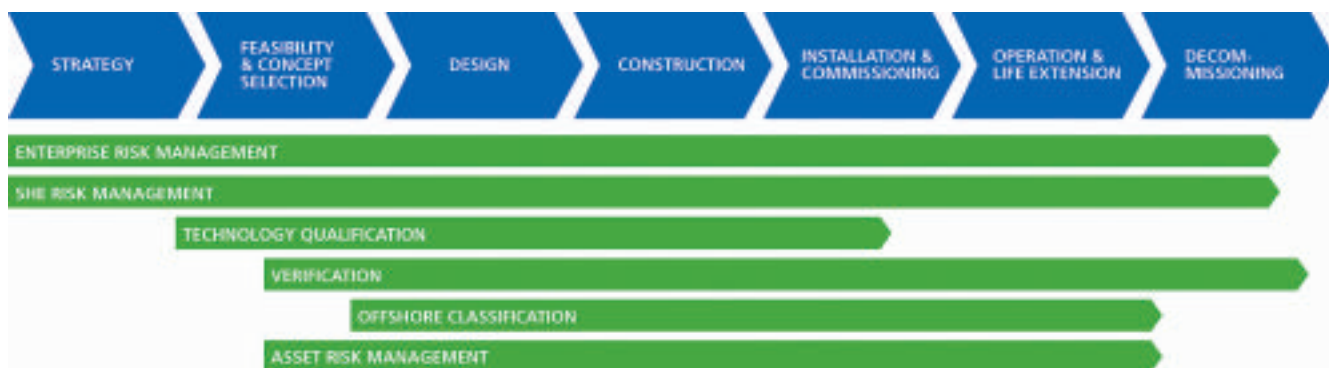
Through a transparent, global and fully independent approach to verification, certification, quality surveillance and marine warranty, DNV helps you reduce and manage risk, thereby increasing the likelihood of success.

■ Offshore Classification

DNV assures owners, authorities and other stakeholders that the facility complies with classification rules and requirements, enabling an optimum approach for both harsh and benign units.

■ Asset Risk Management

DNV supports you in responsibly obtaining maximum value from your facilities, equipment and people without compromising safety or the environment.



Achieving global wind leadership

DNV has acquired the US-based wind consultancy company Global Energy Concepts (GEC). The combination of DNV's global energy risk management expertise and GEC's engineering and technical services establishes a leading player within the global wind power consultancy market.

OSLO/SEATTLE: By joining forces, DNV and GEC will provide expanded service offerings, capabilities and international reach by bringing together European and North American expertise in wind energy. The market will be offered an unparalleled array of wind energy services for a wind project's entire life cycle, including both onshore and offshore applications.

Joining for global leadership

DNV's head of Cleaner Energy, Elisabeth Tørstad, explains: "GEC has for many years been a global leader in the wind energy industry, and has conducted direct work on wind projects representing more than half of the new installed wind energy capacity in the US. The Seattle-based company supports the industry with a broad range of services – from initial site selection and wind resource assessment to power performance testing and financial due diligences for investors."

Tørstad says that DNV has considerable expertise in wind energy and is the world's leading provider of offshore project certification services. "Our current wind centre in Denmark has more than 20 years of wind experience, and more than 40 years of experience within oil, gas and energy, with a corporate global footprint of 300 offices in 100 countries.

"DNV's 20 wind experts are now joining forces with GEC and its 100 employees. This a big step forward, as we aim to rapidly build a powerful and dynamic professional services environment. With GEC

on board, DNV will be the wind world's leading service provider," she concludes.

Capitalizing on rapid growth

The global wind energy market is growing annually by 20% and 2007 was another record year for the wind energy industry. The US is the fastest growing wind market; wind contributes more than 30% of its new generation capacity. This makes wind the second-largest source of new power generation in the country – surpassed only by natural gas. The US Department of Energy has recently announced an ambition to have 20% wind-generated electricity by 2030.

DNV Energy's COO, Remi Eriksen says: "The energy future will be dirty, uncertain and expensive unless hydrocarbon-based energy is made cleaner and renewable energy starts to play a bigger role. No single solution will deliver the necessary changes. Therefore, we need a mix of options which focus on developing more

energy sources, using energy more efficiently and lowering carbon intensity. DNV is committed to making a difference in the energy future, and strongly believes that wind energy will be an important factor in improving the security of supply and fighting climate change."

DNV's goal is simple: the wind energy industry is growing fast and has to deal with numerous technological, economic and political uncertainties. "We want to help key players in this industry to drive new solutions and to manage the risks that come with these," he emphasises.

"DNV is confident of the viability and commercial maturity of wind as a major contributor to the world's energy needs. We therefore see the need to have a strong professional environment within the wind market, so that we can make an impact. The global wind industry is gearing up for rapid growth and we are now at the forefront to capitalise on this," says Tørstad.



Elisabeth Tørstad



Remi Eriksen

INTEGRATED OPERATIONS

The Integrated Operations High North project will produce new technology for a digital infrastructure in addition to an information extraction and retrieval platform. Risk measures relating to safety, security and availability will be the main key words.

The project's focus will be on improved solutions for a number of pilots:

- A semi-autonomous control system for unmanned drilling rigs
- Production regularity and security in the Arctic regions
- Sub-ice operations

DIGITAL INFRASTRUCTURE

Operations become more complex in difficult environments and with increasingly automated processes.

The digital infrastructure and information platform will therefore consist of several elements that will be demonstrated in the pilots:

- Risk management measures that will reduce the likelihood of a production shutdown or HSSE incidents due to unreliable information or infrastructures. These include relevant standards and practices relating to the design and implementation of the digital infrastructure and information platform for Integrated Operations.
- Information integration to support the interpretation of sensor data, information validation and web services. The project will extend and improve the quality of the ISO 15926 based oil and gas ontology and develop an information validation methodology.
- Information transfer - the connection of professional services to network nodes by investigating networks and developing a platform for web services and information validation that supports automatic monitoring, simulation and optimisation.
- Real-time information exchange between sensors, activators and nodes in a high-capacity network by developing autonomous sensor-near software. The project will produce new knowledge and technology for sensor-based, robust control systems.

Digital platform for Integrated Operations

To be able to operate safely and sustainably in remote and hazardous areas, major Norwegian stakeholders are now joining forces to develop a digital platform for next generation Integrated Operations. The project is a unique collaboration between the IT, defence, oil and gas industries.



It is widely acknowledged that human and organisational aspects pose great challenges to operators implementing Integrated Operations (IO), but there are also massive technological challenges to be solved. Some are related to information quality and to the poor integration capabilities of both software and business processes.

“Based on this reality, a new DNV-managed joint industry project, ‘IO in the High North’, aims to facilitate the implementation of next generation Integrated Operations by developing a common digital platform,” explains Thore Langeland, manager of Integrated Operations at the Norwegian Oil Industry Association (OLF).

“Integrated Operations are a key element in the future of the oil and gas industry. New technology and work processes will lead to safer, faster and better decisions. The result is a potential for considerable value creation and the opportunity to enter new, prospective areas,” says Langeland.

Complexity in remote and harsh areas

Oil and gas operations in the high north are likely to entail the remote and distributed control of assets – leading to heavy demands on the communication links and information flow. Connecting and integrating business processes and information sources across organisational boundaries add to the complexity. Further, operations in the high north require a lot of attention to be paid to environmental aspects, as the tolerance for environmental hazards in such vulnerable areas must be as close to zero as possible.

In order to meet all the requirements and at the same time maintain profitable operations, the industry has to create new field development and operation concepts that include heavily instrumented facilities. There must also be a significant focus on the transfer of real time data between fields and operation centres located elsewhere, and on automated key work processes. Hence, a prerequisite for this

development is a robust digital infrastructure and a platform for effective and efficient information exchange, which is the project's main task.

A four-year horizon for major stakeholders

"During the coming four years, the participants in the "IO in the High North" project plan to go from conceptualisation to industrial implementation. During this period, the project will both benefit from and contribute to the extensive Integrated Operations development on the Norwegian continental shelf," says Heidi Brovold, who is responsible for IO at DNV.

"The "IO in the High North" project consortium includes operators, service providers and software vendors. In addition,

the Norwegian Armed Forces is working with the project to resolve common infrastructure and communication challenges."

The project is supported by the Norwegian Oil Industry Association (OLF), the Business Association of Norwegian knowledge- and technology-based enterprises (Abelia), and the Norwegian Defence and Security Industries Association (FSi). The total budget of MNOK 90 will be financed by the partners and the Research Council of Norway.

"Collaboration between different industries is important to meet the challenges of the future. "IO in the High North" shows how the Norwegian knowledge industry is taking a leading role in the global oil and gas industry," says Brovold.

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Sponsoring research on Integrated Operations

DNV has become sponsor of the Centre for Integrated Operations in the Petroleum Industry (IO Centre) in order to promote the better resource utilisation of oil and gas.

The IO Centre at the Norwegian University of Science and Technology (NTNU) was established in cooperation with the SINTEF research group and the Institute for Energy Technology. The centre's goal is to conduct research, achieve innovation and provide education within the field of Integrated Operations and to promote accelerated production, increased oil recovery, reduced operating costs and enhanced safety and environmental standards.

Industry and academia

It collaborates with a broad range of leading international academic institutions such as Stanford, Kyoto and Delft Universities, as well as with companies like StatoilHydro, Gas de France, ConocoPhillips, Shell, Petoro, Aker Solutions, Kongsberg

Maritime, IBM, and now also DNV.

The centre is a meeting place for industry and academia, and its leader, Professor Jon Kleppe, says: "We are very much looking forward to the new cooperation with DNV through this partnership. In addition to the R&D objectives, the centre is expected to contribute to new products and new companies. And since DNV has a strong focus on harvesting from high-end research institutes and academia for innovation and commercialisation purposes, the partnership with DNV will very much contribute to pushing our activities in this direction."

Revitalising technology

The relatively new field of Integrated Operations is known by several different

names: e-operations, e-field, smart field, field for the future and digital oil fields. However, it is all about integration. Traditional borders are becoming erased as oil companies, suppliers, groups and people working offshore and onshore are linked through new types of cooperation using computer technology.

The activities at the IO Centre will focus on integration at all levels of the knowledge process, from the collection of information to the making of smart decisions in real-time. The centre will develop a knowledge bank, methods and tools for IO for upstream petroleum activities that will bring substantial progress and revitalise the industry's technologies and practice.

www.ntnu.no/iocenter



THE CENTRE HAS THE AMBITIOUS GOAL OF BEING AT THE FOREFRONT OF RESEARCH AND DEVELOPMENT FOR THE NEXT GENERATION OF INTEGRATED OPERATIONS, IN CLOSE COOPERATION WITH OIL COMPANIES AND THE SERVICE INDUSTRY. DNV WILL BE AN IMPORTANT PARTNER IN THIS DEVELOPMENT.

Professor Jon Kleppe, leader of the IO Centre's

Taking the ghost out of the machine

The refining and chemical process industries have been rocked by some widely publicised incidents in recent times. To help reduce the number of accidents, DNV uses a risk-based approach through the isrs7 tool. TEXT: ROSIE COLLYER

Londoners held their breath last November as all the major news channels showed images of 30-metre-high flames bursting out of the isomerisation tower at Petroplus' Coryton refinery. Miraculously no one was killed or injured, but the public was once again made aware of the risks associated with the refining and chemical processing industries.

THE ADAPTATION OF THE ISRS7 TOOL TO ENCOMPASS PROCESS SAFETY MANAGEMENT ENABLES THE CONSIDERATION OF SPECIFIC CONTROLS NEEDED FOR MANAGING PROCESS SAFETY RELATED EVENTS.

A UK Health and Safety Executive investigation is still ongoing at the Coryton Refinery. Yet leading refiners remain uninformed about the extent to which risk affects the industry as a whole:

"They (refiners) have generally only been interested in their own pool of refineries in terms of safety. But when they look at the industry as a whole, it is usually in terms of margins or the future of refining, but they don't tend to be focused as an industry on their safety record, and it is the focus on safety that DNV is bringing to the industry," says Hari Vamadevan, DNV Energy's director of operations in Europe and North Africa.

Since January 2005, DNV has been

recording major incidents and accidents in the refining and chemical process industries that are in the public domain. Over 1,800 incidents have been recorded thus far, and 45 lives were lost in 2008 alone.

Lessons learned

When the media spotlight is redirected elsewhere and the New Risk Reality seems less real, the fact still remains that most refineries and chemical processing plants in Europe and the US run assets that are over 30 years old. The conventional view of industry decision makers has been to pour money into asset optimisation programmes.

The Baker Report commissioned following the 2005 blast at BP's Texas City refinery that killed 15 and injured 180, suggested that improvements in safety management systems and corporate culture were needed to manage major accident risks.

"Management systems designed primarily for occupational safety issues rarely perform well in managing major accident hazard potential. A detailed risk-based process safety management programme is a necessary foundation to prevent major accidents," warns Graham Bennett, director of Refining and Petrochemicals in DNV Energy.

The industry is at last warming to the idea that an integrated approach to Safety, Health and Environment and asset management is needed in order to achieve the necessary process safety improvements.

"Plants operating in the US and the EU have definitely advanced in terms of personnel safety improvements, and some basic process safety initiatives have been implemented via OSHA 1910 in the US. And most promising of all: last year the Center for Chemical Process Safety, a US-based corporate membership organisation, committed itself to a series of Process Safe-

ty Management related initiatives," explains Graham Bennett.

Prevention is better than cure

By mid-2006, DNV Energy responded to growing industry demand by launching the isrs7 Process Safety Management tool. Designed to assess the status of the multiple layers of hazard management protection, isrs7 uses a structure of 15 processes with the aim of stimulating continual improvement within an integrated management system (see fact box). The approach also allows benchmarking Process Safety Management performance, which is of particular interest in an industry with multiple stakeholders.

DNV has undertaken a number of Process Safety Management implementation projects, using the isrs7 tool. OMV, Austria's largest listed industrial company with over 40,000 employees, turned to DNV for help in 2006 after a number of incidents occurred at two of their oil refineries. Some of the incidents highlighted the major loss potential; and although no injuries were caused, OMV was keen to maintain its good safety record.

"We undertook a Root Cause Analysis of a number of the incidents to identify the systemic causes. The review of systemic causes highlighted the need to develop a new approach to Process Safety Management, which is being led by the newly formed OMV Centre of Excellence," explains Graham Bennett.

Atom and evil

While the refining and chemical processing industries have been dealing with the New Risk Reality in recent years, the nuclear industry has been battling with risk-related myths since its inception.

Sellafield on the east coast of Great Britain has been a hotbed of public debate since it opened in the 1950s. As



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DNV has observed and participated in several regulatory and engineering approaches aimed at reducing major accident risks over the past decade.

Europe's largest industrial site it is home to over 200 nuclear facilities, including two reprocessing works and a plant for making mixed uranium and plutonium fuel called Mox. It is currently undergoing decommissioning, a process that requires optimum management effectiveness as well as the highest possible understanding of health and safety issues.

In 2005, DNV was awarded a contract by the British Nuclear Group to provide isrs7 related services at its Sellafield site. DNV undertook an initial isrs7 (Alpha) Assessment of 1,200 people in the Environment, Health, Safety & Quality (EHS&Q) department at Sellafield. This evaluation identified a number of issues concerning the effectiveness and understanding of the systems in place for managing EHS&Q risks.

"Following the success of this project, DNV was appointed to map and assist with the implementation of a knowledge management (KM) programme at the Sellafield nuclear services site. DNV's role is to help shape the company's knowledge management strategy and to train the Sellafield KM team in a range of KM prac-

tices," says Eric Pape, Head of DNV Utilities in the UK.

On the other side of the Atlantic, public opinion on nuclear energy has thawed since the Three Mile Island accident in the 1979 in which radioactivity was spread across the countryside after a fire broke out in a reactor chimney. Insufficient of information from the owners about the severity of the incident exacerbated public anxiety. The media then filled the information gap with mixed results. USA eased building additional nuclear power stations in the aftermath of the accident, and has only very recently begun entertaining the possibility of reviewing that stance.

In 2006, President Bush announced an "Advanced Energy Initiative" that involves investing more in zero-emission coal-fired plants; revolutionary solar and wind technologies; and clean, safe nuclear energy. So the need for Process Safety Management systems looks set to increase in the refining, chemical processing and the nuclear industries.

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ISRS7 PROCESSES

The tool is comprehensive and detailed. The processes include:

1. Leadership
2. Planning and Organisation
3. Risk Evaluation
4. Human Resources
5. Compliance Assurance
6. Project Management
7. Training and competence
8. Communication and promotion
9. Risk Control
10. Asset Management
11. Contractor Management and Purchasing
12. Emergency Preparedness
13. Learning from events
14. Risk Monitoring
15. Results and review

Taming wind and waves

“We’re a new entrant in offshore wind, and it’s fun to be shaking things up a little bit!” says Anne Strømmen Lycke, StatoilHydro vice president, wind power. “We’re bringing in new ideas and using all our experience from offshore oil and gas.”

TEXT: KAIA MEANS

HOW HYWIND BEGAN

Hywind is a new concept for producing wind power offshore in deep waters. Hydro’s Dag Christensen got the idea for a floating windmill when observing a buoy during a sailing regatta in 2001. “If we make that 100 meters tall instead of four, then we could have a windmill tower,” he thought to himself. He discussed the idea with his colleague Knut Solberg at lunch one day, and they drew a sketch on a serviette. He realised that Norway could be a major producer of wind power after calculating that one windmill per km² in an area of the North Sea area of 70 by 70 km would double the nation’s electricity production.

Since 2001 the project has been through various research phases, eventually with smaller models of floating windmills going through tests in wave tanks at Marintek in Trondheim.

StatoilHydro announced earlier this year that it will build the world’s first full-scale floating windmill, to be installed in the North Sea outside off Karmøy in the autumn of 2009.

HYWIND SPECIFICATIONS

Turbine size: >=5MW
Annual production: approx. 22 GWh/turbine
Draft hull: 120 m
Hub height above sea: 80 m
Rotor diameter: 120 m
Water depth: 100-700 m
Displacement: 8,149 t
Mooring: three lines

Towering 65 meters above water with a rotor diameter of 80 meters, StatoilHydro’s planned Hywind offshore floating wind turbine – the first ever of its kind – will be impressive in size. But few people will ever get the chance to admire it in its working life, as it will be towed to a location in the North Sea, ten km off Karmøy on Narway’s west coast. That is the whole point.

Since so much resistance to wind power has centred on concerns about aesthetics, the need for space and potential environmental concerns, much hope rests on the Hywind project in which many of these issues are mitigated. Ever fewer onshore and shallow-water sites are available. In addition, some areas have very limited or no shallow shelves to use, such as California, Japan and Norway. The questions remaining are, “Can it be done?” and more specifically, “At what cost?”

That remains to be found out, as the wind turbine is scheduled to run for a two-year trial period.

Worldwide interest

Ms Lycke believes that floating wind turbines can one day be an important source of cost-efficient renewable energy – with parks full of 100-meter-tall turbines in oceans across the globe.

“We’ve had a lot of people calling us from all over the world. They’re very interested in talking with us about the possibility of future offshore wind turbine parks in their countries,” says Ms Lycke.

A delegation from StatoilHydro recently accompanied the King of Norway on an official visit to Portugal, and learned about the innovative Portuguese programmes to support offshore wind development.

“We think this will be a new icon, symbolising our company’s technology, innovation and ability to look in new directions. It is opening up a whole new business area in the world,” she says of the NOK 400 million project. “It’s easy for us to find part-

ners – and that’s always a good sign.”

The power platform uses a floating structure known from the oil and gas industry, a technology that StatoilHydro has years of experience with in its offshore operations, secured with three anchors in water depths of 100–700 meters. The sites available for offshore wind parks are thereby multiplied. Although the platform is full size, engineers have settled for a relatively small, conventional turbine.

“We want to test the concept, so we’re using a 2.3 MW Siemens turbine. It’s one of the world’s most tested turbines, so we’re sure it will work properly,” says Ms Lycke.

A smaller-scale model has been tested in a water tank at Marintek in Trondheim. Technip will deliver the sub-surface-floating element, and Nexans will lay the sub-sea cable to land. Engineers will be able to control the turbine remotely, adjusting the angle of the rotors in relation to wind and waves. All of the data will be recorded and used in the two-year research project. The electricity generated will be delivered to Haugaland Kraft, a Norwegian power company.

“The interaction between the wind and waves will be exciting to see,” says Ms Lycke. “If it is as successful as we think it will be, there will be no reason why we shouldn’t decide to let it continue to produce electricity after two years have passed.”

The turbine is designed to have a lifespan of 25 years, but already StatoilHydro is working with partners – among others, DNV – to see how the original design life can be extended.

StatoilHydro already operates an Arctic land-based wind turbine park at Havøygavlen in Finnmark, northern Norway; the world’s northernmost wind turbine park. The experience of operating the park for the past six years in harsh weather conditions, including extreme temperatures, has been invaluable. Havøygavlen is jointly owned with the Dutch company Nuon.

The European Union has stated that 20



Photo: StatoilHydro, Davide Burke



"I'm not here to save the world," she says matter-of-factly. "This is a business project that we'll hopefully make money on."

per cent of its energy should come from renewable sources by 2020. Ms Lycke thinks this will be a challenge. But some European countries, such as the UK, are investing large resources into making this happen. The UK is about to go ahead with a third licensing round for offshore fixed wind turbines, and StatoilHydro is intending to make a bid.

Political goodwill

Before offshore wind energy can really get going, politicians have to make some key decisions.

"There's a lot of political goodwill in Norway for wind energy, and that's important. The previous petroleum and energy minister did a good job of promoting Norway, and focusing on the possibilities for becoming a big exporter of renewable energy. But to develop offshore wind, you need laws and regulations that we don't have now. We have also asked for a licensing system similar to that used for the oil and gas industry, which would solve some of the usage conflicts," she says.

The power generated from offshore wind turbines will be more expensive to produce than the current market price. Ms Lycke expects that state subsidies will be needed to support the greener energy, but how much remains to be seen.

If wind parks are built in four North

Sea blocks, she says, the energy generated will equal the production from the Ormen Lange field, which produces 22 BCM. That is equal to 20 per cent of the UK's natural gas consumption.

Hydro had ten years of experience with wind energy before the merger with Statoil.

"Wind energy has really been supported in the new company," says Ms Lycke. "There's a real focus on technology and innovation here, and this fits in very well. The combination of Statoil and Hydro has made us stronger in renewable energy. We have a broader portfolio and a more pronounced focus on technology. Our main focus areas are CO₂ management, renewable power production and sustainable biofuel."

StatoilHydro takes part in a wave energy project where three floating test devices off the coast of Portugal use pressure from wave movements to generate electricity. Also, an underwater turbine that harvests tidal energy has been running in Kvalsundet in Finnmark for five years with good results – owned by Hammerfest Strøm AS where StatoilHydro is the main shareholder.

"Commercially, that's very interesting, since the tide is moving all the time. It's a lot easier to sell into the electricity grid, when it's a stable production," says Ms Lycke.

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FROM OIL TO WIND

Ms Lycke's background is from Hydro, where she started as a geologist 25 years ago. She loved the excitement of looking for and finding oil. Throughout the years she has had various positions at Hydro, including project manager for designing a new natural gas transport system and a new tariff model, which was finished in 2002. After the merger with Statoil, she was asked to take over the wind energy department, which has 25 people, in addition to the people involved in the various projects.

She says that she's always enjoyed most the times when she's been part of creating something from the very beginning, looking for new and creative solutions. That's when she's in her element.

PREDICTING WAVE IN DECK AND SUBSTRUCTURE LOADS AND RESPONSE

Previously, there have been no established methods for determining the loads that deck structures are subjected to during wave impacts. DNV now performs extreme storm analyses run using advanced software such as COMFLOW, a computational fluid dynamics (CFD) programme. The most complicated analyses can take up to five days to process. Non-linear finite element (FE) analyses are then utilised to predict the effect of the loads – showing exactly what loads each joint and brace is subject to under a given storm condition. The FE software USFOS is used in this work.

In connection with writing the new NORSOK N-006 standards, DNV has pioneered research and published papers, such as 'Prediction of Increased Jacket Substructure Loads Due to Wave in Deck.'

Insufficient air gap is an important factor in platform damages caused by waves. The original design requirement for positive air gap is no longer fulfilled for a number of jacket-type structures still in production due to seabed subsidence and/or more onerous weather criteria.

The DNV study examines the effect of extreme wave crests hitting the deck of a jacket-type structure. The kinematics in the wave beneath the deck are strongly influenced by the deck itself. In this case, the increased fluid particle velocities must be accounted for when assessing the load on obstructions located in a zone below the deck, i.e. the upper part of the substructure and on under-deck attachments.

Usually the wave-in-deck loads and substructure loads are calculated separately by two different analysis programs. The undisturbed velocity field is then applied to the substructure. DNV researchers compared two methods, both based on computational fluid dynamics (CFD), for calculating the increased substructure loads due to disturbed fluid particle velocities during extreme wave-in-deck events.

New standard to cover platform lifetime extension

To meet the challenges of severe weather conditions and ageing platforms, DNV is developing a new NORSOK standard to deal with platform lifetime extension.

Norway's Oil Industry Association (OLF) has asked DNV to propose a new NORSOK standard encompassing rules and regulations for issues involved in lifetime extension, which have previously not been covered by newbuild standards such as NORSOK N-001. The new NORSOK N-006 will be an alternative to NORSOK N-001 for cases where structures are to be operated beyond original design requirements and structural resistance is not easily documented through ordinary design calculations.

The new standard is applicable to the assessment of complete structures, including substructures, topside structures, vessel hulls, foundations, mooring systems and subsea facilities.

The proposal for NORSOK N-006 has been close to a year in the making, and is now out for review in the industry. The process has been demanding, involving issues that have not been codified and regulated before. The final version is expected to be completed and ratified this autumn.

Operators must apply to the Petroleum Safety Authority to extend an operating license beyond the original design life – and must provide documentation that the platforms will be operated safely for people, for the environment and will also be profitable, with the efficient use of infrastructure.

Unique position

How should operators document the condition of the platform? What type of information should be sent to the authorities? How do you take existing rules and regulations and expand them for new conditions

while maintaining the same level of safety?

DNV has an unique position to take on the task, due to our involvement in writing regulations for many years. We fully know the basis for the rules, and the possibilities for bringing them forward. Chief specialist for Offshore Structures at DNV, Gunnar Solland, has led the work with the new standard.

One of the main issues for maturing platforms on the Norwegian shelf is subsidence. In the most extreme cases, platforms have sunk by up to 10 meters. This level of subsidence is the most extreme in the world; and waves can now reach the platform decks in some instances.

Wave heights in the North Sea are estimated to be greater now than they were 30 years ago – perhaps due to climate change, or perhaps due to greater accuracy in measurement and more statistical data.

The combination of subsidence and high storm waves means that platforms endure much greater loads than they did at the beginning of their design lives. Some platforms no longer satisfy the original design requirements, or current NORSOK requirements for manned structures.

What are the criteria for shutting down and unmanning a platform? How big do the waves need to be? The proposed NORSOK N-006 standard – specifically written for Norwegian conditions – will provide the guidelines to these questions.

According to the current NORSOK standards, manned structures must withstand a 10,000-year wave, and people must be safe in such a condition. If this requirement is not fulfilled, the platforms must have unmanning plans for instances when waves



are predicted to exceed a predefined safe level. The proposed new standard sets the criteria for safe operation in such cases.

Limiting evacuations

One of the subsiding fields is Ekofisk. It was partially evacuated due to storms just once last winter, with production shutting down on a third of the platforms. The number of evacuees to land was limited to approximately 500. The evacuation decisions were made based on data supplied by DNV. Optimally, knowledge and expertise will give full control, making it possible to limit evacuations and shutdowns to the minimum.

DNV is working with the Norwegian Meteorological Institute to define the

height and forecast the type of wave that can cause damage. Today we have much better data on wave height than just a few years ago, and more reliable data means safer operations.

Improving methods

Solutions to reinforce ageing platforms are many. In the 1980s, DNV assisted in jacking up sinking platforms on the Ekofisk field. Due to cost increases, that procedure is less attractive today.

But, there are other options. If a mature jacket platform needs strengthening, one common method is to insert grout into the braces. New extra diagonal braces can also be mounted on the platform. If water is hitting the deck, it is possible to open the

deck so the water goes straight through. Another option is to build a wall to protect the deck from waves.

Scour is another issue for ageing platforms. The seabed can be gradually washed away around the piles over the years. One area covered in the proposal is how to assess areas that are not possible to inspect, for example the piles.

Basic maintenance, such as the removal of marine growth, is also important. Generally there is a good safety culture in Norway, and operators take safety seriously. Conditions are changing, and the new NORSOK standard will take into consideration new weather and foundation challenges – which we increasingly will meet in the future.



Jan Egil Sæberg

Jan Egil Sæberg is DNV's director of Technology. He joined DNV in 1985, after graduating from NTH with a MSc in offshore structures. At DNV he has worked with both fixed and floating offshore structures, and as project leader for technical developments and engineering. In 1996 he became section manager for Offshore Structures. His current position includes offshore structures, marine operation, and cranes and machinery. Also, he participates in the DNV global segment network for floaters, and the global service network for verification.

Sæberg experiences a high degree of focus on platform life extension – and

consequently an increased demand from operators and rig owners for such services.

In the area of platform technology, DNV provides consulting for operators and owners to determine optimal solutions for platform life extension, and is one of the leading providers of life extension consulting services in the North Sea.

DNV also contributes with Structural Reanalyses Systems, based on decades of experience with implementation and operation. Issues tackled are among others: fabrication defects, cracks, degradation, corrosion and fatigue.

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Developing a CO₂ pipeline standard

Specific issues related to CO₂ in the dense, high pressure phase are not covered in existing pipeline standards or regulations. DNV, together with major industry partners, is therefore developing a new standard for transportation of CO₂ in pipelines.

As Carbon Capture and Storage (CCS) projects could become an important mitigation option related to climate change, this is an important step forward.

Relating to CO₂ pipeline transmission, stakeholders today demand a robust, traceable and transparent approach that gives credibility to the proper management of the risks and uncertainties. Unfortunately, the current pipeline standards do not take into account considerations related to the pipeline transmission of CO₂ from large-scale capture plants to suitable storage sites. This serves as a barrier to the effective large-scale deployment of CCS.

Broad joint industry project

DNV has therefore initiated a specific industrial collaboration to develop a standard reference guideline for the onshore and submarine pipeline transmission of dense, high-pressure CO₂.

Project Manager Frøydis Eldevik at DNV says that the project's partners are Statoil-Hydro, BP, Shell, Vattenfall, Dong Energy,

ArcelorMittal, Gassnova, Gassco, Petrobras and ILF. The Technical Reference Group consists of government representatives from the UK, The Netherlands and Norway. The European Commission is also supporting this DNV initiative.

"This joint industry project is an important milestone for CCS and is absolutely timely since the industry really needs this recommended practice. It will be an important contribution to the development of large-scale CCS projects," explains Eldevik.

The novel issues related to the onshore and submarine pipeline transmission of dense, high-pressure CO₂ will be covered. The point of departure will be existing pipeline standards for the transmission of hydrocarbons, such as ISO 13623 and DNV-OS-F101.

Minimising risk throughout the life cycle

The guideline is intended to help designers and operators limit and manage uncer-

tainties and risks related to the pipeline transmission of CO₂ by incorporating current knowledge related to both offshore and onshore operations. It will state rules for managing risks and uncertainties throughout the pipeline's lifetime, including the design, testing, inspection, operation, maintenance and de-commissioning phases. It will also incorporate the lessons learned from existing and previous projects.

"Due to the features lacking in the current industry standards, this project's scope of work is related to issues like safety, fast propagating ductile fractures, fatigue crack growth, pipeline operation conditions, flow assurance, corrosion and material compatibility," says Eldevik.

In order to meet the urgent needs of upcoming CCS initiatives, the guideline will be ready within 18 months.



DNV's offshore standards

Sharing knowledge and expertise is an important aspect of DNV's work. One way to do so is by publishing codes, standards and best practices.

"DNV's in-depth knowledge, coupled with its role as an independent partner, gives us the mandate to publish a great number of standards. This work is done together with the industry and authorities worldwide," explains Kjell Eriksson, DNV Energy's director of service and technology development.

The DNV Offshore Codes consist of a three-level hierarchy of documents: Offshore Service Specifications, Offshore Standards, and Recommended Practices. The development of codes is based on:

- new or changed needs in the market
- research findings and joint industry projects
- changes in international conventions and standards (IMO, IACS, ISO, IEC, etc.)
- lessons to be learned from practical applications
- the need for clarifications, interpretations, etc.

The Offshore Code process

New and amended Offshore Codes are all subject to a formal, documented process

in which stakeholders are invited to review them and submit written comments. Finally, the received comments are evaluated by a design review board. Such internal and external consultation processes last 8-10 weeks and are followed by a design review meeting where decisions are made on how to handle the comments received. The board then recommends that DNV's management team approves the publication.

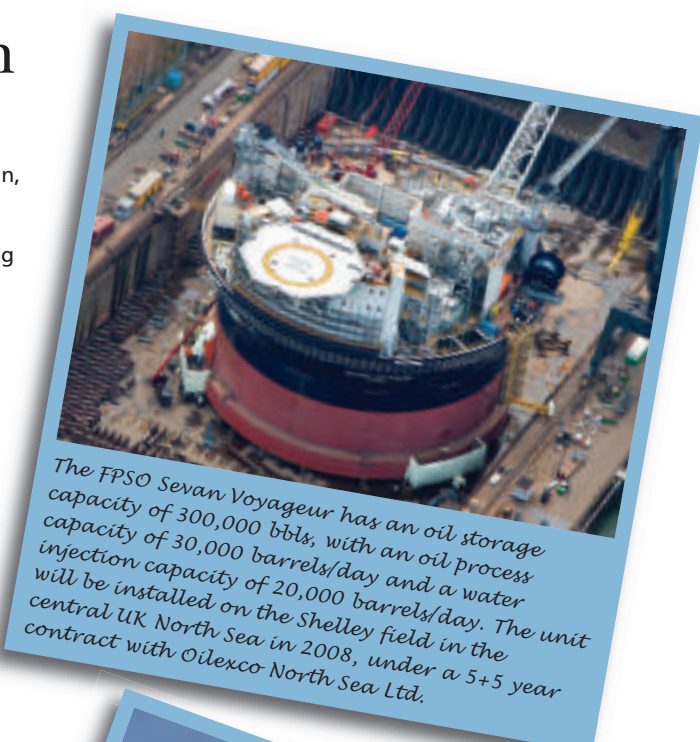
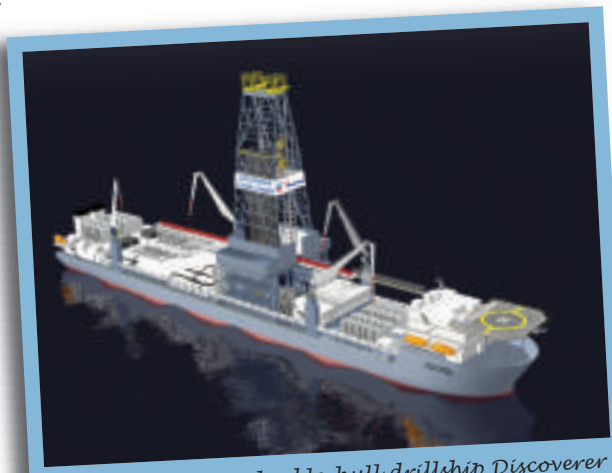
Offshore codes on which comments are currently being invited:

RP 2008-03	DNV-RP-D101 (new) Structural Analysis of Piping Systems
RP 2008-04	DNV-RP-F112 (new) Design of duplex stainless steel subsea equipment exposed to cathodic protection
RP 2008-02	DNV-RP-D201 (new) Recommended Practice for Integrated Systems
RP 2008-07	DNV-OS-C106 (revision) Structural Design of Deep Draught Floating Units/Spars (LRFD and WSD Methods)
RP 2008-25	DNV-OS-E301 Position Mooring
RP 2008-26	DNV-OS-E302 Offshore – Mooring Chain
RP 2008-28	DNV-OS-E406 (new) Design of Free Fall Lifeboats

See www.dnv.com/resources/rules_standards/ for more about DNV Rules and Codes.

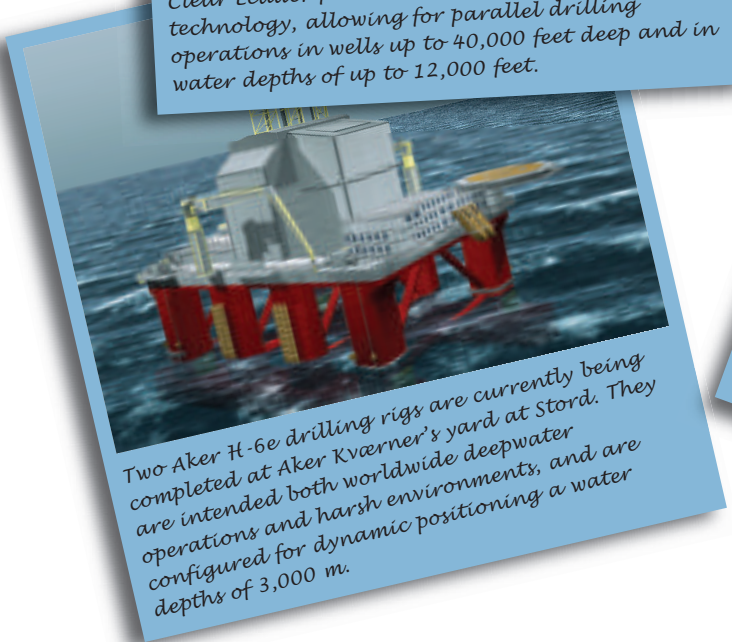
DNV Offshore Classification

DNV helps clients ensure adequate safety and reliability through offshore classification, thus providing assurance that requirements laid down in applicable rules and regulations are met during all phases of the asset's design, construction and operation. Our Offshore Classification offices are located in Oslo, Stavanger, Aberdeen, London, Rotterdam, Houston, Rio de Janeiro, Dubai, Koje, Korea, Shanghai and Singapore. Of the current total newbuilding orders, 43 per cent of drilling semisubmersibles, 42 per cent of drill ships, 45 per cent of FPSOs and five per cent of jack-up units are awaiting DNV class.



The FPSO Sevan Voyageur has an oil storage capacity of 300,000 bbls, with an oil process capacity of 30,000 barrels/day and a water injection capacity of 20,000 barrels/day. The unit will be installed on the Shelley field in the central UK North Sea in 2008, under a 5+5 year contract with Oilexco North Sea Ltd.

Transocean's new double-hull drillship Discoverer Clear Leader features a dual-activity drilling technology, allowing for parallel drilling operations in wells up to 40,000 feet deep and in water depths of up to 12,000 feet.



Skeie's N-Class Harsh Environment Jack-up rig is a self-elevating drilling unit scheduled to operate in the North Sea and in Canadian waters. It can operate in water depths of 132 meters and can drill in depths up to 10,667 metres.

Two Aker H-6e drilling rigs are currently being completed at Aker Kværner's yard at Stord. They are intended both worldwide deepwater operations and harsh environments, and are configured for dynamic positioning a water depths of 3,000 m.

We welcome your thoughts!

DNV is a global provider of services for managing risk, helping customers to safely and responsibly improve their business performance. DNV is an independent foundation with presence in more than 100 countries.

DNV Energy News is published by DNV Energy for the energy industries.

It is distributed to DNV customers and stations worldwide. It is also available at DNV's web site www.dnv.com/publications

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