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GL Garrad Hassan GL www.gl-garradhassan.com

energize

energy. efficiency. engineering.

renewables

High Performance

market Tailwind for Renewables

installation Hybrid with a Bright Future

grounding Basics for Foundations

To Our Readers

Andrew Garrad

GL Group has gone solar: On the roof top of GL's headquarters in Hamburg, 240 photovoltaic modules are now feeding electricity into the grid. They are expected to generate 36,500 kWh p.a. and save about 25,600 tonnes of CO_2 emissions – a good way to demonstrate our commitment to becoming greener and also to GL Garrad Hassan's growing interest in solar energy as a business. The question of how solar arrays and wind turbines can be operated in tandem is discussed in our article on page 28.

GL Garrad Hassan has joined the Desertec Foundation, under whose auspices gigantic wind and solar projects are planned in Africa and the Middle East, capable of supplying about 15 per cent of the European electricity demand by 2050. Read more on page 26. "Perspectives for Offshore Wind Energy" (page 13) gives an outlook for wind power in Europe and presents some highlights from the "Offshore Market Report" recently published by GL Garrad Hassan.

In Northern Europe offshore wind energy is the most dynamic market but it is also extremely challenging, requiring sophisticated engineering and installation logistics. GL is a major technology contributor to the development of next-generation specialised installation ships. Read more in "Hybrid with a Bright Future" (page 8).

In the harsh offshore environment, safety and long-term structural stability are core concerns. With its "Guidelines for the Certification of Offshore Wind Turbines" (page 36), GL Renewables Certification has presented a new set of certification rules specifically for the offshore wind power industry. GL Renewables Certification is also supporting the industry in implementation of upcoming EU legislation for "Safety Throughout the Life Cycle" (page 32).

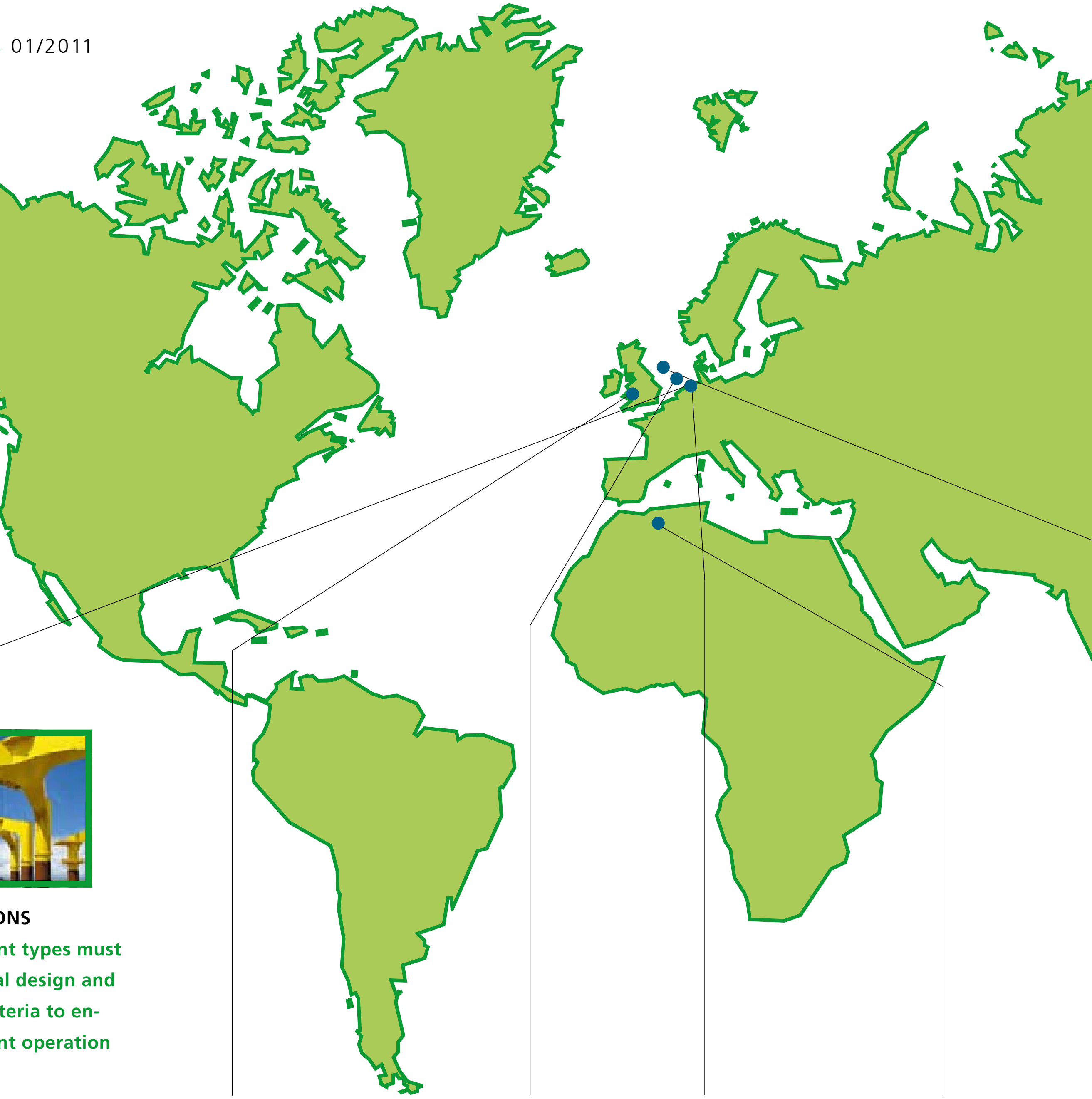
To broaden the knowledge base for future advances in technology, the German RAVE initiative is collecting comprehensive on-site data to learn more about the loads which offshore turbines must withstand and their long-term consequences. Read about how GL experts combat the elements to install measuring devices on turbines of the "alpha ventus" wind farm (page 16).

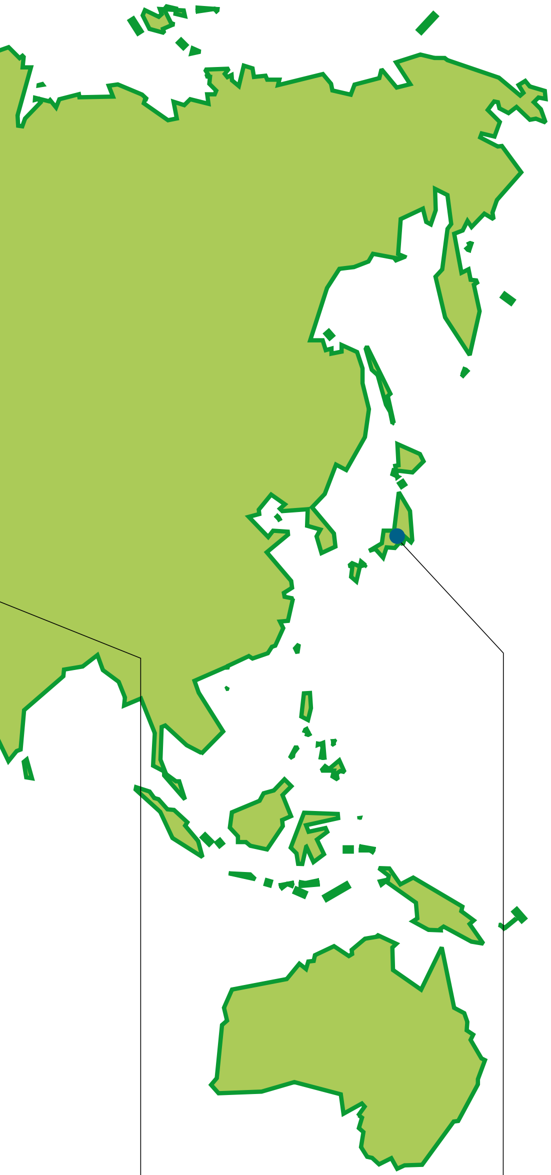
This edition of Energize provides a glimpse the fascinating challenges which renewables – all the renewables – face and of how we are addressing them inside GL.

Sun, wind and waves – the perfect industry!

Yours sincerely,

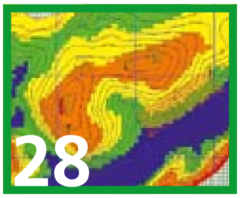
Andrew Garrad
President of GL Garrad Hassan





COLLISION

How risk analysis can help to prevent collisions between vessels and offshore wind farms



CONSULTING

Installing photovoltaic panels in the free spaces of a wind farm – a double energy harvest?

In Brief:

GL's Renewables Business Segment

- **GL GARRAD HASSAN** is one of the world's largest renewable energy consultancies. It offers an unique level of service expertise and global presence across the whole project lifecycle with 750 members of staff in 42 locations, across 23 countries. Its technical scope covers all relevant aspects of onshore wind , offshore wind, marine renewables, and solar energy. It addresses the requirements of manufacturers, operators, investors, project developers, authorities, and the supply industry with regard to all technical aspects of renewable energy applications. Given the current focus on wind energy, GL Garrad Hassan is able to provide a comprehensive set of services including the optimal design of wind parks, improvement in the performance of existing wind farms, measurement projects (wind resource, wind turbine performance and structural behaviour), inspection services, a large array of software products and turbine design services. In addition, GL Garrad Hassan has gained substantial experience in tidal and wave power generation and is involved in various solar projects.

- **GL RENEWABLES CERTIFICATION** is a leading certification body primarily focussed on the certification of wind farms, wind turbines and their components as well as marine renewable energy. At the forefront of know-how in renewables technology, it is abreast of all the necessary standards and requirements and takes a harmonized approach in ensuring that these are met. Manufacturers, banks and insurers around the world rely on the state-of-the-art service provided by GL Renewables Certification.

  Together, **GL GARRAD HASSAN AND GL RENEWABLES CERTIFICATION** form the Renewables business segment of the GL Group.

- **GL GROUP** is a technical assurance and consulting company for the energy industries and also a leading classification society. GL employs almost 6,900 engineers, surveyors, experts and administrative staff. Its global network consists of more than 200 stations in 80 countries.

offshore

As a technical authority on the offshore wind market and with its significant project management expertise, GL Garrad Hassan provides support across the complete project lifecycle.

Photo: E.On UK/PAGE ONE

HIGH-TECH. Modern installation vessels enable the erection of wind farms dozens of kilometres off the coast.

Illustration: BELUGA HOCHTIEF Offshore

Hybrid with a Bright Future

The wind turbines of the future stand far out at sea. Achieving commercial viability for offshore electricity, however, calls for sophisticated installation logistics. The core element of a sustainable concept will be the installation vessels

ABSTRACT

- Transportation, lifting and placement with just one installation unit: this is the new concept of the BELUGA HOCHTIEF Offshore erector vessels
- GL is involved in the development of these innovative ships

Autumn 2014, about 45 sea miles northwest of the island of Borkum: The rising wind drives the waves to a crest height of three metres. At the offshore wind farm (OWF) “Windjammer I”, the erection experts stop the installation work on the wind turbines, each weighing several hundred tonnes. The action of the wind and the waves has rendered the use of the jack-up platform impossible. This termination of the installation activities marks the beginning of a long pause; only in May 2015 will the weather conditions permit a resumption of the erection work at “Windjammer I”.

At the neighbouring OWF “Rasmus Nord”, on the other hand, the work is continuing. The “heavy lift jack-up vessels” (HLJVs) being used are able to operate safely, despite the worsening weather. The work there will only be interrupted by a severe storm in early December. Following a brief hiatus and the passage of a bad weather system, the activities will be resumed soon.

The scenario is fictitious, but certainly realistic. Jack-up platforms, which are towed to their operating site and are able to move about the area only to a limited extent, are characteristic of the second generation of installation ▷

MULTI-TALENT. **The special ships combine the advantage of a transport vessel with those offered by a jack-up platform.**

equipment, as used for the erection of "Windjammer I". Strictly speaking, this approach is an onshore concept that has been moved onto the ocean: a transport platform – onshore a truck, offshore a barge – brings the individual components to the final destination, where they are assembled with the aid of a crane. In both cases, the crane supports itself on four legs – in the case of the offshore installation, however, they are 50 metres or more in length and stand on the ocean floor.

DEMAND. Hochtief is forecasting an annual average of 800 new installations of wind turbines in the North Sea and Baltic.

Blazing a New Trail

The next generation of the offshore installation equipment can do more. The HLJVs (heavy lift jack-up vessels) fetch the preassembled foundation structures and wind turbines from the quay, transport them autonomously to the intended position, extend their four legs, and then install everything by means of their own shipboard crane. Loading, transporting and installing with just one installation unit – this is the new concept which the construction group Hochtief Solutions AG and the project and heavy lift carrier Beluga Shipping are pursuing in their joint venture "BELUGA HOCHTIEF Offshore". "With a length of about 147 metres and a beam of 42 metres, these special ships combine the advantages of a transport vessel with those offered by a jack-up platform," states Beluga Shipping.

In this way, BELUGA HOCHTIEF Offshore intends to gird itself for the offshore future. An enormous market is developing here – with many opportunities, and not only for the manufacturers of wind turbines. Hochtief Solutions AG is forecasting an annual average of 800 new installations

Wind Energy on the High

RENEWABLE SOURCES OF POWER – with wind energy as the leading technology – are gaining strongly in acceptance. In the space of only ten years, 20 per cent of the electricity consumed in Europe is to come from renewable sources. In this concept, offshore wind electricity is playing a key role. The coastal states of the North Sea and Baltic Sea have already erected or are planning offshore wind farms (OWFs) to a considerable extent, and this trend is also being followed in China and the USA.

In Germany alone, some 25 gigawatts of wind power is to be realized on the high seas by 2030. In Great Britain, the plans are even more ambitious, as is also the case in the USA. Even small countries such as Denmark, the Netherlands and Belgium have drawn up bold programmes for harvesting the high wind speeds at sea.

PROTOTYPE. In a series of tests at MARIN, the performance of the heavy lift jack-up vessel was verified.

Photo/Illustration: BELUGA HOCHTIEF Offshore

of wind turbines in the North Sea and Baltic for the period 2012 to 2020, says Hochtief's Managing Director Civil Engineering and Marine Works, Martin Rahtge. He emphasizes: "According to experts, the greatest obstacle to growth is the lack of erection and assembly capacities." Estimates project that these tasks would have to be handled by 20 highly specialized installation ships – but none have reached the water thus far. In response, BELUGA HOCHTIEF Offshore is stepping up the pace and has already ordered the first jack-up vessel.

GL Strongly Involved

The first heavy lift jack-up vessel is to begin service by mid-2012. "This is not only the right ship for 2012, but also for the 20 years to follow," Teena Tillessen is convinced. As the project manager and also the Deputy Head of Department for Project Management of Merchant and Navy Vessels at GL, she represents the nerve centre connecting the diverse GL departments to the ambitious project of BELUGA HOCHTIEF Offshore. "This jack-up vessel represents a top investment for the joint venture," says Tillessen. "With the third generation of offshore installation units, the BELUGA HOCHTIEF Offshore ships may well turn out to be technology leaders worldwide."

And precisely this calls for qualified personnel: "As a parallel track to constructing the hardware, we are pushing forward with the development of our Beluga Offshore Training Academy, where the future crew members can, for example, already use the Offshore & Heavy Lift Cargo Handling Simulator to learn and practise the operation of the new ships and their cranes," states Beluga Shipping.

GL has been involved in the development of these innovative ships since late summer 2009. The required tasks extend far beyond the usual certification activities. "We were already strongly in demand as a partner early on in the design stage," Teena Tillessen smiles. "We are contributing the wide-ranging experience of the entire GL Group." These services include consulting for the crane design as well as guidance for the jacking system ▷

Illustration: BELUGA HOCHTIEF Offshore

Facts and Figures

LENGTH: 147 m
BREADTH: 42 m
DRAUGHT: max. 7.20 m
WORKING DEPTH: up to 50 m
JACKING SYSTEM: 4 lattice legs with rack-and-pinion drive
SIGNIFICANT WAVE HEIGHT FOR JACKING AND DP: 2 m
MAX. WIND SPEED FOR CRANE OPERATION: 18 m/s
CARGO LOAD: 8,000 t
CRANE CAPACITY: 1,500 t

and FEM analyses by GL Maritime Services. The development is profiting above all from the expertise provided by the GL subsidiaries GL Garrad Hassan and GL Noble Denton with regard to the operational challenges faced by offshore installation and turbine technology. For instance, GL Noble Denton is one of the international leaders in failure mode effect analysis (FMEA) – a method of identifying the potential causes of equipment faults. "FMEA is a prerequisite for the so-called Dynamic Positioning 2 capability, i.e. the autonomous, dynamic positioning by means of lateral thrusters and GPS within the installation area," Tillessen points out. The system's design offers a level of redundancy so that the ship can remain manoeuvrable even if any of the units should happen to fail.

FMEA. Failure mode effect analysis is a method of identifying the potential causes of equipment faults.

Outside of the installation area, the most powerful jack-up vessel will be able to cruise at a maximum speed of 12 knots. This is considerably faster than a towing train with a transport barge. At 147 x 42 metres, the deck is large enough to accommodate two of the biggest jackets currently planned, together with the associated anchoring piles for the wind turbine foundations – these being colossal structures of 65 metres in height and a total weight of 1,000 tonnes each. In addition, six complete wind turbines – including the towers – will still fit on the ship. The planned Liebherr crane, which is being analysed and subjected to design reviews by the FEM experts at the crane department of GL Maritime Services, will lift 1,500 tonnes with an outreach of 31.5 metres.

Flexibility in Demand for the Regulations

A lot of know-how is needed for the assessment of the design and in the actual certification process. Which regulatory framework can be applied? "The installation vessel is really a hybrid between a ship and a jack-up platform," is how Teena Tillessen describes the initial situation. "For its length, the vessel is extremely wide. Then again, when jacking itself up, the HLJV lifts out of the water and is then no longer a ship but a work platform. As regards the regulations and standards to be used, we are dealing with many different codes here, which even contradict each other in certain aspects – well-honed judgement is needed."

For BELUGA HOCHTIEF Offshore, the multifaceted activities of GL had already thinned out the number of possible business partners at an early stage of the development, says Tillessen. "The need for coordination is high. But it is all worthwhile, because with GL the customer has in many respects just one point of contact instead of several." □ **TT**

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Perspectives for Offshore Wind Energy

With the release of its "Offshore Market Report", GL Garrad Hassan provides insights into the offshore potential of twelve European countries

ABSTRACT

- Information is the most important basis for investment decisions
- The new report analyses the perspectives of the European offshore wind market

Having a global presence pays off: "Thanks to our network of branch offices all over the world, we have a very good knowledge of the market in the wind energy sector," says Daniel Argyropoulos, Head of the Strategic and Policy Studies Group at GL Garrad Hassan in Bristol. Argyropoulos and his colleagues prepare renewable energy reports that examine in fine detail the market situation in the various countries. One of their latest reports is the "European Wind Energy Offshore Market Report 2010".

"The report is targeted at the entire offshore industry, including developers who wish to enter the market and at government agencies who want to obtain an overview," says Argyropoulos. "Many hundred hours of work went into its making."

Gaining Momentum

For twelve European countries, the report describes in detail how the industry is positioned, where offshore wind energy is currently trending, and what may be expected in the near future. The review offers a treasure trove of ▷

Photo: Photocase

PLANT. The success of the industry depends on the political framework.

energy-related topics: from the first offshore installation installed worldwide (225 kW off the coast of Nogersund in Blekinge county, Sweden, in 1991) to the necessary expansion of the Irish electrical grid and the power plants of the globe's biggest net importer of electricity, Italy. To collect this stock of know-how, the specialists at GL Garrad Hassan are able to tap into a world-spanning network of competence.

FOCUS. The epicentre of the offshore wind scene is currently in Europe – with the northern countries as the key players.

"GL Garrad Hassan is represented in more than 23 countries. Our local experts are well-connected, know the systems in that area and speak the local languages," says Daniel Argyropoulos. These offices provided the input which Argyropoulos and his team then sorted, concentrated and conditioned. "We are already known for our technical services and we would like to increase our profile with a whole series of market reviews," he points out. Spanning a hundred pages, the report on the European offshore market has now been published in its second edition.

And it has appeared at just the right time. At present, the offshore boom is gaining momentum. In view of the climate change and the question of energy security, this subject is in the focus of discussions in many parts of the world. Although a major offshore farm has been built off China's coast (Dong Hai Bridge, 102 MW) and the first projects are also taking shape in North America, the epicentre of the offshore wind scene is currently in Europe – with Great Britain, Germany, Denmark, the Netherlands and Sweden as the key players.

Within the scope of the "Round 3" expansion programme, Great Britain alone has set itself the development goal of 25 gigawatts of installed wind energy capacity – almost a quarter of Britain's power demand. These "primary markets" are described in depth by the report, which is published in English. This includes countries that have already made concrete efforts and implemented their first projects. Annual offshore installations in double-digit gigawatts are expected for these markets from 2015. In addition, the review identifies "secondary markets", i.e. the countries Poland, Belgium, France, Ireland, Spain, Italy and Norway. Considerable potential is projected here for the near and midterm future. The following topics are addressed for each of the twelve countries:

- **market development**
- **targets, incentives and policy**

- **grid access**
- **planning, regulation and licensing.**

To highlight an example: Denmark. The trailblazer for wind energy has lagged behind in recent years. Political changes have made it difficult for the industry to continue its growth – above all on the open sea. Another hurdle is that this small Scandinavian country, with a population of only 5.5 million, is already an electricity exporter today.

Basis for Investment Decisions

The market in the Netherlands has also been influenced significantly by public policy. With an installed capacity of 249 megawatts, the country is still far from realizing its former plans. Still, the prospects are good: within the scope of the National Water Plan of 2008, the target was increased by an additional 450 megawatts. Then, in 2009, this figure was set even higher: to 950 megawatts.

However, the experts at GL Garrad Hassan believe that this goal will be missed, because the kilowatt-hour prices are higher than initially assumed. Then again, the electrical grid in the Netherlands is well developed – with good cross-border connections. As a cooperative venture with Denmark, the "COBRAcable" link is in the planning stage. From 2016, it is to accept electricity predominantly from sustainable sources and distribute it in the grids of both countries.

Background facts for decision-makers: The comprehensive knowledge base of GL Garrad Hassan can, in the view of Daniel Argyropoulos, help to clarify many of the questions that have plagued offshore technology thus far. "Offshore wind is relatively new compared with onshore wind and therefore fraught with risk. The offshore scene requires support. The success of the industry depends strongly on the prevailing political framework. The farther a technology is from market maturity, the more it needs funding instruments to give it market acceptance – for example Renewable Energy Certificates or feed-in tariffs."

Argyropoulos is pleased that the market report is meeting with a positive response from industry players: "It is possible that the report will be published yearly in future." **DH**

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Photo: Newscast/Ally Carmichael

Get ready. Video and radar at the helmets for observing the waves.

Research Against All Odds

It is all a matter of timing: Scientists, engineers and divers fight the elements to gather all kinds of data relating to offshore wind turbines. They want to learn about the technical stability of these structures and their effects on the environment

What makes offshore projects so challenging is their exposure to the untamed elements of nature. Tides, waves and wind often severely hamper the work of the small number of experts qualified and experienced enough to carry out offshore installation tasks. The parties involved must be extremely flexible to seize any opportunity for action. GL Garrad Hassan expert Wilhelm Heckmann can confirm this first hand: In a project at the "alpha ventus" offshore wind farm, it took him and the installation team 28 days to complete a seemingly simple mission due to weather and tidal constraints.

ABSTRACT

- Offshore wind turbines operate in a harsh environment. Current technology has yet to prove its long-term viability
- Germany's first commercial wind farm "alpha ventus" supplies a constant stream of measurement data for further research

Research at alpha ventus, or RAVE, is a publicly funded scientific initiative to gather and evaluate a wide array of data relating to the structural integrity, operation and environmental impact of offshore wind farms. In the project mentioned above, Wilhelm Heckmann and the team had to plan, coordinate and supervise the installation of strain gauges on the underwater foundation piles of four wind turbines.

14 divers had been contracted for this assignment. Their challenge was the time constraint: they could only work at half-tide when the water level reached its minimum or maximum, respectively, and the tidal currents were more or less passive. The resulting time windows, 60 to 90 minutes in length, occurred four times a day.

The men finally succeeded in installing the sensors after many failed attempts due to adverse weather conditions. "In the offshore environment," Heckmann explains, "when the conditions are finally right, you have to act quickly, whether it is by day or by night. And even when you are finally able to proceed, this work is anything but pleasant." ▷

Mission. **A team of 14 divers had to install strain gauges on the underwater foundation piles of four wind turbines.**

Time Slot.
The divers could only work at half-tide, when the tidal currents were passive.

The strain gauges the divers had to install and wire now deliver data on horizontal and vertical flexing movements of the piles and their long-term effects on the stability of the substructure. In fact, some of the alpha ventus turbines are fitted with sensors all over. The idea is to generate a holistic view of the turbine components, their performance, the stresses they endure over time and their response to them. Engineers will use this information to pinpoint the best design features and the most reliable foundation technology for the next generation of wind turbines and to confirm the assumtions of their design calculations.

The RAVE installation team, monitored by GL Garrad Hassan, also had to attach hydrophones to the turbine towers to measure underwater acoustics. The data gathered will help environmental scientists learn more about the effects of offshore structures in general and wind turbines

alpha ventus

The alpha ventus offshore wind power project is Germany's **FIRST COMMERCIAL WIND FARM**. It is operated by Deutsche Offshore-Testfeld und Infrastruktur-GmbH & Co. KG (Doti), a joint venture of energy companies EWE, E.ON Climate & Renewables and Vattenfall Europe Windkraft who also jointly built the farm. Its **TWELVE 5-MW-CLASS TURBINES** were all erected in 2009. Six of them have tripod foundations and AREVA turbines, the remaining six are REpower turbines on jackets. Commissioned in April 2010, the wind farm feeds an estimated **220 GWH PER YEAR** into Germany's utility grid, enough to supply 50,000 households with electricity.

About RAVE

RESEARCH AT ALPHA VENTUS (RAVE) is an initiative combining a number of research projects sponsored by the German Ministry for the Environment, Nature Conservation and Reactor Safety (BMU) and coordinated by the Fraunhofer Institute for Wind Energy & Energy System Technology (Fraunhofer IWES), part of the internationally renowned German Fraunhofer research foundation. The **SCIENTIFIC WORK** of the RAVE initiative serves a number of purposes: **GATHERING OPERATIONAL DATA** as a basis for future engineering developments; **ENHANCING SCIENTIFIC KNOWLEDGE** about offshore wind projects; and **ASSESSING THE ECOLOGICAL IMPACT** of offshore wind farms.

Monitoring. **Ready for the next dive: It took the installation team 28 days to complete their job. The attached sensors now deliver data on flexing movements of the piles or underwater acoustics.**

in particular on marine life, such as bird and fish migration and marine mammals. Within this project GL Garrad Hassan also cooperates with the operator of alpha ventus, "Deutsche Offshore-Testfeld und Infrastruktur-GmbH & Co. KG" (DOTI), by using the same diving support vessel for the RAVE project and the periodic inspections of the underwater structures and confirming the integrity of the seabed. Thus led to a more cost efficient project realisation splitting MOB/DEMOB costs and the weather risk.

The Initiative

The RAVE research project is directly linked to the first German offshore wind farm "alpha ventus", located in the North Sea, 45 kilometres north of the island Borkum. Alpha ventus consists of twelve 5-MW wind turbines installed in a water depth of 30 metres.

The German Federal Maritime and Hydrographical Agency (BSH) with his subcontractor GL Garrad Hassan jointly coordinate the research activities of the RAVE initiative, implementing the overall measurement concept and supervising the installation and technical realisation of the measurements. The project partners share the tasks associated with the operation, maintenance and inspection of the instruments as well as logistics, data management and the maintenance of the integrated database.

Since the data capturing began in 2010, 1,200 individual readings have been logged every minute. The growing database, providing comprehensive information about offshore wind generation, will be made available to wind farm developers, manufacturers, financiers and scientists to boost the continued development of wind power. ◻ **SG**

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Collision Risk Analysis for Offshore Wind Farms

A comprehensive understanding of risk relevant causes and effects is essential for the assessment of offshore wind farms. Sophisticated simulations help to prevent collisions

COEXISTENCE. **Vessels and offshore wind farms use the same environment – accidents should be avoided.**

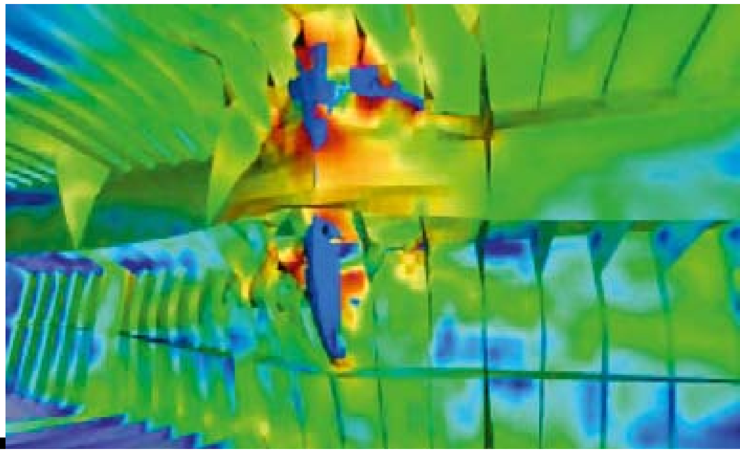


Photo: Dreamstime/Rodiks

Technology.
Sophisticated simulations assess the consequences of collisions.

Within the next decade, numerous offshore wind farms will be installed worldwide, especially in Europe and North America. For German areas in the North Sea and the Baltic Sea, up to 25 GW total power it to be installed. This exceeds the power output of numerous typical nuclear power plants. It is necessary to study the effects of these wind farms with respect to the safety of shipping in order to estimate the related risks to people, ship traffic and the environment.

Risk = Probability × Consequence

In formal safety assessment, a risk R is defined as the product of the probability or frequency f and the consequence c of the undesired event: $\mathbf{R = f \cdot c}$

ABSTRACT

- Within the next decade, numerous offshore wind farms will be installed worldwide
- It is necessary to study the effects of these wind farms, e.g. on the safety of shipping
- GL has performed several risk analyses

Considering the ship collision risk for an offshore wind farm, f is the ship collision frequency and c is the amount of oil spilled.

For approval in Germany, detailed risk analyses have to be submitted, to enable the authorities to evaluate a proposed offshore wind farm based on clear and traceable criteria. Additional salvage tugs or ship traffic control can reduce the risk. Such risk control measures can be evaluated with respect to their efficiency in order to achieve the highest safety standard for people and the environment.

Additionally, risk analyses provide the necessary safety information for insurers and operators of wind farms. Within the approval process, the authorities will examine compliance with acceptance levels for collision frequency and risk, based on calculated collision frequencies (often expressed as average time between collisions) and oil spill quantities. The effects of risk control measures can be quantified and thus have a direct influence on the acceptance of wind farms.

GL has performed several risk analyses, and also took part in the approval processes on behalf of planners in Germany. Since the seventies, a variety of approaches for calculating the collision frequencies of ships with other ships, platforms, bridges or lighthouses were developed, and over the last decade some were adapted to the collision of ships with wind farms. The methods used by GL were developed in various research projects and are constantly being enhanced. A new guideline for these risk analyses will be released in 2011.

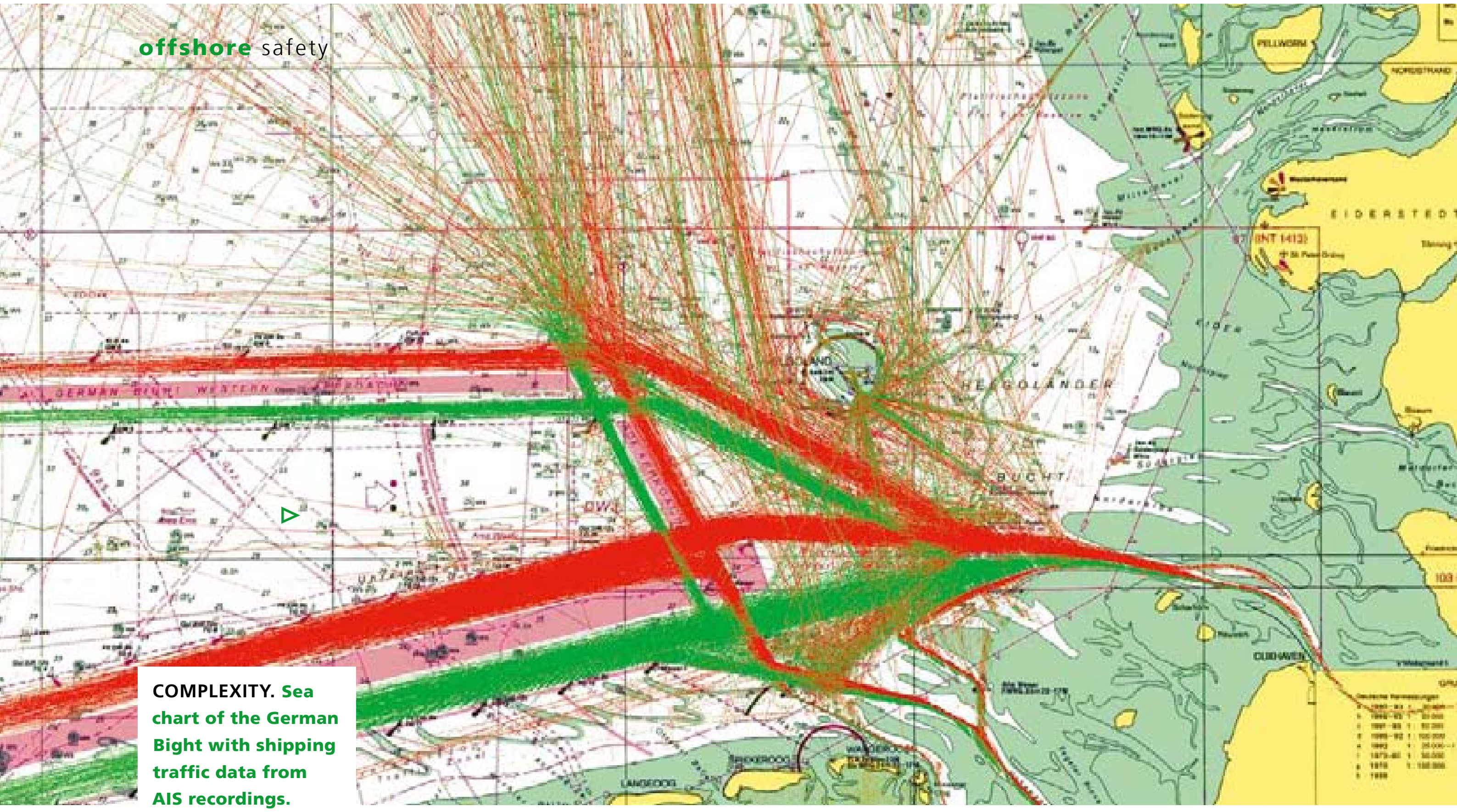
Separate Consideration Required

Two different scenarios must be distinguished:

- collision of powered ships with offshore installations
- collision of drifting ships with offshore installations.

This distinction is necessary because the two scenarios differ in cause, progress and outcome. Because of the divergent nature of the events, different calculation methods are necessary to calculate the frequencies of those events. For the collision risk analysis, different input data is required. Most important are the ship traffic, meteorological and hydrological data for the investigated sea area.

The method for powered vessels follows proposals developed at the Danish Technical University. Two collision categories are considered: ▷



COMPLEXITY. **Sea chart of the German Bight with shipping traffic data from AIS recordings.**

- Expected navigational inaccuracies or, for example, wind and waves, meaning the vessels will be more or less off track (lateral displacement);
- some ships fail to change course at a waypoint.

Collisions of a powered ship with an obstacle are possible if two conditions are fulfilled simultaneously:

- The ship is on a collision course with the obstacle.
- The officer of the watch undertakes no correction of the erroneous course. The probability of this condition is modelled by a so-called causation factor.

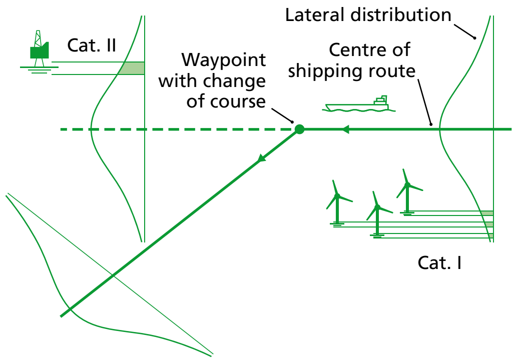
Monte-Carlo Simulations for Drifting Ships

The causation factor depends on the risk control measures planned for the offshore installation. Figures are taken from statistical accident data and were harmonized by various experts including GL. The collision frequency can be derived from the probabilities of these two conditions. The probability of a ship being on collision course with an offshore wind farm follows from the traffic distribution function in a shipping area and the dimensions of the ship and offshore installation.

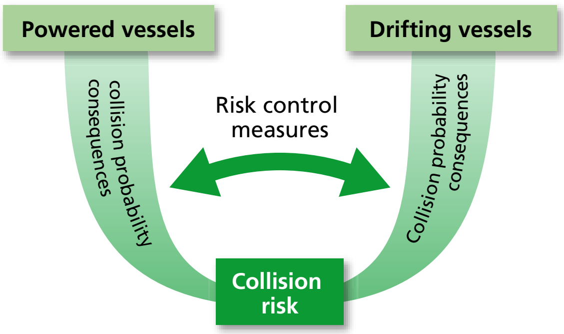
Disabled ships drift depending on wind, wave and current forces as well as time dependent tide/current forces. These are largely random variables. The aim is to find the probability of those particular combinations of wind, current, waves, ship size and ship type that result in a collision between a ship and an offshore platform or wind farm. For this reason, GL developed a computer program to calculate this probability.

VARIABLES. GL developed a computer program to calculate the effects of a combination of wind, current and wave forces, etc.

The method is based on a Monte Carlo simulation, where a multitude of possible combinations of the random input variables is analysed, reflecting the real-world probabilities of occurrence for each random variable. A lot of runs are performed with new start conditions for each run. Counting the number of runs with collisions and dividing this number by the number of simulation trials results in the collision probability for disabled ships.



Combination. Possible collision categories for offshore structures. The combination of ship, wind, current and waves is important.



Two Types. Collision risk for powered and drifting vessels. The risk control measures are planned for the offshore installation.

Photo: iStockphoto/David Cannings-Bushell

RISK. Wind farms can affect the safety of shipping.

A collision involving a drifting vessel can be prevented by self-repair, emergency anchoring or salvage tugs. The first two measures are controlled by the crew of the disabled vessel drifting towards the offshore installation. Therefore, the only external risk control measure is the salvage by tugs with sufficient bollard pull to stop drifters in the sea area. In the risk analysis, various numbers of salvage tugs with different bollard pulls can be included.

Ship traffic data including distributions by ship type and ship size have been recorded for the North Sea and Baltic Sea and are now readily available for collision risk analyses. AIS (automatic identification system) data gives additional details to update databases for such analyses.

Consequences Determined in Simulations

The consequences of a collision have to be determined by sophisticated simulations. The simulations yield expected damages and subsequently expected oil spills. If necessary, the offshore wind farm structures can be redesigned to become more "collision friendly". The approach used extensive experience gathered for tanker safety (ship-ship collisions), both for the simulation technology and collision-friendly structural designs.

Cost-effective Adaptation

A rational and transparent approach allows safety assessment and cost-effective adaptation of designs. In summary, the combination of collision risk analysis and collision consequence analysis leads to a comprehensive understanding of risk relevant causes and effects for the assessment of offshore wind farms. Preventive actions increasing both active and passive safety can be assessed regarding their effect in early planning stages. □ **DP**

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solar

GL Garrad Hassan's solar experts support stakeholders in both solar photovoltaic (PV) and concentrated solar power (CSP) projects. They offer a comprehensive range of technical and project services, throughout the entire solar project lifecycle.

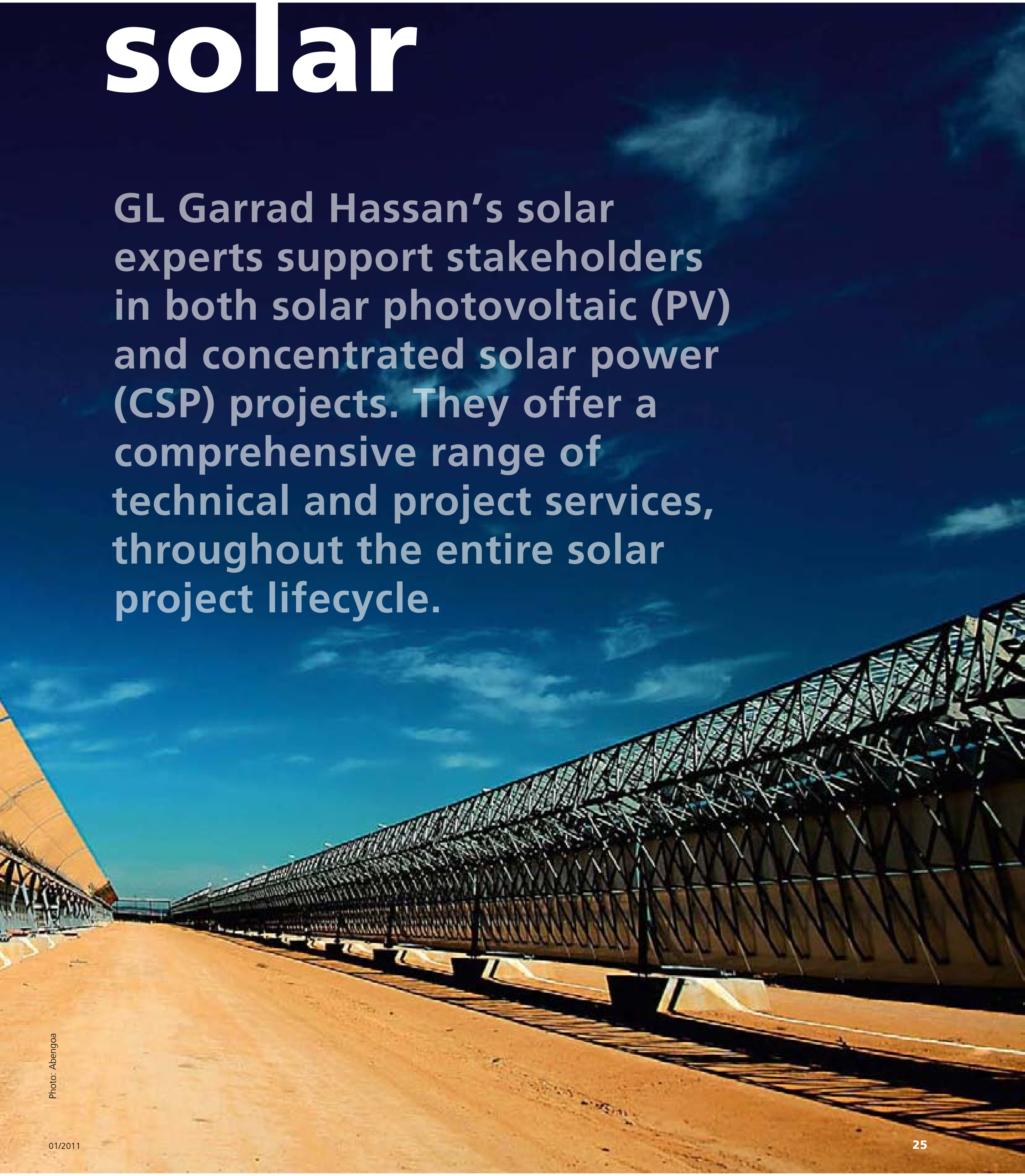

Photo: Abengoa

Clean Power from the Deserts

By 2050, the new wind and solar projects in Africa and the Middle East are to cover about 15 per cent of the European electricity demand

"Within six hours, deserts receive more energy from the sun than all humankind consumes within a year," says Dr Gerhard Knies, Chairman of the Board of Trustees of the Desertec Industrial Initiative (DII). The organization calls for a vast array of wind farms, photovoltaic parks and concentrating solar thermal power projects to be built across North Africa capable of providing 15 per cent of Europe's electricity requirements by 2050.

GL Garrad Hassan has teamed up with the DII to provide support to all stages of solar and wind projects with a special focus on bringing costs down to a competitive level. The consultancy sees "Desertec as an opportunity to demonstrate the potential of renewable energies, in particular in the solar field", according to Andrew Garrad, President of GL Garrad Hassan. "GL Garrad Hassan is a renewable energy consultancy with interests in wind, wave, tidal and solar sources. Our joining the DII also marks part of a major initiative to expand our business in the solar field".

ABSTRACT

- Desertec is one of the world's biggest renewable energy joint ventures
- GL Garrad Hassan provides consultancy services with a special focus on bringing the costs down

The Desertec Industrial Initiative is a consortium of companies from North Africa, the Middle East, Germany and other European countries to develop renewable energy projects in the Sahara Desert and generate power for the region and for Europe. The DII was founded in October 2009 by the non-profit Desertec Foundation and 12 industrial partners to accelerate the implementation of the Desertec Concept in the Europe/Middle East/North Africa region. Currently, the DII has 18 shareholders and 32 associated partners, including the largest German and international industrial powerhouses.

GL Garrad Hassan's involvement in the project will centre on participating in working groups and preparing reference projects and plans. This is a major step for GL Garrad Hassan in making its expertise available to wind and solar projects in North Africa and the Middle East. Dr Helmut Klug, Regional Manager of GL Garrad Hassan for Central Europe, the Middle East and Africa, said: "We are proud to be part of one of the world's biggest renewable energy joint ventures, which aims at generating sustainable, climate-friendly electricity in the deserts of North Africa and the Middle East.

GL Garrad Hassan's global team, including the GL Garrad Hassan office recently opened in Egypt, allows us to provide the best possible services to the stakeholders of the Desertec Initiative." **OM**

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GRID. **The DII will develop renewable energy projects in the Sahara Desert and other regions in North Africa and the Middle East.**

Source: DESERTEC Foundation, www.desertec.org

Sun and Wind – Does That Work?

It sounds like a winning proposition: why not install photovoltaic panels in the free spaces of a wind farm and reap a double energy harvest? Experts from GL Garrad Hassan explain the ifs and buts

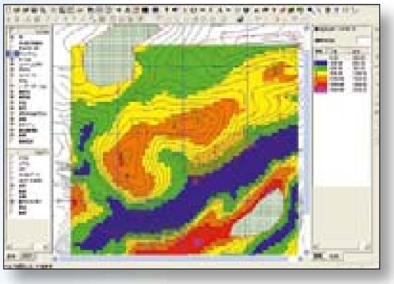
As often in life, the answer is: It depends. Apart from the usual considerations, such as sun irradiation, you also have to analyse how the wind turbines will influence the operation of the solar panels and vice versa.

Shadows, Ice and Turbulences

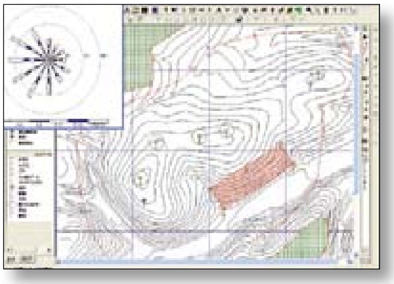
In the northern hemisphere, solar panels should be facing south, undisturbed by shadows cast by obstacles or mountains. As wind farms are typically located on a hill top, only the southern slope will receive enough sunlight for photovoltaics. The layout of the site

ABSTRACT

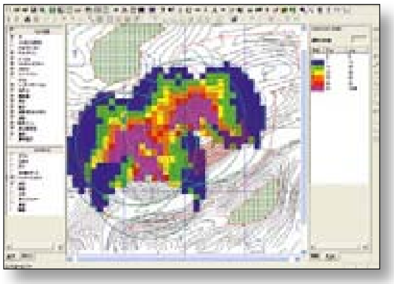
- Solar arrays and wind farms require different weather conditions
- Combining both involves highly complex considerations
- Few sites are suitable for both types of renewable energy



SOFTWARE. **The wind energy map, and the calculated layout of the wind turbines and the solar PV plant.**



INFLUENCE. **6 to 12 m high PV supporting structures can affect the flow of the wind turbines.**



DESIGN. **Shadow flicker map for the energy-optimized wind turbine layout.**

can be planned using GL Garrad Hassan's wind farm design software GH WindFarmer. The optimiser tool helps planners identify the layout with the best energy yield.

Another important factor to consider is the way the wind and solar structures affect each other. PV supporting structures can have a significant effect on the wind flow to the turbines. The hub height and the predominant wind direction are key parameters. The solar panels should be placed on the downwind side of the turbines. GL WindFarmer assists in making these decisions.

Shadow flicker, which occurs when the shadows of rotor blades cross the solar panels, can have adverse effects on the inverters and should be studied carefully. GH WindFarmer can easily identify the areas and times of potential shadow flicker so the phenomenon can be avoided.

In cold climates, the solar panels should positioned away from potential ice throw from the wind turbines. It is also recommended to allow space around the wind turbines for maintenance operations.

Clouds and Vegetation

Wind farms are often located in mountainous areas where wind conditions are best but frequent cloud cover would interfere with photovoltaics. There are some exceptions, such as the windy yet sunny mountain plateaus in central Spain.

A fire could destroy a solar array completely but leave the wind turbines largely unaffected. Solar arrays therefore require agricultural work to eliminate flammable and dried vegetation.

Grid Capacity

Concurrent wind and solar power production peaks might overload the grid. A study of the electrical flow and loads must be prepared to determine the risks. GL Garrad Hassan can provide energy predictions for both the wind farm and the solar array. Short-term energy forecasts as supplied by the GH Forecaster service are very useful for electrical management.

It Can Be Done

Since the best sites for wind farms are usually less than optimal for solar panels, the combination of both is often not commercially viable. Yet several experimental sites in Germany and Spain have tested the concept successfully. In any case, it is advisable to consult with GL Garrad Hassan before making any investment decisions. ◻ **YU/CHL**

Photo: Dreamstime/Selestron76

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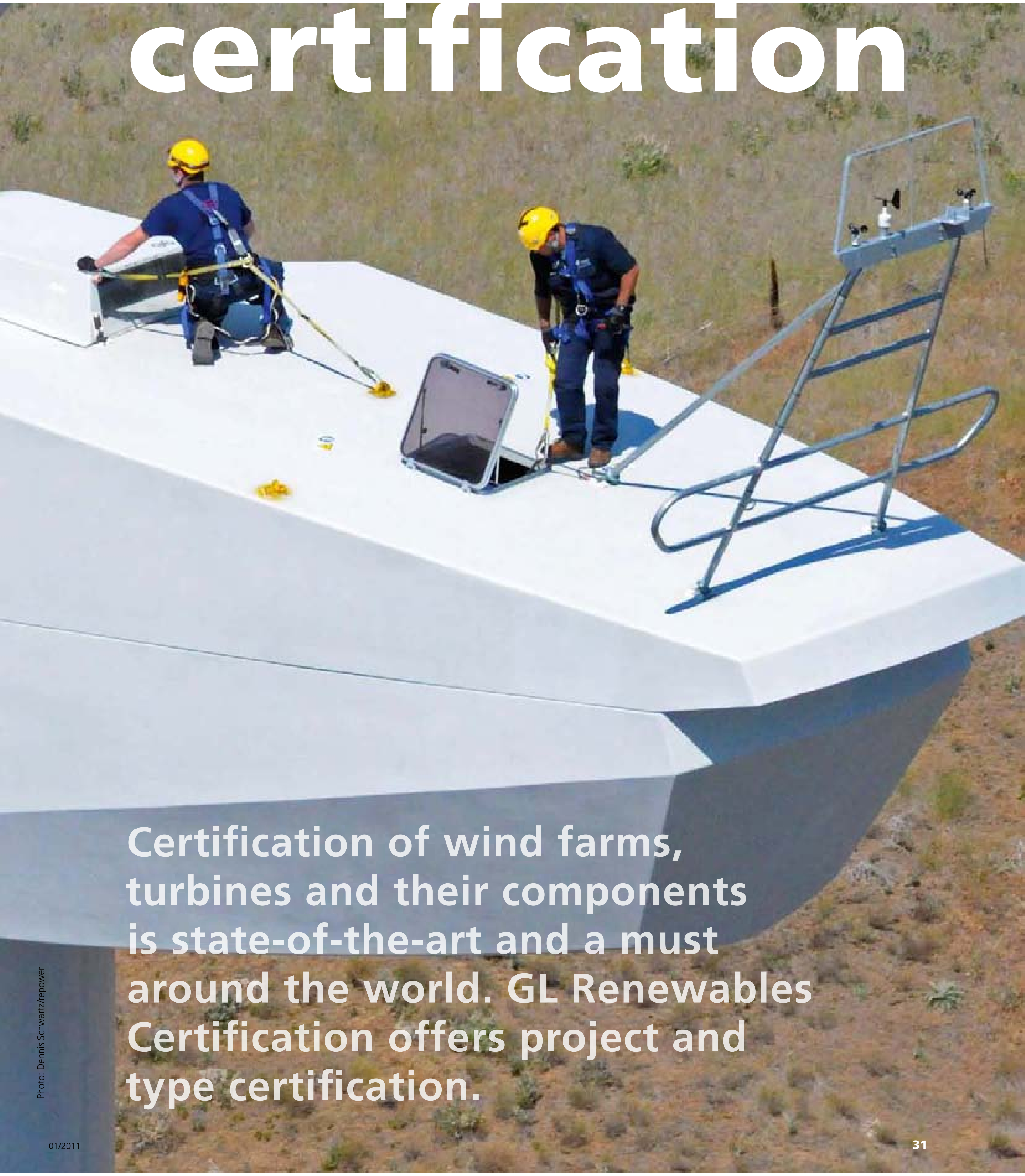
certification



Certification of wind farms, turbines and their components is state-of-the-art and a must around the world. GL Renewables Certification offers project and type certification.

Photo: Dennis Schwartz/repower

Safety Throughout the Lifecycle

Wind turbines in the EU are subject to a large number of requirements providing comprehensive cover for all aspects of product safety

All products distributed in Europe must meet statutory safety requirements. The European product legislation is compiled in the form of directives that must be implemented as national law by the member states of the European Economic Area (EEA) to become enforceable.

ABSTRACT

- All types of wind turbines in the EEA are subject to several European and national directives
- GL supports manufacturers of wind turbines and components by carrying out the required risk assessments

Manufacturers of wind energy converters (WECs) must ensure that the equipment they sell fulfils the legislative requirements. This not only serves the functional safety of wind turbines but it also minimizes the risk of property damage and personal injury resulting from the operation of wind turbines. The benefit for the manufacturers is quality assurance and legal security against liability risks.

All types of wind turbines in the EEA are subject to the Directive on General Product Safety,

Alternative. **If the normal way out is blocked, take the emergency escape – one of the topics of the EN 50308 standard.**

the Directive concerning Liability for Defective Products, the Directive on the Introduction of Measures to Encourage Improvements in the Safety and Health of Workers at Work as well as the so-called CE directives.

Among the CE directives relevant for wind turbines are the Directive on Machinery, which has been in force since 29.12.2009, and the Directive on Electromagnetic Compatibility. With the CE mark the manufacturer attests conformity with the applicable CE directives and takes sole legal responsibility. Furthermore, the Low Voltage Directive also applies to certain wind turbine components.

Assessment for Certification

Additional product-specific requirements apply to wind turbines within the scope of certification. At most sites worldwide certification of wind farms, wind turbines and their components is mandatory. Internationally recognized basic principles of certification include, for example, the guidelines issued by Germanischer Lloyd and the IEC WT 01 standard soon to be replaced by IEC 61400-22. IEC 61400-2 is a code specifically for small wind turbines.

Type certification includes design assessment, implementation of the design requirements in production and erection, evaluation of quality management, and prototype tests. Project certification is based on type certification and addresses site analysis, site-specific design assessment, production, transport and erection surveillance as well as commissioning and periodic monitoring. A statement of conformity is issued for each assessment module completed successfully, and the relevant certificate upon successful conclusion of all relevant modules.

Within the EEA, these stipulations are complemented on a national level. Conformity assessments can also be performed against other directives and standards (e.g. DIN EN 50308) by bodies accredited for this purpose.

While certification rules and the European and national product laws overlap to some extent, certification does not in itself ensure compliance with product safety law. Monitoring of this is not up to the certifying bodies but rather to the national market surveillance authorities.

Similarly, the requirements of product safety laws frequently extend beyond the CE requirements. While a manufacturer may bring its CE-compliant wind turbine into circulation within the EEA, he is ▷

Photos: Alpha Ventus/Jan Oelckers

Training. **EN 50308 requires that all parts of the turbine be accessible in a safe way.**

Photos: Alpha Ventus/Jan Oelckers

also obligated to fulfil the "state of science and technology" within the scope of product safety law, provided this is economically reasonable. To attain an optimum level of product safety and thereby maximum legal security with respect to European liability law, the CE conformity assessment process must be fully integrated into the corporate structure of a wind turbine manufacture.

CE.
The abbreviation CE stands for "Conformité Européenne", which means European conformity.

Types of Liability

For the legal compliance of products originating from non-EEA countries, the distributor (for example the importer) is the responsible party. Within the scope of European liability law, companies are liable according to civil law and administrative law. In rare cases, the persons working for companies may also be found criminally liable.

- **LIABILITY UNDER CIVIL LAW**
  Civil liability of the company towards contractual partners or injured parties (complaints and compensation claims); consequences: financial claims
- **LIABILITY UNDER ADMINISTRATIVE LAW**
  Regulatory liability of the company towards supervisory/regulatory authorities (violation of EC or CE directives); consequences: restrictions, administrative fines
- **LIABILITY UNDER CRIMINAL LAW**
  Criminal liability of persons towards the penal power of the state (personal injury, personal injury resulting in death, offences against the environment); consequences: criminal fines or imprisonment

Civil liability may be subdivided further into contractual liability and delictual liability. A precondition for contractual liability is the existence of a legal relationship between the claimant and respondent that is based on a contract. If this is the case, claims may be pursued on account of deficiencies, for example in respect of functional impairments. For the delictual liability, on the other hand, a factual relationship is the prerequisite. This means the injured party may address liability claims for damage to the manufacturer even if there was no contractual relationship between them. Claims for damage to goods not intended for private use may be directed at the manufacturer within the scope of producer liability. The manufacturer is under suspicion of guilt if the injured party can assign the following prerequisites for producer liability:

- violation of an objective legal duty to maintain safety (design duty, manufacturing duty, instruction duty, product monitoring duty)
- damage to an absolute right (especially life, health, ownership, possession)
- causality between the breach of duty and the damage.

This is where the CE conformity assessment process, properly executed, comes into play: The wind turbine manufacturer needs to document the CE conformity assessment process to defend himself against the suspicion of guilt. Product Liability originates from the European Directive 85/374/EEC concerning liability for defective products. For product liability to take effect, the following prerequisites must be demonstrated:

- objective product defects
- damage to an absolute right (especially life, health, ownership, possession)
- causality between the product defect and the damage.

Product defects fall under Product Liability. A product is defective if it is not as safe as the product user, as well as any passers-by, may reasonably expect. This extends to, for example, the information content of the user documentation, such as installation handbooks, commissioning documents, maintenance manuals and operating instructions. According to the Product Liability Act, the liability for damage arises independently of culpability. Here the circumstance of defective manufacture is the sole decisive issue. To exonerate the manufacturer, the documentation of the CE conformity assessment process is indispensable here too. The Product Liability Act also covers products intended for private use, for example small wind turbines.

To identify and mitigate product defects and the resulting risks at an early stage, all potential risks, even those arising from foreseeable incorrect use, must be assessed and documented for all life-cycle phases of the wind turbine. The risk assessment must be performed in parallel to the development process, and forms an important part of the documentation of the CE conformity process.

Estimating the Risk

A major portion of the risk assessment of a wind turbine coincides with the preparatory work for certification. This includes aspects such as a safety-related control system or the contents of the user information.

The delictual liability includes the regulatory and criminal liability according to the Product Safety Act. A prerequisite of criminal liability is the intentional violation of a penal law. The burden of proof is entirely upon the criminal investigation agency, which will request inter alia the documentation of the CE conformity assessment. The regulatory liability extends to violations of the CE directives, addressing issues such as sales bans and recall instructions by the supervisory authorities, faulty CE marking, consequential damages due to inadequate CE conformity or recourse liability of the accident insurers in the case of work-related accidents and insufficient CE conformity.

The bottom line is therefore: the best reassurance for a manufacturer of wind turbines is a CE marking process that is completely integrated and diligently practised. Appointing a "CE officer" or "CE coordinator" is recommended, and independent experts, such as Germanischer Lloyd, may also be called in for risk assessments. This not only affords protection against liability risks and financial losses, but it also yields tangible economic benefits, such as quality assurance and the standardization of technical solutions.

The responsibility for the safety of persons lies primarily with the wind turbine manufacturer. Certification covers product-specific safety requirements with due consideration of the design specifications. The diverse statutory requirements for product safety thus provide a comprehensive safeguard for equipment as well as people. ◻ **DM**

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Foundations Standing the Test

There are several different types of foundations for offshore wind turbines. All of them have to meet special design requirements and welding criteria to ensure safe installation, efficient operation as well as permanent durability even during severe weather conditions

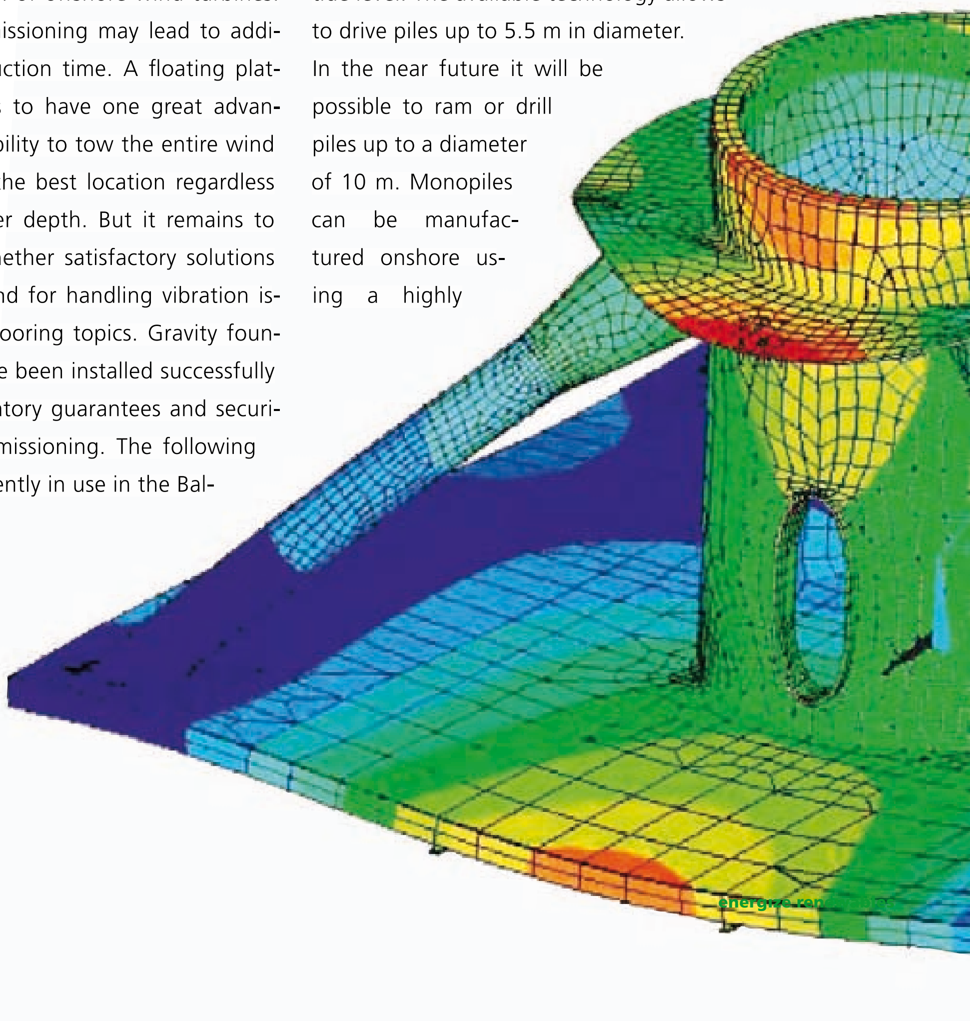
The logistical challenge during the installation of offshore wind turbines has become a major topic recently, in addition to the technical and commercial aspects. Specific weather conditions are required for the installation of offshore wind turbines. Postponing the date of commissioning may lead to additional costs and loss of production time. A floating platform seems to have one great advantage: the ability to tow the entire wind turbine to the best location regardless of the water depth. But it remains to be seen whether satisfactory solutions can be found for handling vibration issues and mooring topics. Gravity foundations have been installed successfully but they are subject to mandatory guarantees and securities for removal upon decommissioning. The following four foundation types are currently in use in the Baltic and North Sea areas:

ABSTRACT

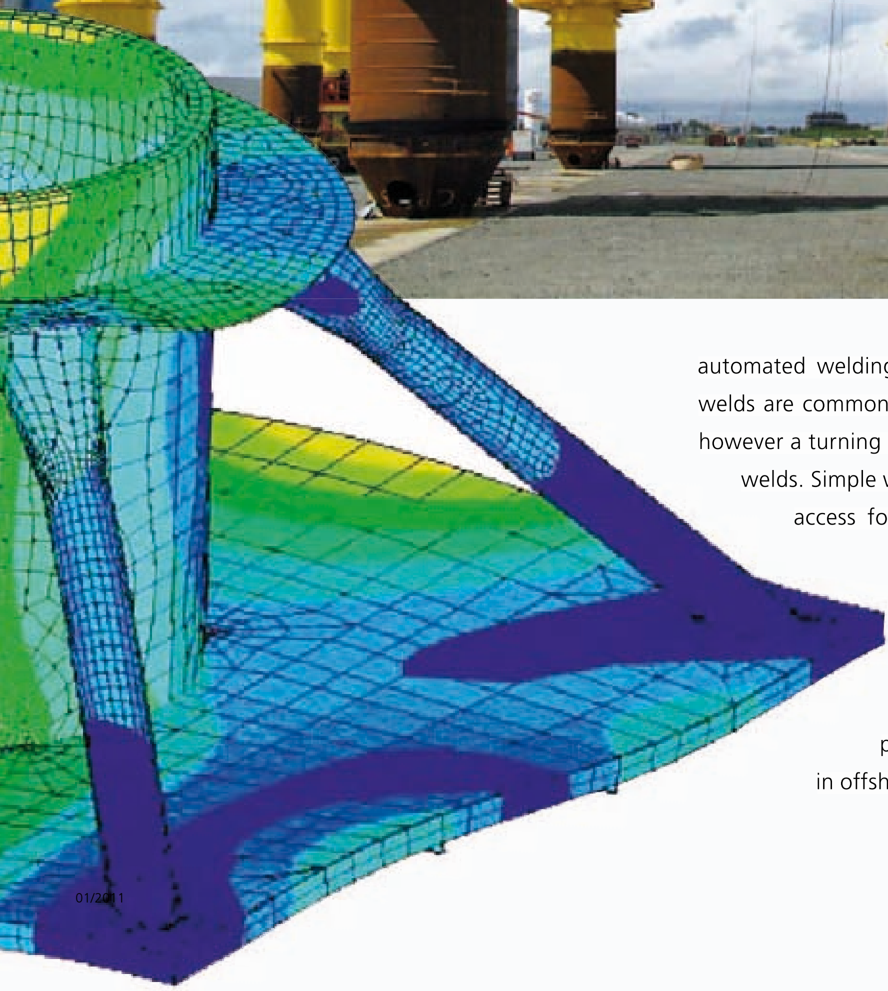
- These four types of foundations for offshore wind turbines are currently in use
- Germanischer Lloyd developed the "Guideline for the Certification of Offshore Wind Turbines"

1. Monopiles

The first offshore wind turbines were installed on monopiles – this being a good choice for smaller units at shallow waters. The hollow piles are driven from a jack up working platform which is relatively independent of the weather conditions. Monopiles can be installed at any tide level. The available technology allows to drive piles up to 5.5 m in diameter. In the near future it will be possible to ram or drill piles up to a diameter of 10 m. Monopiles can be manufactured onshore using a highly



Model. **A welded joint on the alpha ventus jacket.**



Giants.
Cross-bracing for the Bard 5M turbine.

automated welding process. Longitudinal and transverse welds are commonly executed by submerged arc welding, however a turning device is needed to carry out transverse welds. Simple weld preparation requirements and easy access for welding and inspections are among the cost-effective properties of this foundation type.

2. Jacket

Lattice-type substructures have a proven track record of several decades in offshore oil rigs. Almost every offshore ▷

▷ wind farm needs at least one jacket-type substructure for the substation which provides the grid access to the sea cable. This platform usually also carries accommodation quarters for service personnel and supervision staff. Jackets have numerous welded joints between the tubular sections. These cannot be carried out automatically and the manufacturing and quality control effort is significant due to complex geometry. Cast joints are also used in some cases in order to avoid oval welds at the nodes below sea level. The turbine loads are transferred into the seabed by three or four foundation piles. Pile driving is rather time-consuming even under ideal weather conditions. Jackets are a suitable foundation type for water depths between 30 and 50 metres.

Key Function. **Making an annular flange.**

Ramming. **Installation of a pile from a jack-up platform.**

3. Tripiles

The cross-bracing concept developed by Bard Engineering combines tripod and monopile elements. The centre joint is located above the waterline to make inspection and maintenance easier. Weld preparations and welding are very complex. Like other foundation types, this method requires foundation piles driven into the seabed. Due to the transition piece geometry, the pile driving procedure demands greatest precision. The unusual load flow requires intensive and complex calculations. A tripile can be installed at any tide level and is suitable for waters with 30 up to 50 m depth.

4. Tripod

A tripod substructure usually consists of a vertical centre column with three upper and three lower braces. The tripod is anchored on the seabed by piles driven through pile sleeves located at the corners of the leg braces. Due to a three-dimensional oval weld geometry at the junction of the braces, a high demand is put on the manufacturing and inspection companies. Tripods can be installed in water depths exceeding 30 m. Installing the tower on top of the centre column is considerably less difficult compared to a jacket. The centre column is assembled with a flange on top, simplifying the design of the connection of the tower.

Regulations and Structural Basics

Offshore structures are exposed to high stresses throughout their lifetime. In the case of offshore wind turbines, the demands due to a high number of load cycles are further aggravated by the ultimate and fatigue loads caused by the wind and wave impact. Therefore the existing regulations were insufficient and could not cover all the issues to ensure a safe operation for these structures. To fill this gap, Germanischer Lloyd developed the "Guideline for the Certification of Offshore Wind Turbines".

Germany's first offshore wind farm "alpha ventus" has been certified according to these rules. In order to determine the proper testing temperature for the notch impact strength of the steel, it is necessary to define the design temperature and the structural class for the entire structure first. The design temperature is -20°C for components located within the splash zone and above the waterline.

Components are assigned to structural groups depending on their importance. If a full or partial failure has no effect on the integrity of the structure (such as the boat landing, ladders, platforms) the components are referred to as "secondary structures". The failure of a primary structure, will generally cause full loss of the turbine. This structural class includes elements such as foundation piles or towers. Certain parts of a turbine structure are subject to especially stringent requirements. Since they are exposed to multiaxial stresses, they must satisfy the highest standards of "special structures". This group includes, for example, welded structural joints which cannot be inspected. □ ØT

This article was first published in the magazine "Ship + Offshore".

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Specific Technical Challenges

JUNCTION WELDS

The junction welds of a tripod substructure have to meet stringent requirements for design and accuracy. Weld preparation is usually done by a fully automated profile cutting process to reduce costs. Depending on the joint geometry, a uniform fillet weld is created around the perimeter of the joint.

Due to the geometric orientation towards the centre column, the three-dimensional joint contour is generally oval. The throat thickness of these joints vary greatly, even with equal wall thickness. Therefore these welds have to be produced manually and depend on the skill of the craftsmen.

TRANSITION DESIGN

One special detail of any jacket foundation is the transition piece between the substructure and the tower. All extreme and fatigue forces induced by wind and turbine loads must be transferred through this point. The tower loads are led directly into the jacket main structure via diagonal braces.

A ring-shaped sleeve surrounds the joint, stabilising and stiffening the transition piece between the tower and the diagonal braces. At the base of the transition, the braces are welded directly onto the platform floor.

FLANGED JOINT

Tower segments are joined together by ring flange connections. The flanges for the intermediate tower segments are verified analytically. Increasingly, numerical calculation methods are used to determine ultimate and fatigue behaviour at the tower top flange. The manufacturer of a flange has to meet the organisational requirements, must use suitable machinery and has to be approved to ensure quality. The tower shells are welded to the neck of the flanges.

Submerged arc welding is the preferred process for serial production. In its search for simpler, less expensive joining methods, the research project HISTWIN has been launched to investigate an insertion-type concept whereby each tower segment slips onto the one below. The segments are then bolted together establishing a clamped connection that eliminates the traditional annular flanges. GL is an active partner in the HISTWIN project.

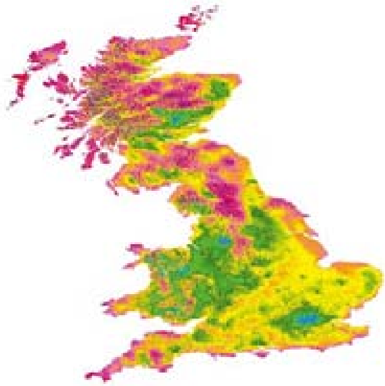
news in brief

MC2 Modelling GL Garrad Hassan Launches Wind Map of UK

bristol The new Feed In Tariff in Britain has produced an increased level of interest in small wind farms. Good wind speed estimates are vital for the proper selection of sites but small projects cannot always afford to erect masts. To satisfy this new need, GL Garrad Hassan has developed a wind resource map of Great Britain as part of its global resource mapping range.

Although there is much publicity and activity attached to offshore wind farms in the UK there is also renewed onshore activity on which this service is focussed. The maps use Mesoscale Compressible Community (MC2) modelling results applied to a microscale flow model in order to predict wind speeds at hub heights of 50 m and 80 m, at 100 m resolution, and are used by individual developers and larger industrial clients. This approach enables thorough consideration of the effect of terrain features on the wind regime at each location within the wind map. GL Garrad Hassan has been making wind speed resource evaluations in the UK for 25 years and these new results have been appraised by GL Garrad Hassan's experts who analyse thousands of megawatts annually.

The Mesoscale model was run at 5 km resolution with a fixed number of climate states, defined by a global database of geostrophic weather statistics based on reanalysis hindcast data. The results have been used to initiate a linear microscale (local) wind flow model. This microscale flow model has been run across the entire land mass of Scotland, England and Wales. Maps at a resolution of 100 m are available electronically in various formats for specific sites, regions or Great Britain in its entirety and wind roses are available to indicate wind direction across the map. Results at the same resolution for Northern Ireland and the Republic of Ireland will be available soon.



Overview. **The service is focussed on the renewed onshore activity.**

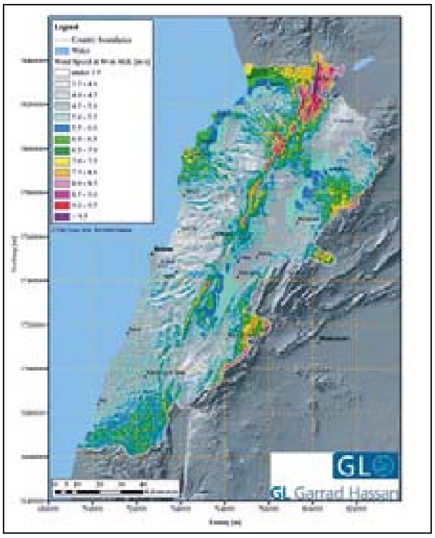
Wind roses – the visual representation of the wind direction frequency distribution – are constructed from the output of the Mesoscale model. They are available at every point on a 5 x 5 km grid, providing an indication of wind direction across the map.

CEDRO GL Garrad Hassan Delivers Wind Map of Lebanon

beirut Lebanon is planning to generate 12 per cent of its electricity from renewable energies by 2020 according to official reports. To support an emergent wind industry in the country, GL Garrad Hassan has developed a wind map of Lebanon. This map is part of GL Garrad Hassan's global resource mapping range which includes wind maps for Great Britain, India, Turkey, and France.

The wind map was produced as part of the United Nations Development Programme and Spanish government funded "Country Energy Efficiency and Renewable Energy Demonstration Project for the Recovery of Lebanon" (CEDRO). The CEDRO project was established in 2007 to provide a renewable energy and end user energy efficiency component to complement the national power sector reform strategy in the country, as part of the government's recovery, reconstruction and reform activities.

GL Garrad Hassan's wind map provides information to all potential stakeholders about the available wind resources at any given location across Lebanon, and therefore the potential for wind farm development.



Bedrock. **The map shows the chances for the country's wind industry.**

Rules for Certification and Construction. Our latest brochures, rules, and guidelines are available on request. Order forms are available on the Internet: www.gl-group.com > Rules & Guidelines

Korea Offshore Basics at the "Offshore Wind Power Korea"

seoul The "Offshore Wind Power Korea 2011" in Seoul organized by the Korean Ministry of Knowledge Economy took place in January. Ian Bonnon, Head of GL Garrad Hassan's offshore business and Mathias Steck, Vice President GL Garrad Hassan Asia, gave presentations on GL's scope of knowledge in terms of offshore wind. Ian Bonnon focused on the lessons learnt from several European offshore wind farm projects.

He highlighted the largest offshore wind park project, Thanet, for which GL Garrad Hassan did the project and risk management in time and budget. In addition, Mathias Steck spoke about offshore engineering and answered questions such as How do offshore loading environments differ from onshore environments? How should an offshore wind turbine be designed? He presented methods for calculating fatigue and extreme loads offshore and showed that an integrated treatment of wind and waves is essential. South Korea plans to complete an 8.2-billion dollar offshore wind farm off the west coast by 2019 with 500 turbines.

Presentation. Ian Bonnon and Mathias Steck spoke about offshore engineering.

Photo: Tianjin Dongqi Wind Turbine Blade

Dongqi GL Shop Approval for Chinese Wind Turbine Blade Production

tianjin Tianjin Dongqi Wind Turbine Blade Co. Ltd. (http://en.dqfdtj.com) received their first GL Shop Approval from GL Renewables Certification (GL) for the production of rotor blades fabricated from fibre reinforced plastics. Based in Tianjin, China, Dongqi at present is the only rotor blade manufacturer in China with GL Shop Approval, certifying the high standard of their rotor blade production.

The shop approval was issued according to the GL "Guideline for the Certification of Wind Turbines", Edition 2010. It confirms that the rotor blades comply with the requirements of the GL instruction regarding requirements for manufacturers, quality management, and materials and production.

Andreas Kamleitner, GL Renewables Certification, inspected the company's production facilities in Tianjin and scrutinized the qualifications of the personnel in charge. After having examined the company, Dongqi was approved as a manufacturer of wind turbine blades made of fibre-reinforced polymers for manual lamination procedure as well as vacuum assisted resin infusion. The shop approval will expire at the end of 2011.

Staff Change in GL Renewables Certification Management

hamburg Christian Nath hands over the management of GL Renewables Certification. Andreas Schroeter has been appointed as his successor as Senior Vice President GL Renewables Certification and Mike Woebbeking will be Vice President GL Renewables Certification and Head of the Certification Body. Over the last decades, Christian Nath has considerably expanded GL's position in the certification of wind energy worldwide. He will continue to support the organization in a consultative capacity until the end of 2011.

Andreas Schroeter holds a degree from the University of Bochum as a Diplom-Ingenieur and an MBA from IESE Business School in Barcelona. He has spent most of his professional life in telecommunications where he has had a variety of sales, service and country CEO positions. He has experience in doing business in both Latin America and Asian countries as well as in Europe.

Mike Woebbeking holds a degree in civil engineering from the Technical University of Hanover and is an Welding Engineer (EWE/IWE). At GL, he has been involved in the certification of wind turbines and the development guidelines and standards since 2001.

Photos: Michael Bogumil

Changeover. Andreas Schroeter and his predecessor Christian Nath.

dates at a glance

Conferences & Fairs

MARCH

14 – 17th
EWEA 2011
Brussels, Belgium

MARCH

24 – 25th
IWEC 2011
Dublin, Ireland

APRIL

4 – 8th
Hannover Messe
Hanover, Germany

7 – 9th
Wind Power India
Chamai, India

12 – 14th
PWEA
Warsaw, Poland

11 – 13th
New Zealand Wind Energy Conference
Wellington, New Zealand

28 – 29th
4th Annual Global Marine Renewable Energy Conference
Washington, DC

MAY

4 – 6th
Solarexpo
Verona, Italy

9 – 11th
Wind Power Africa
Cape Town, South Africa

EWEA. The former EWEC with 13,000 m² of stand space.

IWEC. 30 renowned exhibitors in Dublin.

Hanover. 13 leading trade shows at one venue.

India. Leading offshore wind power event in Asia.

Warsaw. Conference and exhibition.

Wellington. Event with a comprehensive programme.

Sustainability. Italy's leading trade fair for renewable energy.

Afriwea. The premier international event on wind energy in Africa.

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