ISSUE 02 • 2012

GL Group

www.gl-group.com

energize renewables

energy. efficiency. engineering.

Taming the Elements

future trends Understanding the Wind

new markets Pooling the Forces

certification Protecting the Assets

Lecture

GL Garrad Hassan

GL GARRAD HASSAN'S EXPERTS PRESENTING AT HUSUM WINDENERGY 2012

HALL 2 | STAND 2G03

Erik ter Horst,
Principal Engineer Offshore
"Cost of energy of Floating Wind"
18 September, 3 p.m. – 3.30 p.m.

Tony Mercer, Head of Turbine Engineering Control
"Turbine mounted LiDAR to improve wind turbine control"
19 September, 11 a.m. – 11.30 a.m.

Jonathan Collins,
UK Team Leader, Forecasting
"Taking the guesswork out of wind power forecasting"
20 September, 3 p.m. – 3.30 p.m

Kevin Herrling, Project Engineer,
EMC/EMF/Power Quality
"High frequent electromagnetic fields on wind turbines"
21 September, 3 p.m. – 3.30 p.m

To Our Readers

Dr Andrew Garrad

"Understanding the Wind" (page 16) in this issue discusses how wind speeds and directions can be anticipated accurately and cost-efficiently using laser technology. Predicting whims of nature can help protect wind turbines against shock loads. This ability will be especially important for future systems rising up to heights of 130 metres, supported by an innovative foundation design (page 34). While wind conditions are more stable in such altitudes, higher wind speeds place greater loads on turbines.

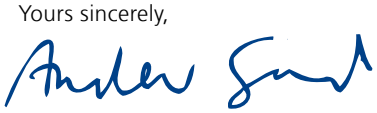
To find out where the wind is blowing, consider visiting the HUSUM WindEnergy conference. For 25 years this event has been attracting international experts and decision-makers from the wind energy industry as an opportunity to discuss new technologies, innovative products as well as future market trends. The offshore market will without doubt be among the top items on this year's agenda. Numerous new wind farms will be built in the North Sea alone over the coming decades. The energy they generate must be fed into the grid exactly when it is needed. GL Garrad Hassan's state-of-the-art power forecasting methods enable highly accurate short-term predictions (page 8).

Finding ways of building offshore wind turbines more safely, quickly and cost-efficiently is another major industry topic. Possible answers include the world's largest wind turbine installation ship (WTIS), "Pacific Orca" (page 22), or floating wind foundations (page 12).

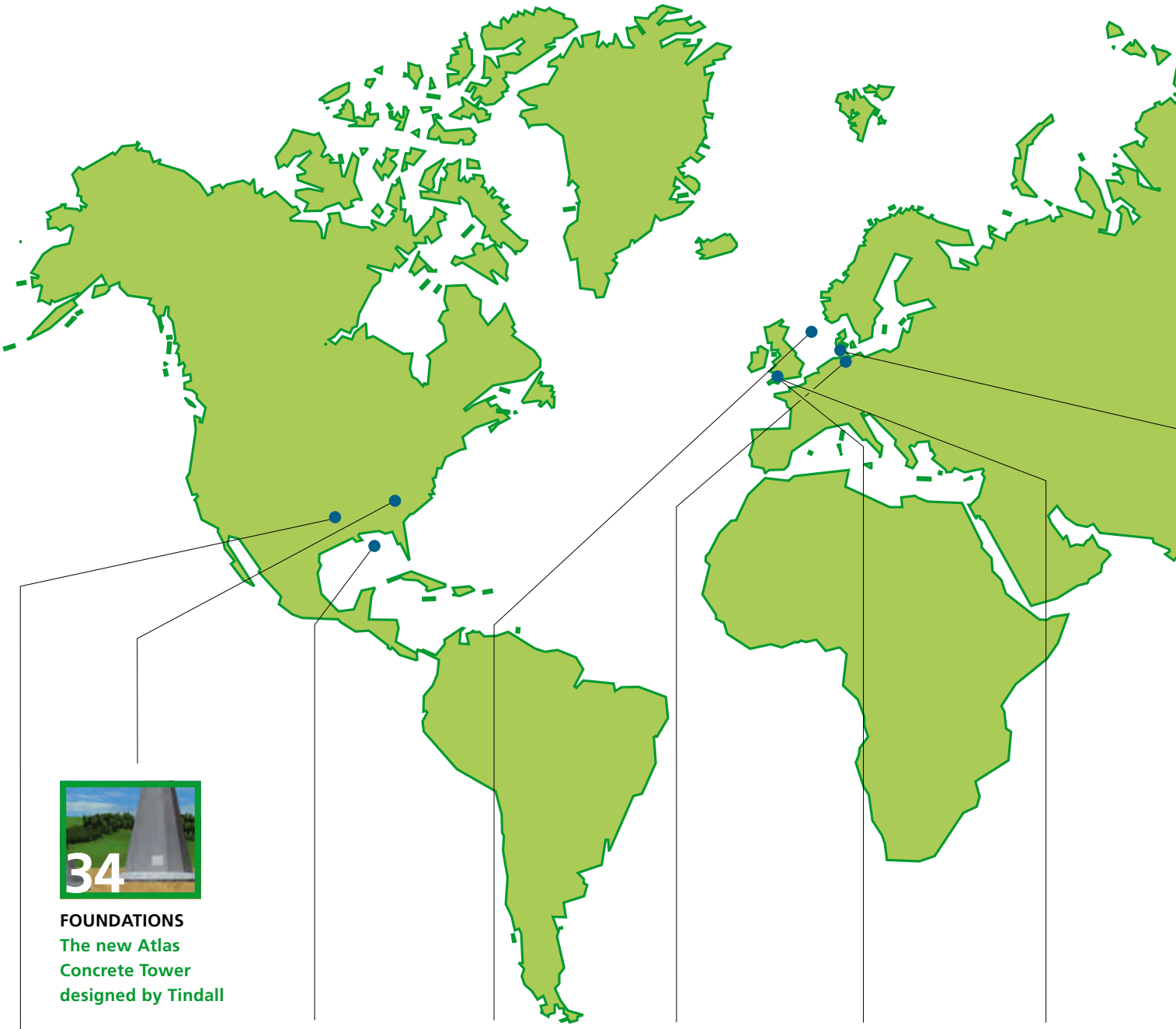
Waves and wind expose offshore structures to exceptionally harsh conditions. But new turbine classes can even withstand the punishing onslaught of hurricanes. GL Renewables Certification is currently developing a new set of rules for these machines (page 28). A smart solution to mitigate the risk of storm damage has been found for New Caledonia: in a UN-registered Clean Development Mechanism (CDM) project, several smaller wind farms built on the Pacific island consist of wind turbines that can be folded down in case of a cyclone alert (page 36). This GL Group-certified project saves 32,000 tonnes of CO_2 annually, underscoring the potential of emissions trading.

Meanwhile, new opportunities are emerging that are sure to benefit our customers. The newly acquired US company PWR Solutions will soon expand the GL Group's services portfolio in the fields of power generation, transmission and distribution (page 24). We would be delighted to show you more of what the GL Group can do for you – in the renewables sector and beyond.

Yours sincerely,

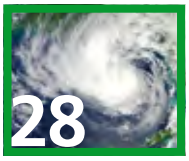


Dr Andrew Garrad
President of GL Garrad Hassan



FOUNDATIONS
The new Atlas Concrete Tower designed by Tindall

CONSULTING
PWR Solutions has joined the GL Group

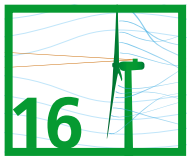


INTERVIEW
The viability of wind farms in hurricane regions

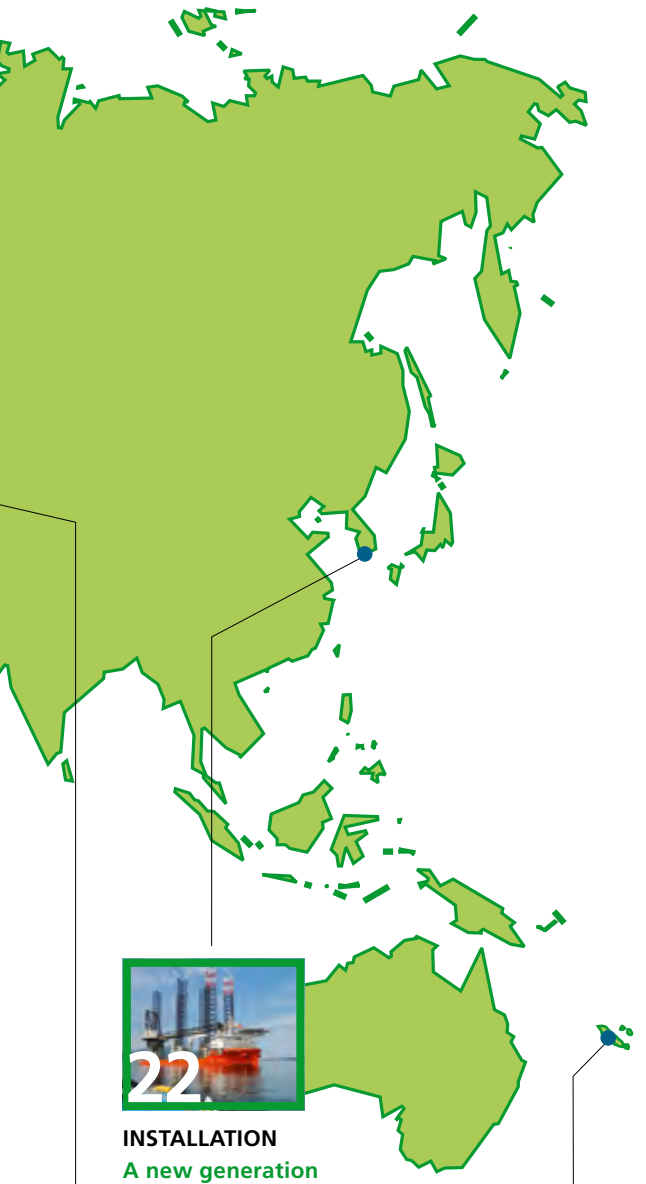
STRUCTURES
Floating wind foundations in buoyant mode

APPROVAL RC
New technologies to digitise the procedure

GH FORECASTER
Grid stability due to state-of-the-art forecasting



INTEGRITY
LIDAR: measuring wind speed and reducing fatigue



INSTALLATION
A new generation of wind turbine installation ships

TESTING
A test field designed to evaluate new prototypes

EMISSIONS
GL as a designated organisation for certification

In Brief:

The GL Group's Renewables Business Segment

- **GL GARRAD HASSAN** is one of the world's largest renewable energy consultancies. It offers a unique level of service expertise and global presence across the whole project lifecycle with approximately 1,000 members of staff in 44 locations, across 26 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 farms, 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 focused 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 harmonised 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.

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

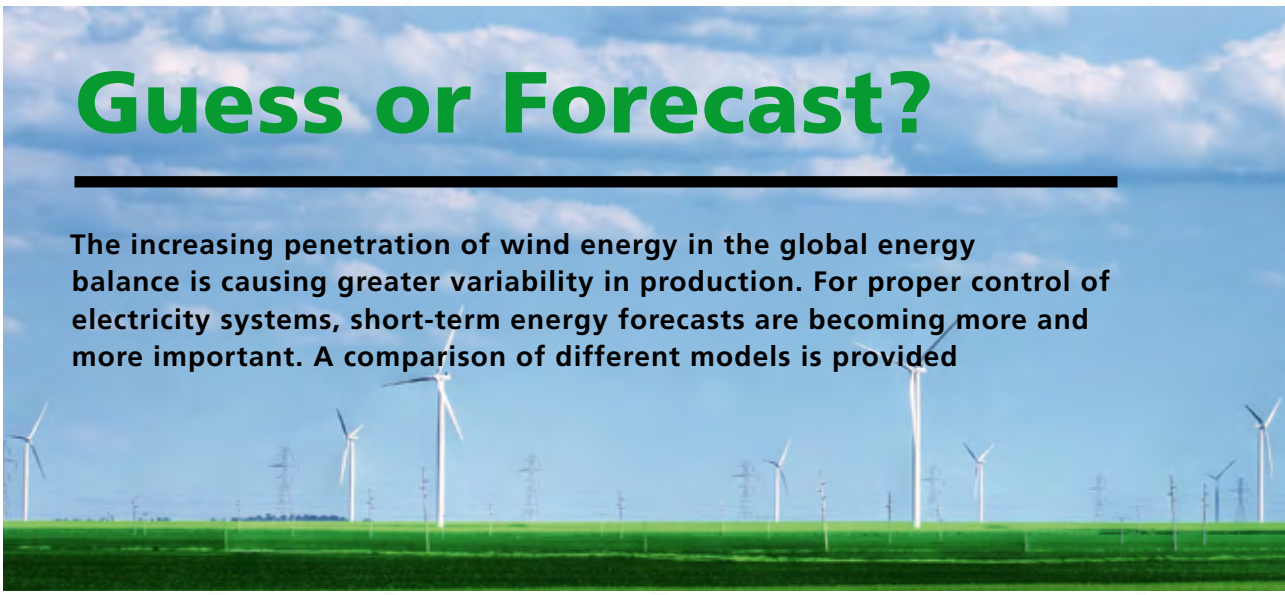
future trends

Whether it is about feeding wind power into the grid, developing intelligent on-shore and offshore wind farm concepts or introducing innovative measurement and testing systems – GL Garrad Hassan provides solutions for tomorrow's wind energy technology.

Photo: Dreamstime/Jacekplacek1977

H

Guess or Forecast?



The increasing penetration of wind energy in the global energy balance is causing greater variability in production. For proper control of electricity systems, short-term energy forecasts are becoming more and more important. A comparison of different models is provided

The main focus of the wind power industry in Europe in the past two decades was on forecasting the long-term productivity of plants. This is easily understandable if we consider that to date all energy supply contracts in Europe have been "Take or Pay". This means that all electricity produced by wind farms is sold for a predefined price, irrespective of the time of year or day. This privileged position is unlikely to be maintained for very much longer, especially because the progressing advance of wind energy in the European energy balance is causing greater variability in production, which is having an increasingly noticeable effect on the electricity system. There are regions in Europe where, on certain days of the year, the wind energy contribution exceeds the energy demand by 100 per cent. The operators of the electricity networks, who work according to supply and demand on a national or regional level, are therefore increasingly forced to forecast and manage these fluctuations. Hence, the increasing level of wind energy fed

ABSTRACT

- Forecasting is essential for the efficient integration of wind generation into electrical systems
- GL Garrad Hassan's state-of-the-art forecasting methods provide highly accurate predictions

Fig. 1 Random Forecasts

Fig. 1 shows the mean absolute error of hourly energy forecasts

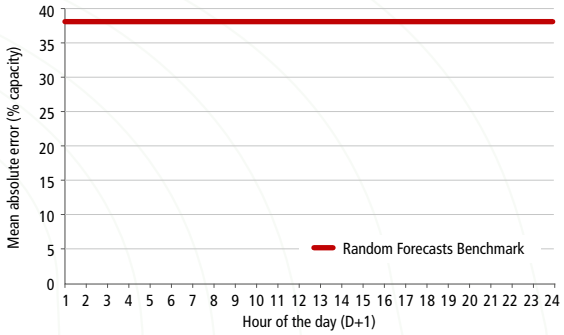
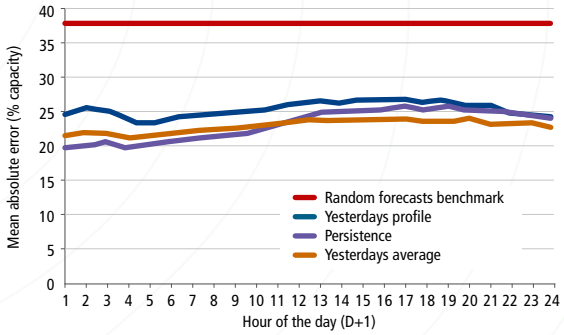


Fig. 2 Three Persistence Models

The models constitute a significant improvement to the random model



POWER. A clear understanding of the expected wind output is essential to manage the supply and demand of a regional and international grid system.

Photos: Dreamstime/Leigh Prather/Zhudifeng/Robert Adrian Hillman

into the electricity networks means the production of electricity from wind power has to be regulated so that it is increasingly adjusted to the energy generated by conventional plants. Because of this, it will soon become necessary to forecast the quantity of energy produced on a short- to medium-term basis, from a few hours to a few days. Some countries already insist operators draw up productivity forecasts; however, only few impose penalties for incorrect estimates. In Italy there is currently a reward system for plants that predict the trend in production in the short term correctly, but there is no penalty system for companies that deliver incorrect forecasts.

Crucial Significance

In February 2012, the Italian authority for electricity and gas (Autorità per l'energia elettrica e il gas – AEEG) issued a reference document (35/2012/R/efr) in which they documented their intent to achieve "an increased accountability of users for the dispatching of plants supplied by renewable sources which cannot be programmed with regard to the efficient forecasting of the electricity fed into the network". The AEEG proposed to introduce penalties for those producers who do not deliver accurate forecasts for the production of their plants. Without going into detail concerning the complicated mechanism for the calculation of the "payment for correct production" described in the reference document of the AEEG, it can be stated that, if this mechanism should come into effect, the precision of short-term energy forecasting would take on crucial significance for the accounts of wind farms.

In this article the accuracy of different methods for short-term forecasting is compared. The real production data, recorded at three wind farms in Europe located offshore, on simple terrain and difficult terrain respectively, were compared to the trends obtained from five different forecasting models. The estimates refer to a period of 24 hours (from midnight [0.00] to midnight [24.00]) and were drawn up on the basis of the data available until 8 a.m. on the previous day. The results presented refer to the average of the three plants considered.

The first and most rudimentary method examined is based on coincidence. The assumption, on which this model is based, is that the production trend is ▷

AEEG. Autorità per l'energia elettrica e il gas – the Italian energy authority proposed to introduce penalties.

completely incidental and cannot be predicted. Therefore, the profile for the production of the following day consists of 24 hourly power values, generated completely randomly in a range between zero and the nominal power of the plant. This model is unfounded and is only used as a basis for comparison or "zero point" in order to assess the quality of alternative models. Figure 1 shows the mean absolute error of the hourly energy forecasts based on the random forecasting model according to the time of day, applied to the database considered in this study.

GH FORECASTER. The tool is able to forecast the power variations of the plant with accuracy.

Three Simple Approaches

The following examines three simple short-term forecasting approaches, known as persistence models. These are based on the assumption that, considering a short period of time, the latest recorded production is a good indicator for future production. Three persistence models are compared in this study:

- persistence model based on the average of the previous hour: it is assumed that the average production recorded between 7 a.m. and 8 a.m. is representative of the following day's production.
- persistence model based on the profile of the previous day: it is assumed that the production profile recorded between the beginning [0.00] and the end [24.00] of the previous day is representative of the following day.
- persistence model based on the mean value of the previous day: it is assumed that the mean production value of the previous day is representative of the following day's production.

The mean absolute error for each of these three persistence models described above is compared to the mean absolute error of the random model in Figure 2. It can be seen that the persistence models constitute a significant improvement with respect to the random model.

The last approach examined in this study is a method developed by GL Garrad Hassan and implemented in the GH Forecaster software. A simplified schematic of its algorithm is illustrated in Figure 3. The operational data of the plant (historical and real-time) are combined with meteorological data and the orography of the location in order to obtain a forecast of the wind speed on a local scale. This is the input for the power model, where the forecast wind speed is converted into a power forecast.

Fig. 3 State-of-the-Art Method

- Intelligent combination of meteorological forecasts collected from several data processing centres
- Adaptability based on the comparison between forecast and actual production

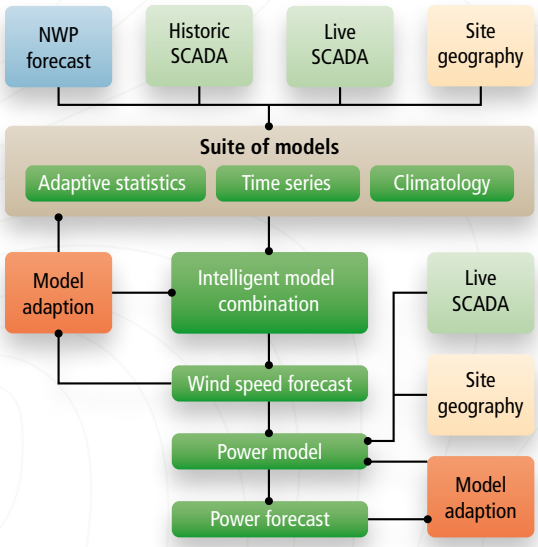
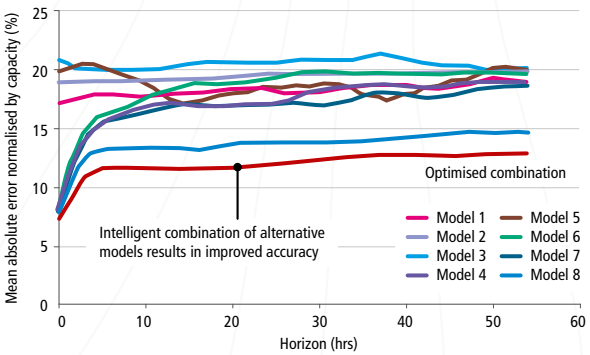


Fig. 4 Intelligent Model Combination

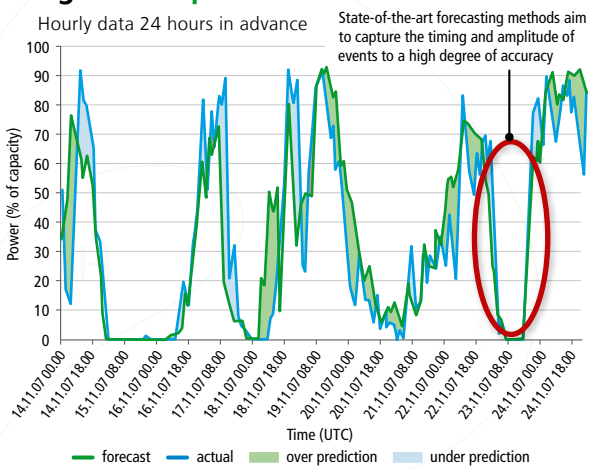
The GH Forecaster model compares the forecasts to the actual data



WEATHER. Meteorological conditions affect the energy forecasts.

Photo: Dreamstime/Kruwt/Robert Adrian Hillman

Fig. 5 Example Forecast



The meteorological forecasts for one geographical area can be obtained by means of numerous numerical models. Thus, for every location, there is a model which predicts wind speed more accurately than the others. Based on this observation, one can move one step ahead and state that for every location and every local meteorological condition (wind direction, humidity, atmospheric pressure, season, etc.), there is a model that predicts wind speed more accurately than the others. The model which on average delivers the most accurate forecasts could then prove to be unsuitable for certain local meteorological conditions.

In other words, the most accurate forecast is not delivered by the model that provides the lowest mean error, but by the intelligent combination of different models appropriately chosen on the basis of the local meteorological conditions. This observation is fundamental and one of the keystones of the algorithm implemented by GL Garrad Hassan. Figure 4 shows the ensemble approach described above. Note that the forecast based on the intelligent combination of several meteorological forecasts provides a result even more accurate than the best forecast based on one service only.

The model used by GH Forecaster continuously compares the forecasts to the actual data by means of statistical regression. The results of this comparison are used to continuously update the model; a kind of self-learning based on the statistical verification of the effectiveness of the model used. Through the application of the forecasting techniques described above, GL Garrad Hassan is able to provide highly accurate and reliable forecasting services, enabling owners to manage their wind farm efficiently, and power companies to maximise the value of wind energy.

Better than Guessing? Yes, Definitely!

This study shows how the latest-generation modelling methods are able to provide accurate forecasts of wind energy production. Since the beginning, GL Garrad Hassan has always observed the wind power industry trends with far-sightedness in order to provide its customers with tried-and-tested and up-to-date solutions. Thanks to the continuous investment in research, the company remains one of the industry leaders and is able to meet the latest market demands with its state-of-the-art forecasting services all over the world. □ **JP**

GL GROUP EXPERT:
Jeremy Parkes
Global Head of Practice, Forecasting
Phone: +44 117 972 9844
E-Mail: jeremy.parkes@gl-garradhassan.com

Floating Wind Foundations in Buoyant Mode

The offshore wind industry seems hesitant to utilise floating foundations. But in contrast to general belief, floating wind becomes an increasingly attractive alternative to fixed foundation structures

Ever since Professor William E. Heronemus, proposed arrays of wind turbines supported on floating buoys in the early 1970s, numerous concepts have been developed to utilise free-floating foundations as an alternative to fixed foundations. After development of small-scale floating foundations over the last decades, currently two full-scale prototypes of 2 MW or more are operational and subjected to offshore test programmes. Valuable data are being gathered regarding the response to the combination of wind and waves, functioning of the system and the marine operations for installation and operation of the unit. The prototype tests have confirmed the viability of the floater technology. However, there is still scepticism in the industry over the economic feasibility of these concepts.

ABSTRACT

- Recent developments in floating wind include upscaling for larger turbines, the development of intelligent control algorithms, optimisation of hull and mooring leg design and increasing efficiency of marine operations
- Thanks to these developments the cost of energy of floating wind is rapidly decreasing

Floating foundations can be subdivided into three main categories: the tension leg platform, the spar buoy and the semi-submersible; each of these concepts is well known to the oil and gas industry. Each concept has its own characteristics with respect to its behaviour in waves and wind, complexity of the structure, the mooring system and method of installation.

New Trends, Strong Efforts

All major floating wind developers have concepts for larger platforms on the drawing board, capable of supporting turbines of 5 to 7 MW. As part of this upscaling, the hull design is optimised to enable more efficient manufacturing, utilising circular members that are fabricated by automated welding, avoiding the need for labour-intensive stiffeners and bulkheads as much as possible. Furthermore, strong efforts are made to reduce the quantity of steelwork of the hull; achieving realistic fully-coupled simulations of the whole system is necessary to avoid over-designing the platform and the recent addition of a floating module in Bladed enables the industry to take this next step.

ALTERNATIVE. Under certain conditions, floating structures can compete with fixed foundations.

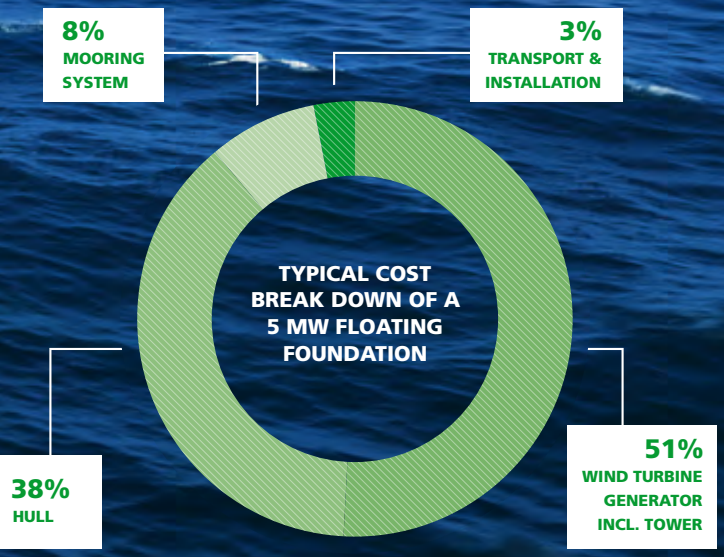


Photo: Principle Power Inc.

In general, there is a strong focus on decreasing the costs of the hull; with about 40 per cent of the total floating turbine Capex, the hull is one of the main cost drivers. Although initially floating foundations were developed for water depths over 100 m, currently there is a strong drive to enable mooring of the unit in shallower waters, even down to a water depth of 40 m. Thereby the UK Round 3 sites, the deeper parts of the German Bight and the French west coast are potentially suitable for the installation of such units, besides the deeper waters of the USA, Norway, Spain and Japan.

The motion behaviour of the floating unit, subjected to a combination of wind and waves, adds new ▷

Photo: Sway AS

MARINE OPERATION. **A floating turbine is erected and commissioned in the harbour.**

Photo: Principle Power Inc.

MOORING. **Towing the unit to its offshore position is relatively cost-efficient.**

▷ challenges to control algorithm design. Measurements of the platform acceleration can be used to inform intelligent control of blade pitch and generator torque to reduce platform motions. Thereby the requirement for structural steel can be reduced and at the same time the system efficiency can be increased.

Lower Installation Costs

One of the main advantages of floating turbines is that no heavy-lift vessels are required for the installation of a fixed foundation and the turbine. For the erection of a jacket foundation and a 5 MW turbine, a jack-up with a large lifting capacity is required. Given the typically high dayrates of such vessels, in combination with the duration of the offshore transport, installation and commissioning activities, the cost of the marine operations are significant. A floating turbine, on the other hand, is erected and commissioned in the harbour. The unit is then towed to the field and moored to the seabed, which is performed by relatively low-cost standard tugs. Generally, the cost of the marine operations required for a floating turbine amounts to only a small percentage of the unit costs. For certain steel price scenarios and different daily rates of the vessel, the lower installation costs of the floater have been shown to compensate for the higher cost of the hull, resulting in an economically more attractive option compared to fixed structures.

For the operational phase, a similar situation applies. In case a major component like a gearbox or generator needs to be replaced, a fixed structure will need the relatively expensive jack-up to be remobilized. In contrast, the floating turbine can be disconnected from its moorings and towed back into harbour by standard tugs for major repairs. Recent operation and maintenance analysis has revealed that for realistic failure rate assumptions, the Opex for floaters is lower compared to that of fixed structures.

Although, according to general belief, floating wind is an economically less attractive option compared to conventional fixed structures, under certain realistic assumptions for steel prices and vessel dayrates, floating wind can compete with fixed structures. It appears that the higher Capex for the hull is compensated by the lower costs of T&I, while the Opex for floating wind is expected to be lower than for fixed structures. Even though steps in the technological development need to be taken, floating foundations are rapidly becoming an interesting alternative to conventional fixed structures. □ **ETH**

OPEX. Operational expenditure is formed to a large extent by the cost of minor and major repairs, and includes the administrative and selling expenses but excludes any interest, taxes, and costs of the goods sold.

GL GROUP EXPERT:
Erik ter Horst
Principal Engineer Offshore, Offshore Wind
Phone: +31 71 523 4484
E-Mail: erik.terhorst@gl-garradhassan.com

Photo: iStockphoto/photonaj

Nordic Trails

PARTNERS. (f.l.t.r.) Stefan Alexander (BWP Janneby e.G), Oke Timmsen (Deputy Mayor, Janneby), Arndt Folkerts (Verw. GmbH Windpark Janneby), Bernd Hansen, Jörg Thordsen and Reinhard Thomsen (all BWP), Volker Köhne and Olaf Bruhn (both GL Garrad Hassan) and Michael Schwarze (GEO – Gesellschaft für Energie und Ökologie mbH).

Independent tests and measurements are key to ensuring the reliability, efficiency and performance of wind turbines, optimising existing ones, and developing next-generation designs to meet the challenges of this booming industry

The only independent wind turbine testing site in the German federal state of Schleswig-Holstein is now accepting machines for long-term trials. The test field, developed jointly by GL Garrad Hassan, GEO – Gesellschaft für Energie und Oekologie mbH and Bürgerwindpark Janneby e.G, received final building approval and will launch testing activities at the beginning of 2013. The opening of the Janneby site will mark the return of independent testing facilities for wind turbines to Schleswig-Holstein, where the last such site closed in the 1990s.

The test field is designed to assess new onshore wind turbine prototypes, a crucial prerequisite for obtaining product certification. The site comprises eight test beds and meets IEC Class II wind condition classification. The average annual wind speed is 7.1 metres per second at 100 metres above ground level. The site is capable of testing machines up to 150 metres in total height.

ABSTRACT

- GL Garrad Hassan is a cooperation partner of a new, independent wind turbine testing site in northern Germany
- The test field is designed to evaluate new onshore wind turbine prototypes

Manufacturers who choose to use the test field will have access to the full range of GL Garrad Hassan services, including noise, power performance, load, power quality and low-voltage ride-through (LVRT) measurements. An additional LiDAR test site is currently under development.

Verifiable Technical Quality

"In the rapidly developing wind energy industry, extensive prototype testing is essential for manufacturers looking to bring new products to the market. Working with globally recognised independent consultants demonstrates to potential clients the verifiable technical quality of a product, which, combined with certification, is essential in the industry today," said Volker Köhne, Country Manager Germany, GL Garrad Hassan. ◻ **SGG**

GL GROUP EXPERT:
Kay Lentzsch
Head of Department, Business Development Germany
Phone: +49 4856-9010
E-Mail: kay.lentzsch@gl-garradhassan.com

Understanding the Wind

The elements of nature can be quite unpredictable. To prevent high loads on wind turbines, scientists are looking at laser technology capable of anticipating approaching wind gusts

In recent years there has been much interest in using advanced LIDAR technology to improve the performance of wind turbine controllers. A turbine-mounted LIDAR system could sense an approaching wind field before it reaches the turbine, allowing the controller to make appropriate adjustments to reduce the loads on the turbine. This would improve cost-effectiveness, especially for large turbines and could also increase energy capture, for example by allowing a larger rotor swept area for the same loading.

In a joint research project, GL Garrad Hassan and two leading suppliers of LIDAR systems, Natural Power and Avent Lidar Technology, studied the potential of LIDAR-assisted wind turbine control to quantify the potential benefits and provide insights about the most useful technical features and characteristics of LIDAR systems.

ABSTRACT

- LIDAR sensors can measure wind speed before the wind arrives at the wind turbine
- LIDAR readings can be used to reduce fatigue and high stresses on wind turbines

Scope of the Research

The work was based on simulation modelling using the 5 MW UPWIND reference turbine model as an example, and the simulation code Bladed which includes the capability for modelling a LIDAR sensor. This was extended and refined to permit modelling of all relevant LIDAR configurations as well as simulating the evolution of turbulence. LIDAR signals were processed to estimate quantities such as wind speed, direction and shear gradients, and the baseline control algorithm was modified to improve the resulting control action.

Both, continuous-wave (CW) and pulsed LIDAR technologies were investigated. Both systems use the Doppler shift of a reflected laser beam to measure the wind component along the beam direction. For pulsed systems the range is determined by the time taken before the reflec-

LOOKING AHEAD. Laser beams reflected by airborne particles reveal approaching wind fields.

tion is received, which allows several different ranges to be sampled simultaneously.

Sampling and Processing

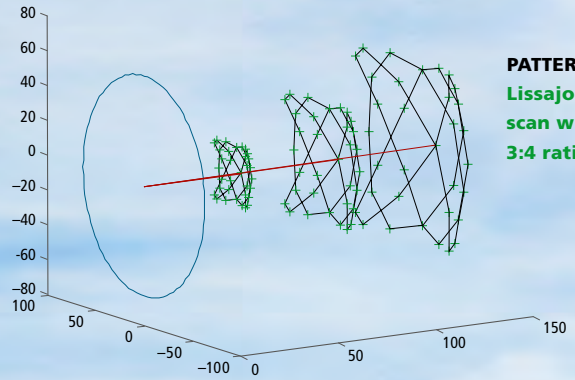
As LIDAR measures only the wind speed component along the beam, assumptions have to be made about the wind field to convert a series of point measurements into wind field estimates. An algorithm was chosen that results in estimates of the longitudinal wind speed, vertical and horizontal shear gradients, and wind direction.

Several general conclusions were drawn from the sensor configurations tested: good coverage of the rotor swept area is important, but there is a trade-off between the number of points sampled and the time taken to sample them all. Sampling the swept area once per second using about ten well-distributed points seemed to work well.

Collective Blade Pitch Control

Collective pitch control regulates the rotor speed to the rated value when operating above rated wind speed and rated power. However, any change to the pitch angle also impacts rotor thrust and hence affects the out-of-plane blade loads, tower vibration, tower bending moments, etc. The collective pitch controller design involves a compromise between tight speed regulation and turbine loads, especially tower moments. A simple feed-forward scheme was used, combining the LIDAR feed-forward with the conventional PI-based speed regulation feedback controller. Simulations were carried out using IEC turbulent wind conditions at a mean wind speed of 13 metres per second. LIDAR configurations were selected for good longitudinal wind speed estimates, and used with appropriate look-ahead times of around five seconds. Compared to the reference case, the LIDAR pitch control was significantly calmer, riding through wind disturbances as expected. The reduced pitch activity reduces vibrations and loads elsewhere in the turbine, in particular, fore-aft tower vibration.

Single Beam



PATTERN. **Lissajous scan with a 3:4 ratio.**

Fatigue Loads

To evaluate the overall effect of LIDAR on fatigue loads, a complete set of fatigue load cases was run with and without LIDAR. The total lifetime damage-equivalent loads (DELs) for key components were calculated (bar charts on page 18), accounting for the material properties of steel and glass-reinforced plastic (GRP).

The hatching indicates the range of values obtained with different LIDAR configurations. The most important results for turbine design are the reduction in thrust (Fx) and hence in tower base My (fore-aft bending moment), also blade root My (out-of-plane bending moment) and Mz (pitching moment, reflecting lower pitch activity). Only the operational cases around and above rated wind speed are affected by LIDAR. In high winds, blade root My was ▷

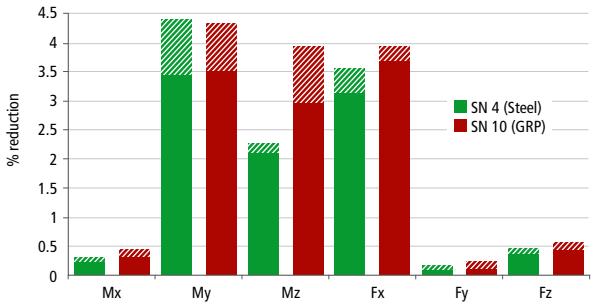
LIDAR. Light detection and ranging systems use laser beams to detect specific atmospheric conditions.

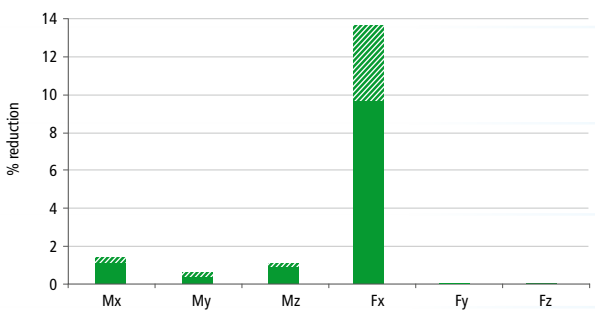
Photo: Dreamstime/Jakub Krechowicz

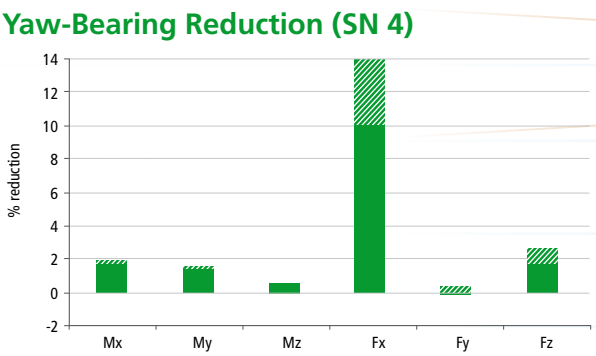
Photo: Dreamstime/Esuslo

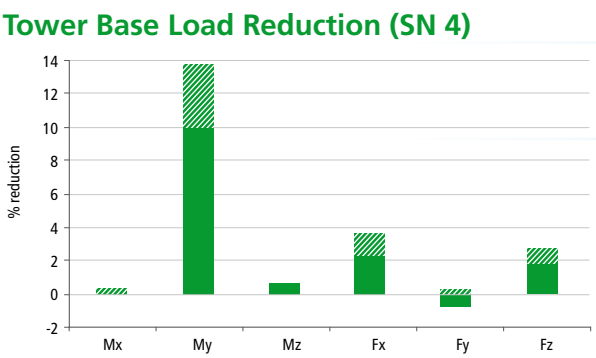
RESULTS. **Lifetime fatigue load reductions for key components of wind turbines.**

ASSETS. **Reducing shock loads can improve the cost-effectiveness of wind farms.**









➢ typically reduced by 6 – 12 per cent and tower base My by 16 – 20 per cent.

Extreme Loads

Prior studies had shown LIDAR-assisted control to highly improve the response to extreme coherent gusts, suggesting that LIDAR technology might allow a turbine to be designed to a reduced extreme-load envelope. Recent standards make less use of extreme coherent gusts in determining extreme loads. Edition 3 of the IEC standard uses them only in combination with events such as faults and grid loss, and operational extreme loads are determined by statistical extrapolation from a normal operational design load case. This would certainly result in a lower extreme tower base moment in the LIDAR cases. There may be a smaller reduction for the blade root load. The analysis did not reveal any systematic change in other extreme loads.

PITCH CONTROL. Each rotor blade can be rotated around its longitudinal axis to adjust to wind speed.

Individual Pitch Control

The use of turbine-mounted LIDAR has also been suggested for improving individual blade pitch control (IPC). The standard IPC action uses PI controllers for horizontal and vertical shear compensation. Two LIDAR configurations (CW and pulsed), selected for good performance in estimating shear gradients, were tested with the same 13-metres-per-second wind conditions. Four cases were run: no IPC, LIDAR IPC, conventional IPC, and LIDAR-assisted conventional IPC. LIDAR IPC reduces loads less than conventional IPC, with a

	Conventional IPC	LIDAR IPC	LIDAR-assisted conventional IPC
Blade root out-of-plane moment (steel)	30.4%	11–15%	30.6–30.8%
Blade root out-of-plane moment (GRP)	31.3%	16–19%	32.2–32.3%
Shaft My bending moment (steel)	41.4%	12–18%	41.3–41.4%
Shaft Mz bending moment (steel)	40.5%	12–18%	40.6–40.8%
Tower top nod moment (steel)	19.9%	4–7%	20.6–20.8%
Tower top yaw moment (steel)	14.1%	3–8%	13.8–14.1%
Increase in pitch travel	127%	62–65%	123%

LOAD REDUCTION. Effects of LIDAR-assisted individual pitch control on load reduction.

correspondingly smaller amount of additional pitch activity (see table above). LIDAR-assisted conventional IPC gives a very small improvement compared to conventional IPC. The ranges indicate the spread of values obtained with different LIDAR configurations.

Cp Tracking

Another way in which LIDAR wind preview information could conceivably improve turbine performance is by helping to maximise energy capture in below-rated winds by maintaining an optimum tip speed ratio to maximise the aerodynamic efficiency of the rotor (Cp). This is normally done by demanding a generator torque proportional to the rotor speed squared so that the rotor speed varies in proportion to the wind speed, but the large rotor inertia will result in an error. A few seconds' LIDAR preview information should allow trajectory planning to minimise this error. The study showed that the rotor speed can indeed be made to track the rotor-averaged wind speed better, but at the expense of unacceptable power and torque variations needed to achieve the high accelerations. In this simulation the mean power increased by only 0.2 per cent, and this is only available in wind speeds between about six and ten metres per second; the annual energy capture increase would be much smaller.

Yaw Control

Conventional yaw control uses a nacelle-mounted wind vane to measure yaw misalignment. Heavy filtering is needed to average out local fluctuations. Bias errors caused by local flow patterns can be corrected by careful calibration. LIDAR could be a valuable calibration tool. While LIDAR showed no obvious advantage in the simulations performed, this result is far from definitive.

Conclusions

The study showed that fatigue and probably some extreme loads can be reduced significantly by enhancing collective pitch control using a turbine-mounted LIDAR system that provides a few seconds' look-ahead time. Minor additional load reductions could be achieved through LIDAR-assisted individual pitch control. The prospects for LIDAR-enhanced Cp-tracking and yaw control are much less clear. Both pulsed and continuous-wave LIDAR types are suitable, provided they can sample roughly ten points per second distributed around the swept area. □ EB

GL GROUP EXPERT:
Dr Ervin Bossanyi
Turbine Engineering
Phone: +44 117 972 9928
E-Mail: ervin.bossanyi@gl-garradhassan.com

WAKE EFFECT. Lidar measurements can also be used for wind resource assessment, power curve measurements and studies of wind turbine wakes.

Photo: iStockphoto/Michael Bodmann

new markets

Accept challenges, seize opportunities, conquer new markets: GL Garrad Hassan delivers to the renewable energies sector a comprehensive portfolio of products and services that keeps growing. Customers benefit from the enterprise-wide close collaboration of GL Group's business segments.

Where It All Comes Together

European offshore wind energy is booming – 132 new turbines worth 523.2 megawatts were put on line during the first six months of the year. But to go on, the industry needs innovative offshore service vessels

Wind turbine installation is a highly specialised activity requiring custom-built ships: aptly called wind turbine installation ships (WTIS). *energize* spoke with GL expert Jan Schreiber about pioneering projects, newly developed rules and future challenges.

ENERGIZE: Recently, the wind turbine installation ship "Pacific Orca" was delivered by Samsung Heavy Industries to Swire Pacific Offshore Operations. What makes this ship special?

JAN SCHREIBER: First of all, she is the largest wind farm installation ship ever built, with a length of 161 metres, a breadth of 49 metres and a depth of 10.4 metres. Her capacity is enormous: she is capable of carrying and installing up to twelve wind turbine units of the 3.6 MW class. Furthermore, the "Pacific Orca" can install foundations and erect turbines in water depths of up to 60 metres. Looking at future projects, this WTIS will also be able to install very large wind turbines with a rated output of 10 MW. Another impressive feature is the ship's ability to lift herself up to 17 metres above sea level. This minimises the impact of waves and wind during installation operations.

ENERGIZE: How did GL contribute to this project?

SCHREIBER: This was a truly collaborative project involving several business segments of the GL Group. Our colleagues from GL Noble Denton undertook the engineering and design work for the legs, spud-cans and the jacking system, including FMEA, as well as integration of these components

WTIS. "Pacific Orca" is the world's largest wind turbine installation ship ever built.

TRIMARANS. The Fjellstrand WindServer will be classed by GL.

Photos: Fjellstrand/Swire Blue Ocean A/S

into the ship's hull. They also provided the shipyard consultancy and site-specific assessment services. FutureShip, a GL company, carried out the global strength and fatigue analyses for the ship afloat and was responsible for owner consultancy. And GL as a classification society conducted the in-place analysis in jacked-up mode and provides the classification services for the "Pacific Orca".

ENERGIZE: Did GL have to develop a new set of classification rules specifically for this special ship type?

SCHREIBER: Yes. GL had published new rules for Hull Structures of offshore service vessels as early as 2010. These rules have recently been supplemented by a set of classification rules for crew boats and offshore wind farm service craft. This was done to consolidate all relevant GL rules, international codes and recommendations applicable to the classification of crew boats into one coherent framework. Using this compendium, designers developing vessels for the needs of their clients will be able to rely on one single collection of rules and guidelines with full confidence that their design will comply with classification requirements.

ENERGIZE: Are these rules being applied in any current projects as yet?

SCHREIBER: Just recently we announced that the new "WindServer" wind farm service trimarans designed by Fjellstrand for World Marine Offshore will be classed by GL. This project comprises two 30-metre and four 25-metre ships. Their designer improved access to offshore installations in difficult weather conditions, enhanced fuel efficiency, reduced the running costs and, most importantly, ensured the safety of the personnel on board, all pursuant to GL's rules. The boats will have a service speed of 25 knots and the capacity to carry 25 and 12 service personnel, respectively. The trimarans are scheduled to go into service as early as March 2013. □ **SGG**

GL GROUP EXPERT:
Jan Schreiber
Offshore Service and Working Vessels
Phone: +49 40 36149-5235
E-Mail: jan.schreiber@gl-group.com

Safety First

HELICOPTERS are an important means of accessing offshore installations. But before getting on board, passengers must first take a certified safety training course. **GL RENEWABLES CERTIFICATION** recently certified the Basic Offshore Safety Induction and Emergency Training (BOSIET) of the German helicopter underwater escape and survival training specialist Deutsche WindGuard Offshore. "Certification to GL standards proves fulfilment of fundamental prerequisites, such as proper documentation and high-quality teaching materials," says lead auditor Reinhold Heller.

Offshore but Centre Stage

BY THE END OF 2012, the first German households will be tapping "green" electricity from a major new wind farm built 45 kilometres offshore the North Sea island of Borkum. The **400 MW "TRIANEL WINDPARK BORKUM"**, spread over 56 km?, is the first large-scale municipal offshore project in Europe. GL Garrad Hassan has played a significant role in its development.

When completed, the 80 five-MW wind turbines of the wind farm will be capable of generating 750 GWh annually, enough electricity to power nearly 400,000 households. The GL Group was initially contracted for some project risk work and technical studies as well as a review of the capital costs of the project. However, the role expanded over time. Today, **GL IS PROVIDING PROJECT MANAGEMENT SERVICES FOR THE CORE PROJECT**, ensuring that all contractors deliver their part of the work on time.

New Opportunities

US company PWR Solutions has joined the GL Group. The acquisition pushes the expansion of the GL Group's service portfolio in the fields of power generation, transmission and distribution

In order to better meet the needs of the challenging power market in North America, PWR Solutions, based in Dallas, Texas, has joined the GL Group. PWR Solutions offers strategic, technical and economic consulting services in electrical generation, transmission and distribution planning, congestion management and risk assessment, as well as design and engineering solutions. The company's customers include independent power producers (IPPs), power marketers, municipalities, cooperatives and investor-owned utilities (IOUs) in North America and abroad.

PWR Solutions' proven and scalable methodologies in electrical generation, transmission and distribution planning will thus complement the GL Group's wide-ranging portfolio of services, which includes renewables-related electrical grid code compliance consulting, electrical power quality and grid protection measurements, as well as power market analysis services and a huge range of non-electrical disciplines.

ABSTRACT

- PWR Solutions will complement the GL Group's wide-ranging portfolio of services
- About 60 per cent of PWR Solutions' business is related to the renewables sector

Worldwide Network

Dr Andrew Garrad, President of GL Garrad Hassan, part of the GL Group's renewables business segment, and Sunil Talati, President and founder of PWR Solutions are pleased about the new perspective: "This partnership will bring great benefits to our customers and employees alike. Having already worked together with PWR Solutions on several electrical grid projects in North America, we could see that bringing their expertise alongside our own was a recipe for success – grid integration is the critical bottleneck to the full exploitation of renewables everywhere in the world. The services of the two companies are very complementary," explained Dr Andrew Garrad. "We are delighted to be part of the GL Group," says Sunil Talati. "This will allow us to bring our clients in North America an even broader range of services and give us a worldwide network of experts and additional capabilities to tap into as we enter emerging markets in the future."

SUNIL TALATI. The founder of PWR Solutions remains in his position as President.

PWR Solutions has a proven track record, with more than 200 studies on site pre-screening, interconnection fea-

Photo: Dreamstime/Bagwold

BRAND.
PWR Solutions has become a member of the GL Group.

PWR Solutions
A GL GROUP COMPANY

sibility, system reliability, and transmission queue management. 60 per cent of their business is related to renewables. The company offers economic assessment, financial feasibility and due-diligence studies, and assessments of the effects of planned market or policy changes on client assets.

They are experts on the subject of electrical design services for the transmission and distribution of electricity, as well as commercial, industrial and institutional facilities. The acquisition of PWR Solutions will see the expansion of the GL Group's service portfolio in the fields of power generation, transmission and distribution. PWR Solutions is now branded as "PWR Solutions – A GL Group Company". □ **SGG**

GL GROUP EXPERT:
Sunil Talati
President PWR Solutions – A GL Group Company
Phone: +1 214 678 1190
E-Mail: talati@pwrsol.biz

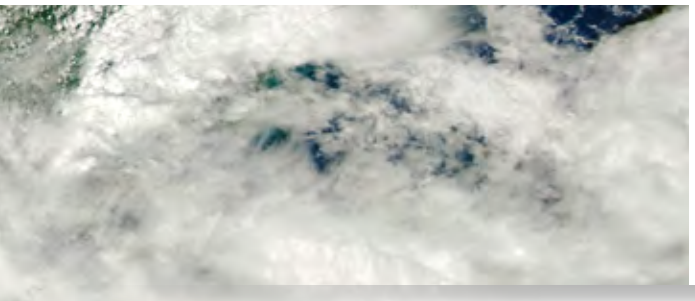
EXPERTISE. PWR Solutions' experts have performed detailed interconnection studies, market access studies, reliability assessment and site pre-screening studies for multiple sites throughout the United States, including most NERC Reliability Councils on behalf of various stakeholders in the electric utility industry.

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.


Germanischer Lloyd

POWER. Hurricane Isaac reached speeds similar to those of its devastating predecessor Katrina.



"Wind Energy Can Also Be Tamed in Hurricane Regions"

Kimon Argyriadis heads the Research and Development Department at GL Renewables Certification. *energize renewables* spoke to him about the viability and limits of wind farms in cyclone-affected regions

ABSTRACT

- Wind turbines in cyclone-affected regions have to meet special requirements
- GL Renewables Certification is working on a guideline

ENERGIZE: Mr Argyriadis, what actually is a hurricane?

ARGYRIADIS: Expressed in everyday terms, a powerful whirlwind, also known as a tropical cyclone. It is characterised by extreme wind speeds and extremely heavy rainfall, and by high waves at sea. Depending on the region, various names are commonly used: in America, these tropical storms are called hurricanes, and in East Asia typhoons.

ENERGIZE: What sort of speeds must we expect with hurricanes?

ARGYRIADIS: Wind speeds exceeding 50 m/s are frequent, sometimes even more than 70 m/s, with maximum gusts going even higher. Speeds as high as 104 m/s have been recorded. In the case of Hurricane Katrina, the winds hit 95 m/s, for example.

ENERGIZE: What is the physical mechanism behind a hurricane?

ARGYRIADIS: Hurricanes arise in tropical regions, when there is very strong heating of the water. Through evaporation of water and through the thermal energy, a cyclone is created: an energy-laden system that then gains height and produces these extreme situations. As long as the storm continues to receive energy over the water, it becomes ever stronger. When it reaches land, however, it loses power very quickly.

ENERGIZE: Where do they predominantly occur?

ARGYRIADIS: Hurricanes are a seasonal phenomenon. There are some areas that are severely affected, such as the Caribbean or the Gulf of Mexico. Southeast Asia, starting with the Philippines area and extending up to southern Japan, is also a hurricane region.

ENERGIZE: A number of offshore farms are being planned in the USA. Seven lie directly off the coast of Texas – right in the middle of hurricane country! Does that really make sense?

ARGYRIADIS: We believe that it is technically controllable. ▷

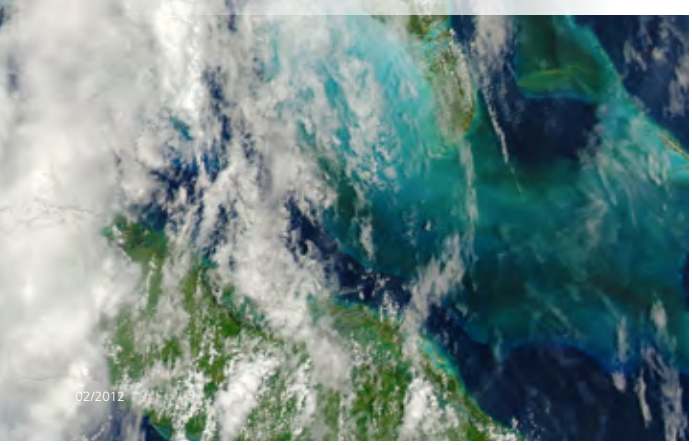


Photo: NASA

Photos: Dreamstime/Fintastique/Igorkov

WARNING. A hurricane may present a serious threat to conventional wind turbines.

▷ Intensive research is progressing on correctly mapping and recording cyclones and on evaluating the effects for the design and dimensioning of offshore wind farms. Nonetheless, all players are really moving into uncharted territory. Initial examinations have shown that we can indeed build safe wind farms in these areas – of course, this will necessitate additional effort.

ENERGIZE: You say that the beast can be tamed. But surely this calls for special technologies?

ARGYRIADIS: Certainly. Simply installing an existing type of wind turbine there without taking any additional measures would be a very risky proposition. Today's turbines are designed for an average wind speed of 50 m/s. The units to be erected in hurricane risk areas will have to be designed specifically to withstand higher wind speeds. This will give rise to new classes of turbines especially suited to these regions.

ENERGIZE: What component is most endangered by the high wind speeds?

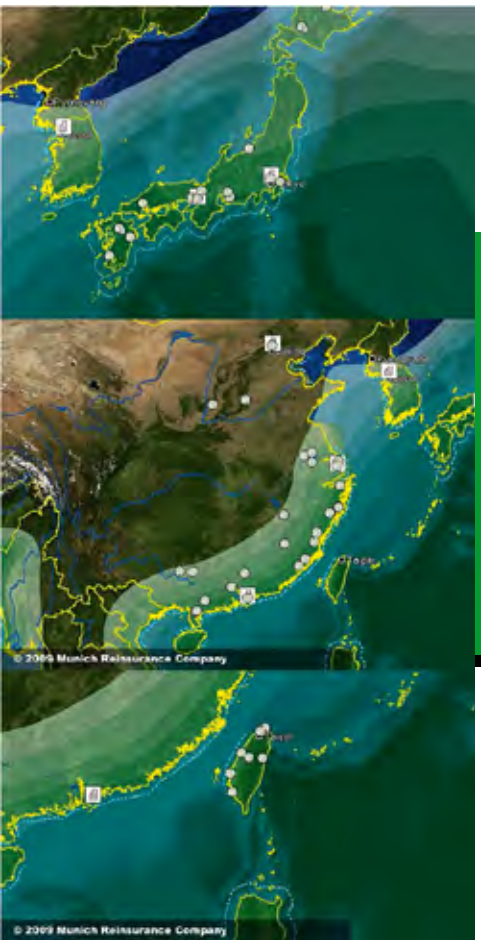
ARGYRIADIS: The key components are the rotor blades and tower. This has also been shown by the experience with turbines that have been hit by cyclones. When we talk about the tower, we really mean the entire tower structure: with its foundation, the anchoring at the ground and its dimensioning. All this means that, to some degree, we will have to use larger foundations, or perhaps switch to other types of foundations or special structures.

ENERGIZE: Can you give us a thumbnail sketch of your current research activities?

ARGYRIADIS: First of all, we asked ourselves: what are the characteristic features of the wind in a cyclone situation? We investigated, for example, how the rapid changes in direction caused by whirling winds play a role. The nacelle must be able to follow the changing wind directions. In the near future, we intend to publish the results and require-

Photo: Dreamstime/Ilja Mašik

STORM. Offshore installations have to satisfy extremely high demands.



RISK. The maps indicate the plans for wind energy sites in regions especially at risk from hurricanes.

Wind Energy and Tropical Storms

- Areas of high wind potential close to big electricity consumers are exposed to cyclones.
- Global targets for renewable energy require entry into these areas.
- Increasing numbers of onshore and offshore wind farms have been proposed in cyclone-affected areas around the world (China, Korea, Japan, USA).
- Far East power companies are asking for cyclone consideration in wind farm design.
- Cyclones observed in wind farms already planned (e.g. Hurricane Irene).

ments for wind turbines in hurricane areas as a guideline, in which we also describe the wind conditions that have to be taken into account. Naturally, it is important to also consider how great the danger is of suffering a cyclone of a certain strength in a particular location. The second part addresses the possibilities of reducing the cyclone loading by means of intelligent controllers and smart structures.

ENERGIZE: Offshore wind farms are already being built in China without the benefit of any special hurricane guideline. How can that be?

ARGYRIADIS: Up until now, no particular requirements have been set for most wind turbines with regard to cyclones. In some cases, an increased wind speed and more frequent changes in direction were assumed for the turbine design. According to what we now know, this is not the ultimate solution when designing a wind turbine for such regions. Viewed for the long term, this simplistic overdimensioning will not remain viable – for economic reasons. We believe that intelligent solutions are preferable. So we will again see two-bladed units, downwind machines and passively controlled systems. But this does not mean that the classic three-bladed turbines with an intelligent control system no longer have a future.

ENERGIZE: Do you already have meteorological simulation models, or must they still be produced?

ARGYRIADIS: To some extent, we do have simulations, but there is more work to be done. We have teamed up with the company aerodyn and with the University of Oldenburg, who are developing such simulation models especially for wind turbines and the wind in cyclone-affected areas.

ENERGIZE: Are the turbine manufacturers giving you the information you need?

ARGYRIADIS: The manufacturers are highly interested in this topic and are giving us plenty of support.

ENERGIZE: When will the guideline be ready?

ARGYRIADIS: We intend to conclude the technical background work in 2013 and publish the results by the end of 2013 or at the beginning 2014. ◻ **JI**

GL GROUP EXPERT:
Kimon Argyriadis
Head of Department Research and Development
Phone: +49 40 36149-138
E-Mail: kimon.argyriadis@gl-group.com

WORKPLACE. Computer-assisted engineering drawing will replace paper printouts.

(Paper-)Less Is More!

Working through mounds of paper documents has been an inevitable chore for reviewers of engineering drawings for wind power equipment. GL Renewables Certification has found a better way

Drawings covering every square inch of desk space – this is the impression of a typical workplace of a testing engineer working. But at GL Renewables Certification (GL RC), this scenario will soon be a matter of the past: new technologies and software products are being implemented to digitise the entire procedure.

Reviewed, Modified, Checked, Dispatched

A vision is becoming a reality: renewable energy technology engineers are reviewing engineering drawings of wind turbines on screen instead of on paper. Earlier this year GL Renewables Certification, initiated the computer-assisted engineering drawing review process called "Approval RC". For the first time, the certification body offers the entire design review process based on digital documents that can be examined on a computer screen. Andreas Anders, Head of Department Process- and Improvement Management at GL RC, highlights the benefits: "We are now able to further increase and optimise the efficiency and transparency of processes for our customers."

Up until now, engineers have had to scrutinise every detail of a given wind turbine design on paper printouts. The number of individual drawings to review, check, copy and dispatch could easily top 2,000 for a single project. GL RC experts had to go through an enormous amount of paper throughout the year. The resulting effort was tremendous, both logistically and in terms of workflow and readability. The need for optimisation was obvious. The online platform "globe" laid a foundation for enabling digital processing of

ABSTRACT

- Reviewing wind turbine engineering drawings and documents used to be a process involving enormous amounts of paper
- GL Renewables Certification (GL RC) is digitising the procedure in a new approach named "Approval RC"

Photo: Dreamstime/Bjørn Hovdal

drawings within the GL Group. This online service allows wind turbine manufacturers, engineering companies and suppliers to submit their engineering documents to the certification body in a digital format and retrieve reviewed copies in the same manner. More than 25 of GL RC's customers are using "globe" already to exchange documents with GL RC, and the trend is upwards.

GLOBE. The global exchange platform can be accessed through a standard Internet browser. The security of the digital interchange is safeguarded by SSL encryption.

Secure and Legally Valid

The advantages of digital data processing are obvious: the drawings arrive on the reviewer's screen securely, directly and in a legally valid form. What truly makes a difference is the fact that in most cases, no printouts are needed for further processing. This greatly simplifies the administrative process. In addition, documents are transmitted much more rapidly. From now on, GL RC engineers will be able to examine any detail of any drawing directly on their computer screens. The software works with the platform-independent Adobe PDF file format. All suggested changes, annotations and comments by the reviewing experts are captured in a list within the PDF document and saved with the file.

Following the comprehensive review process, the commented digital drawings are transmitted back to the customer. The comments, accessible in a list format within each reviewed document, can be edited directly and integrated into the client company's internal workflow. Once the entire approval cycle has been completed, an electronic seal can be attached to each document.

Numerous Benefits

"Processing the engineering drawings digitally also improves data quality and streamlines archiving since media breaks, such as having to switch from the digital format to paper and vice versa, are eliminated," explains project leader Andreas Anders. "The fast availability and global accessibility of the system are definitely outstanding features to support our plans to expand our business worldwide", adds Andreas Schröter, Managing Director GL RC.

Further functional enhancements of the "Approval RC" software are in the planning stages. The "Approval RC" process revolutionises the working routines and workflows at GL RC. A challenge indeed – but one well worth the effort. Leading-edge information technology has arrived at the desks of GL RC's experts – for the benefit of all parties involved. □ **SGG**

GL GROUP EXPERT:
Andreas Anders, Head of Department Process- and Improvement Management
Phone: +49 40 36149-118
E-Mail: andreas.anders@gl-group.com

We are now able to further increase and optimise the efficiency and transparency of processes for our customers.

ANDREAS ANDERS Head of Department Process- and Improvement Management

GO GREENER. **It is no longer necessary to print out documents to do assessment work.**

Sure Footing for High Risers

Increasing hub height is a strategy for increasing turbine efficiency and output – but that comes with added engineering and financial challenges. The new Atlas Concrete Tower Base designed by Tindall Corporation is a novel approach

Catching the wind at altitudes as high as 130 metres can certainly boost energy output. However, the forces at work at such heights increase the load on the tower and its foundation, which complicates the design and can significantly raise construction costs. Tindall took the challenge head-on, developing its innovative Atlas Concrete Tower Base (Atlas CTB). "This is a unique system that provides a wide, stable base for wind turbine towers, enabling heights of 120 to 130 metres and large turbines in the 1.5 to 3-megawatt classes," explains Tindall's Bryant Zavitz.

With a base 30 to 40 metres tall, this foundation can elevate a conventional 70 to 100-metre steel mono-tower to far above 100 metres. The foundation, generally 15 to 18 metres in diameter, is a tapered structure consisting of precast staves made of pre-stressed concrete. The tower itself is mounted to a concrete transition section for added stability.

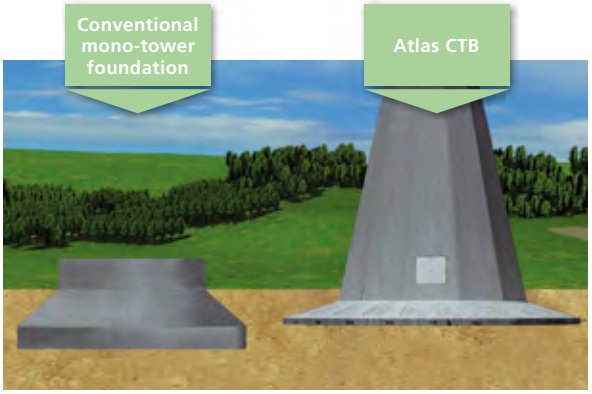
Following three years of research and development, testing and certification, Tindall recently installed a prototype of its shallow ring foundation and tower system in Atlanta, USA. "We are verifying our production, transportation and installation methods now and will then begin promoting our product in North America," adds Zavitz.

ABSTRACT

- Wind conditions at higher altitudes are steadier
- Taller wind turbines would cost more and be subject to excessive loads

Added Advantages

Compared to conventional foundations, the Atlas CTB reduces the concrete, steel reinforcement and installation costs by 50 to 70 per cent. "One benefit of the Atlas CTB is that the tower can be installed under less than optimal soil conditions. Thanks to its wide base, it is largely unaffected by common subgrade issues, including settlement. The increasing diameter of the foundation cone establishes a more advantageous load path transferring axial and bending loads to the ring foundation," Zavitz explains.

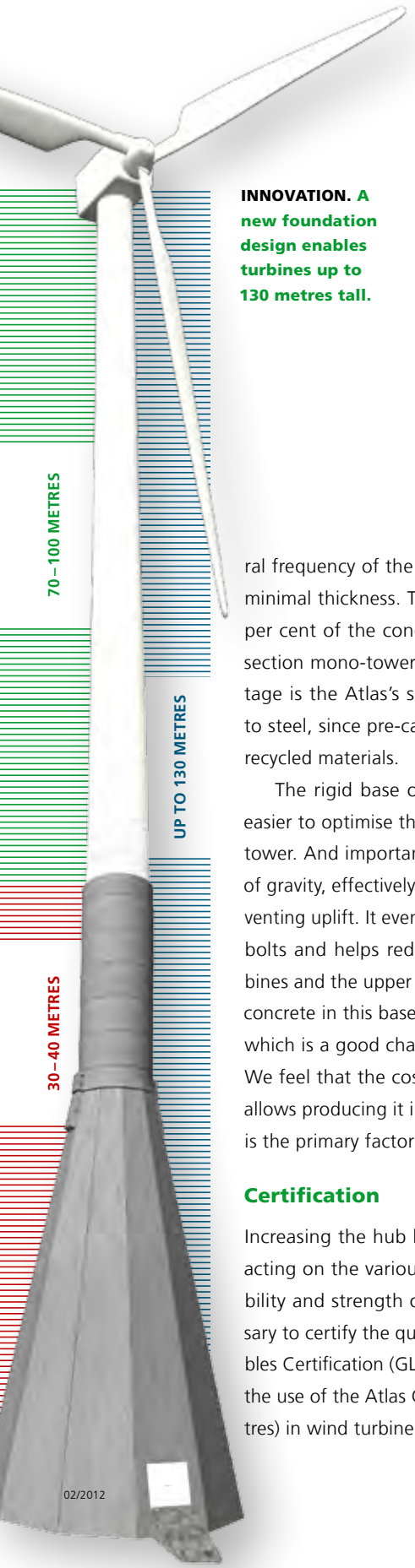


Illustrations: Tindall Corp.

ADVANTAGE. The Atlas CTB multi-section mono-tower and shallow ring foundation offer superior stability.

Due to its large-diameter footprint, unique post-tensioning process and the inherent dampening characteristics of concrete, the Atlas CTB can deliver high reliability and performance. Its design leaves the transition zone of the tower structure in a state of bi-axial compression, protecting the transitional elements and stave sections from the fatigue associated with high cyclical loading.

The Atlas's concrete ring foundation provides resistance to bending, shear and torsion loads while raising the natu-



INNOVATION. **A new foundation design enables turbines up to 130 metres tall.**

AWEA 2012. **Mike Wöbbeking, Vice President GL Renewables Certification (3rd from left), handing over a statement of compliance to Tindall for their 40-metre Atlas Concrete Tower Base.**

ral frequency of the tower. Minimal bending allows for minimal thickness. The foundation requires only 30–50 per cent of the concrete used for a comparable multi-section mono-tower foundation. One additional advantage is the Atlas's smaller carbon footprint compared to steel, since pre-cast concrete is made of natural and recycled materials.

The rigid base of this foundation design makes it easier to optimise the structural properties of the upper tower. And importantly, Atlas CTB takes full advantage of gravity, effectively resisting overturning loads and preventing uplift. It even eliminates the need for foundation bolts and helps reduce life cycle costs for blades, turbines and the upper tower itself. Zavitz assures: "All the concrete in this base is permanently under compression, which is a good characteristic for extended fatigue life. We feel that the cost of the system is competitive and allows producing it in the US using local resources. That is the primary factor driving economics."

Certification

Increasing the hub height changes the stress patterns acting on the various components. To ensure the feasibility and strength of the entire installation it is necessary to certify the quality of all components. GL Renewables Certification (GL RC) issued certificates to Tindall for the use of the Atlas Concrete Tower Base (32 and 40 metres) in wind turbine installations up to 130 metres high with a three-megawatt rated power output. The certificate confirms that the components have been designed in compliance with the GL RC Guideline for the Certification of Wind Turbines, 2010 Edition. □ **SGG**

GL GROUP EXPERT:
Stefan Baars
Head of Group Civil Engineering Concrete
Phone: +49 40 36149-7560
E-Mail: stefan.baars@gl-group.com

Tindall

WITH MORE THAN 45 YEARS EXPERIENCE in design, manufacture and erection of advanced concrete structural systems throughout North America, Tindall is one of the largest suppliers of pre-cast, pre-stressed concrete products and building systems in the US. Tindall products are manufactured in PCI-certified plants, eliminating the effects of weather on product integrity and quality as well as schedules. In 2006, Tindall began investing in the wind energy business. Today the company's wind energy department has a dedicated staff of 15 experts.

Making the Mechanism Work

For years, GL has been active as a designated organisation for the certification of emission reduction projects. The accreditation by the United Nations Framework Convention on Climate Change (UNFCCC) was recently renewed

The industrialised nations have recognised the necessity: to counteract climate change and make up for the failings of the past, the overarching goal is to reduce emissions or – if this is not possible – to compensate accordingly. Emission trading, which was implemented on a global scale for the first time with the Kyoto Protocol, has meanwhile gained international acceptance. Its concrete effect, however, is difficult to estimate.

ABSTRACT

- Emission certificates can be purchased from CDM projects that are certified by an independent organisation
- Objectives: reducing CO_2 emissions and fostering technology transfer

Besides the so-called "mandatory market" within the scope of the Kyoto Protocol, with which many industrialised nations agreed to specific climate protection targets, there is also a voluntary market for emission certificates. A large number of leading enterprises have declared climate neutrality to be one of their corporate values. Often, this can only be achieved through targeted investments in emission reduction projects.

The emission certificates can be purchased from projects that are registered as "Clean Development Mechanism" projects (CDM projects) at the UNO. ▷

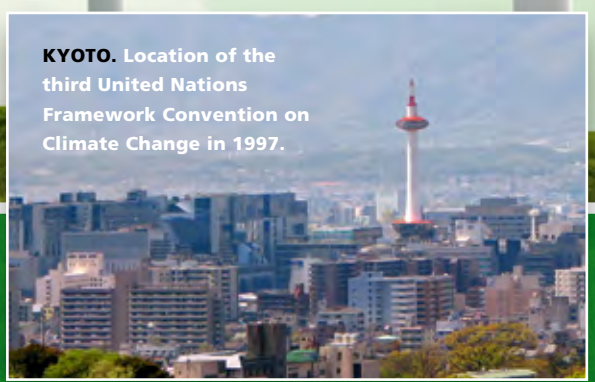
Is There a Future for Trading with Emission Certificates?

In *energize renewables*, Markus Weber, Global Head of Greenhouse Gas Services at Germanischer Lloyd, ventures an outlook

ENERGIZE: Mr Weber, what are the tasks of GL's Greenhouse Gas Services?

MARKUS WEBER: As part of the GL Group, the Greenhouse Gas Services unit is responsible for the assessment of emission reduction projects. We are accredited by the United Nations Framework Convention on Climate Change. In addition, we are approved for the examination of voluntary emission reduction projects

ENERGY. **Wind farms help to reach climate protection goals.**



KYOTO. **Location of the third United Nations Framework Convention on Climate Change in 1997.**

in accordance with the Verified Carbon Standard and the Gold Standard. Our team currently consists of 20 permanent employees in China, Thailand, India, Singapore, Brazil, Mexico and Germany. The scope of our assessment services covers both the validation and the verification of emission reduction projects.

ENERGIZE: What contribution are the certificates really making towards solving the problem of climate change?

WEBER: The basis for the certificates is the introduction of a pollution charge for greenhouse gases, as envisaged by the Kyoto Protocol. This makes the reduction of emissions more attractive. In conjunction with ▷

Photos: Dreamstime/Grafiker37/Zentilia, B. Gagnon

This project involves the installation of small wind farms in New Caledonia, equipped with wind turbines that can be folded down in case of a cyclonic alert. The electrical current is injected into the local network and allows the production of renewable electricity to replace fossil fuel electricity (80 per cent of the electricity produced in New Caledonia).

Six small wind farms were set up on two sites, Kafeate and Prony. A total of 116 wind turbines were installed, representing a production capacity of 31 MW with an es-

▻ Here the focus is on providing incentives for projects in developing countries.

For the registration of a CDM project, certification by a Designated Operational Entity (DOE), such as Germanischer Lloyd Certification (GLC), is required. Within the voluntary market, the Verified Carbon Standard (VCS) as well as the WCD and the Gold Standard have also been established with the aim of ensuring quality and transparency on a global scale. These standards all have in common that their goal is not just to reduce the global emissions of CO_2 but also to encourage developing countries to engage in sustainable growth, and to transfer technology and know-how to regions that are able to profit from this in future. □ **AMO**

CDM. The Clean Development Mechanism allows industrialised countries to buy emission credits or to set up emission reduction projects in developing countries.

GL GROUP EXPERT:
Markus Weber
Global Head of Greenhouse Gas Services
Phone: +49 36149-9051
E-Mail: markus.weber@gl-group.com

▻ the international trading of emission certificates, it stimulates investments in emission reduction projects and in projects for enhancing efficiency.

All this in turn promotes the use of efficient technologies – which clearly makes a valuable contribution towards climate protection. However, it is close to impossible to quantify the significance and effect of these measures.

To put it in more concrete terms: for the companies in the EU that are affected by the greenhouse gas emission regulations, the price to be paid for releasing emissions has in the meantime become a factor in their investment decisions. Then again, the trading of certificates is by no means the only way of approaching the climate change issue. We also need programmes for the targeted incentivisation of renewable energy sources and the efficient utilisation of resources.

ENERGIZE: How do you view the future of emission certificate trading?

WEBER: At the climate conference in Durban, the parties to the UNFCCC agreed to a number of deadlines. From 2015 onward, a new climate protection agreement is to be drafted. Whether this will also include a global trading system which is then supported and im-

SMART APPROACH. **The Pacific Islands region faces increasing environmental and socio-economic pressures, sharpened by global climate change. New Caledonia is located in a hurricane hotspot; the wind turbines used in the project are specifically designed for this type of climate. They can be tilted down within a few hours in the event of an extreme weather alert.**

Wind Farm in New Caledonia

timated yearly production of 40 GWh. To facilitate the installation and maintenance, these systems are lightweight, easily transportable and can be assembled and disassembled by two people without any use of large machinery. The wind turbines can withstand Category 5 hurricanes.

"The project in New Caledonia has resulted in the creation of 20 new permanent positions and 30 part-time jobs. The staff are trained by the plant manufacturer, which is not the usual arrangement. This is a very encouraging example of how not only a technology transfer but also a knowledge transfer can take place," says Markus Weber, Global Head of GL's Greenhouse Gas Services.

The project was verified by GLC in accordance with the Gold Standard and is saving 32,000 tonnes of CO_2 a year. "It was a great pleasure for us to receive the final documents almost two weeks before the agreed deadline. This does not happen so often in this market. We really appreciate the professional attitude of GLC," said Patrick Bürgi, CTO and Regional Director Thailand of South Pole Carbon Asset Management Ltd.

plemented by the USA, India and China remains open. If such a system were to come into being, this would greatly stimulate the mandatory market. If no agreement is reached, the number of CDM projects is expected to linger at the current level or, more probably, even shrink.

The fact that China, Taiwan, Japan and Australia are planning or have even already introduced an ETS which includes the CDM is something I regard as a strong indication that this mechanism is being prolonged and possibly even extended.

The Interview was first published in Swiss National Bank's ecoreport.

Profile: Markus Weber

Markus Weber was born in Germany in 1966, and studied geography and landscape ecology in Münster. From 1994 to mid-2007, he worked for various German and international environmental consultancy firms.

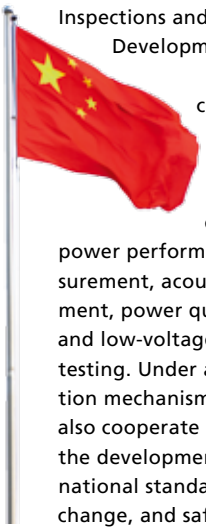
In August 2007, Markus Weber joined GL to develop the Greenhouse Gas Services. In addition to the conduction of assessments his current responsibilities cover the coordination of all operational aspects. He is also involved in the development of new services such as Carbon Footprint.

Photos: Dreamstime/Grafiker37/Zentilia, South Pole Carbon

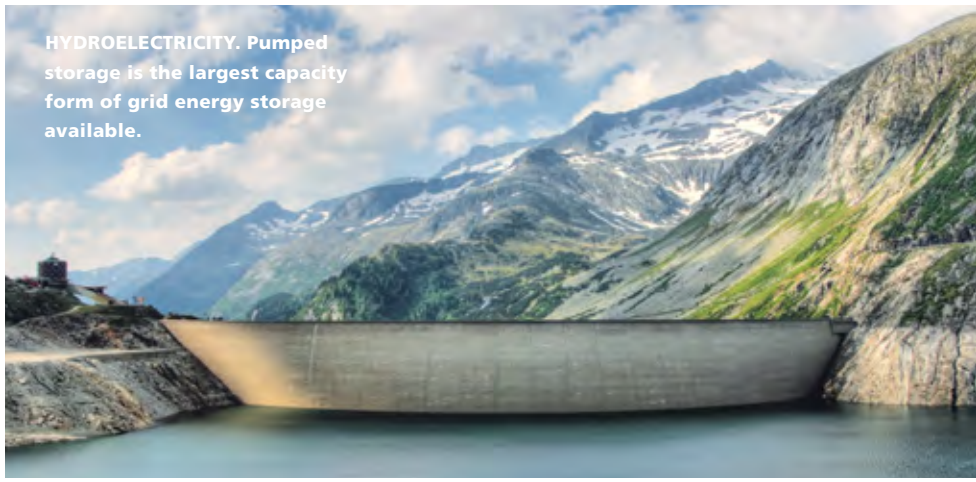
projects in brief

CEPRI RED Bolstering China's Wind Industry

china The Renewable Energy Department of the China Electric Power Research Institute (CEPRI RED) and GL Garrad Hassan have signed a memorandum of understanding (MOU) on cooperation in wind turbine prototype measurements, Wind Turbine Inspections and Technical Guideline Development.



Both companies will cooperate to offer prototype tests for wind turbines. This involves a number of evaluations, including power performance tests, load measurement, acoustic noise measurement, power quality measurement, and low-voltage-ride-through (LVRT) testing. Under a strategic cooperation mechanism, both parties will also cooperate on such activities as the development of industry and national standards, information exchange, and safety-related training.



HYDROELECTRICITY. Pumped storage is the largest capacity form of grid energy storage available.

EASE Supporting the Energy Roadmap 2050

brussels The European Association for Storage of Energy (EASE) in Brussels is the voice of the energy storage community and promotes energy storage globally. The organisation supports the Energy Roadmap 2050. This entails objectives for a cleaner future underlining the EU energy policy to ensure a smooth transition to a low-carbon energy system.

GL Garrad Hassan has been appointed a member of the organisation. Their target is to actively support energy storage of renewables to improve the flexibility and delivery services to energy systems in compliance with the European energy and climate policy. EASE ultimately aims to support a sustainable, flexible and stable energy system in Europe.

GLC Improving Internal Processes

hamburg The certification of management systems is increasingly in demand in renewable energy industries. Players are looking for continuous improvement of their internal processes and management systems to demonstrate reliability and professionalism. GLC offers certification services for a wide range of integrated management systems.

ISO 9001: This quality management system is used to develop and implement quality standards on the basis of customer needs. Company processes are orientated and optimised around quality objectives.

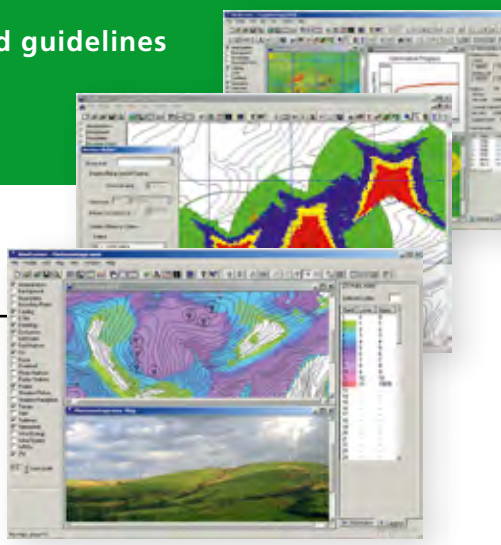
OHSAS 18001: This occupational health and safety management system helps to minimise working risks and to prevent accidents and downtimes. It increases awareness about safety and ensures compliance with legal requirements.

ISO 14001: This environmental management system observes all major environmental issues of a company. It leads to the efficient use of resources, ensures that numerous environmental regulations are adhered.

ISO 50001: This energy-saving management system is especially important for manufacturing companies. It examines the technical infrastructure of a company. Furthermore, energy consumption data is recorded and analysed. Optimisation activities are derived and systematically implemented.

GL GROUP EXPERT:
Daniel Wilhelm, GL Systems Certification
Phone: +49 40 36149-4463
E-Mail: daniel.wilhelm@gl-group.com

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



GL RC Streamlining the CE Marking Process under the LVD

europe CE marking is an essential part of bringing products to the European market. Manufacturers of wind turbines face a particularly difficult challenge when attempting to sort through the raft of legislation which might apply to them. The Directive for Low Voltage Equipment (LVD) (2006/95/EC) has 681 harmonised standards potentially applicable for wind turbines.

To enable manufacturers to more quickly and easily determine which of these standards they have to consider. GL Renewables Certification (GL RC) has undertaken a comprehensive survey of the standards within the LVD as they apply to wind turbines.

GL RC has identified twelve categories of electrical equipment within wind turbines which are implemented or possibly implemented in wind turbines and subject to CE marking. Based on a comprehensive assessment of the harmonised standards taking into account the electrical layout of modern turbine systems, the 681 harmonised standards have been split into three categories "White", "Black" and "Grey".

406 "Black" standards are considered to not be applicable to CE marking of wind turbines; 176 standards in the "White" category, judged to be fully applicable standards. The 99 standards in the "Grey" category will apply under some circumstances. To concentrate only on the applicable set of standards within the LVD will save manufacturers and their representatives considerable time, effort and expense in the CE marking process.

GL GROUP EXPERT:
Manuel Gemünd, GL Renewables Certification
Phone: +49 40 36149-4066
E-Mail: manuel.gemuend@gl-group.com

GL Garrad Hassan WindFarmer Update

hamburg The new version of GL Garrad Hassan's wind farm design software has been released. WindFarmer 5.0 aids the design and analysis wind farm layouts to give maximum energy yield with minimum environmental impact. WindFarmer is the industry standard software for making energy production assessments based on measured wind data.

This software tool integrates wind farm energy and environmental assessments with wind farm layout design and data handling. It is acknowledged not only for its user-friendly interface and the speed and accuracy with which it provides calculations but also for the transparency of its data models.

BDEW Need for PV Certificates

germany Before photovoltaic (PV) systems are connected to the German grid, their grid compatibility must be confirmed on the basis of the so-called Medium Voltage Guideline of the German Association of Energy and Water Industries (BDEW). PV operators have to submit a project certificate and proof of conformity to grid operators by 31 December 2012, as requested by the BDEW. The Medium Voltage guideline requires a project certificate from grid operators for grid connection of PV systems larger than one megawatt. As an independent certification body, GL Renewables Certification tests whether a PV system meets the legal requirements and issues project certificates according to the guideline of the German Renewable Energy Act (EEG), the Ordinance on System Services by Wind Energy Plants (SDL-WindV), the German Association for the Promotion of Wind Energy (FGW) TR 8, TC 2007 and BDEW.

GL GROUP EXPERT:
Dr Matthias-Klaus Schwarz
GL Renewables Certification
Phone: +49 40 36149-7187
E-Mail: matthias-klaus.schwarz@gl-group.com

PHOTOVOLTAIC. The system has to meet legal requirements.

Photos: Dreamstime/DanicekIhaquim/Xiaohuan

dates at a glance

Conferences & Fairs

OCTOBER

03. – 05.10.2012
Renewable Energy World Asia 2012
Bangkok, Thailand

Asia. The region's leading renewables event.

09. – 11.10.2012
AWEA Offshore 2012
Virginia Beach, USA

Virginia Convention Center. Premier conference in the US offshore wind industry.

14. – 17.10.2012
CanWEA 2012
Toronto, Canada

Direct Energy Centre. Discussing the Canadian wind energy industry.

17. – 19.10.2012
ICOE 2012
Dublin, Ireland

Convention Centre Dublin. Marine renewable energy in focus.

22. – 24.10.2012
WINDABA
Cape Town, South Africa

Cape Town. Full range of wind energy subjects.

30.10. – 01.11.2012
RenewableUK 2012 – Wave & Tidal Pavilion
Glasgow, UK

Conference. Wave and tidal energy in the UK.

NOVEMBER

07. – 08.11.2012
DEWEK 2012
Bremen, Germany

Bremen. Focus on multi-megawatt wind turbines

28. – 30.11.2012
WindPower India 2012
Chennai, India

India. The subcontinental's largest wind power show.

IMPRINT

energize renewables, issue no. 02/2012, September 2012 **Frequency** energize renewables is published twice a year **Published by** Germanischer Lloyd SE, Hamburg **Editorial Director** Dr Olaf Mager (OM), Corporate Communications **Managing Editor** Steffi Gößling (SGG) **Authors of this issue** Simon Adams (SA), Anne Bartels (AB), Dr Ervin Bossanyi (EB), Monika Dippel (MD), Jörn Iken (JI), Anne Moschner (AMO), Jeremy Parkes (JP), Erik ter Horst (ETH) **Cover photo** Dreamstime/Ana Sousa **Design and production** printprojekt, Schulterblatt 58, 20357 Hamburg, Germany **Layout** Lohrengel Mediendesign **Translations** Eugen Klaußner, Andreas Kühner **Prepress** Lohrengel Mediendesign **Printed by** Media Cologne Kommunikationsmedien GmbH, Luxemburger Straße 96, 50354 Hürth, Germany **Reprint**

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

Subscription service: For address changes and orders please send an e-mail to publications@gl-group.com

MIX Paper from responsible sources FSC® C006038

Photos: DF08, Finlay McWalter, Magnus Manske.

GL Garrad Hassan

TRAINING COURSES – DATES 2012

Wind Farm Design and Intro to WindFarmer
26 – 27 Sept. Madrid, Spain
17 – 18 Oct. Helsinki, Finland
18 – 19 Oct. Toronto, Canada
25 – 26 Oct. Johannesburg, SA

Introduction to Wind Turbine Technology
6 – 7 Nov. Bristol, UK

Offshore Wind Energy
24 Oct. Hamburg, Germany
22 Nov. Bristol, UK

Verifying and Optimising Wind Power Performance
27 Sept. Hamburg, Germany

Wind Farm Construction and Operations Procurement
29 Nov. London, UK

For more information on these courses, see:
www.gl-garradhassan.com/en/Training.php

GL Group

Head Office

Brooktorkai 18
20457 Hamburg
Germany

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

www.gl-group.com

GL Garrad Hassan

Region North America

45 Main Street
Suite 302
Peterborough, NH 03458
USA

Phone: +1 603 924 8800
Fax: +1 603 924 8805
E-Mail: info.usa@
gl-garradhassan.com

Region CEMEA

Marie-Curie-Straße 1
26129 Oldenburg
Germany

Phone: +49 441 36116880
Fax: +49 441 36116889
E-Mail: info@
gl-garradhassan.com

Region UKIIS

St Vincent's Works
Silverthorne Lane
Bristol BS2 0QD
UK

Phone: +44 117 972 9900
Fax: +44 117 972 9901
E-Mail: info@
gl-garradhassan.com

Region Asia/Pacific

Room 1818–1839
Shanghai Central Plaza 381,
Huaihai Middle Road
Shanghai 200020
People's Republic of China

Phone: +91 80 30 91 1000
E-Mail: mste@gl-group.com

Region Iberica and Latin America

C/ San Clemente, nº 20
1ª Planta
50001 Zaragoza
Spain

Phone: +34 976 43 51 55
Fax: +34 976 28 01 17
E-Mail: info@
gl-garradhassan.com

GL Renewables Certification

Brooktorkai 18
20457 Hamburg
Germany

Phone: +49 40 36149-0
Fax: +49 40 36149-1720
E-Mail: glrenewables@
gl-group.com

0E712 2012-09