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# WINDBLATT

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**Cover photo:** Installation of E-126 at Rysumer Nacken, Emden.

# Dear Readers,

This summer the German government finally adopted a comprehensive package of climate protection measures. The key measure in the electricity sector is a review of the Renewable Energy Act (EEG). The Federal government's field report on the Renewable Energy Act submitted on 5 July provided a good basis for discussions. The report suggested taking the degression rate for wind energy down from 2 to an annual one percent. Although this is a step in the right direction, it is still not enough to bear the increase in costs for raw materials such as copper, steel, electroplates, nickel and chemical products such as paints and resins needed for wind turbine production. Since the last Renewable Energy Act amendment in 2004, steel prices on the international commodities market have risen by 50 percent and in the same period the price of copper has tripled. At least a portion of these costs has to be passed on to our customers. The wind industry is in desperate need of a temporary suspension of the degression to prevent the development of wind energy in Germany from being paralysed.

A second topic being considered is the introduction of a technology bonus: This would be extremely wise as it would reward wind turbine owners who choose sophisticated systems for their wind farms. Such an arrangement would not only guarantee Germany a long term security of energy supply, but would also be a further incentive to promote more efficient and flexible renewable power supply systems. An appropriate bonus would support efforts made by innovative companies, who – like ENERCON – actively contribute to further technological developments in the wind energy sector. One of the more recent examples is the new FACTS (Flexible AC Transmission System) feature of ENERCON wind farm power electronics: This feature provides for immediate reactive power supply without the intervention of additional sources (capacitors, inductors), as well as the capacity to ride through grid failures. ENERCON wind farms are thus able to contribute to power supply security even in weak grid sectors.

Another growing factor contributing to the expansion of wind energy is the development of forest areas. Many of the best wind sites in the southern part of Germany are often situated in forest areas along the ridges of low mountain ranges. An advantage of these sites is that they are off the beaten track – often so far away from the nearest housing construction that only hikers notice the wind turbines. At the same time, wind energy is opening up more financial opportunities for forest owners: In January this year, vast forest areas in Germany were devastated by hurricane Kyrill. Revenue from wind energy could provide the necessary funds to devise new concepts for restoring and managing forested landscapes.

Yours sincerely

Aloys Wobben
Managing Director ENERCON GmbH

## First ENERCON production facility inaugurated in Viana do Castelo

Picture: Paulo Duarte/Jornal de Negócios

*Portuguese Prime Minister José Sócrates (centre) with ENERCON managing directors Aloys Wobben (l.) and Klaus Peters.*

"This is an important day for our country; a decisive moment", said Portuguese Prime Minister José Sócrates at the inauguration on November 16th of the ENERCON rotor blade production plant, the first of five ENERCON manufacturing facilities in Viana do Castelo, a port city in Northern Portugal. "From today on, Portugal has an industrial core with the capacity to produce and export state-of-the-art wind energy technology", said Sócrates.

Minister for the Economy Manuel Pinho emphasised the harmonious and trustful relationship between the Government, local authorities, ENERCON, and the other consortium members Energias de Portugal (EDP) as well as the companies Generg, Finerge and Térmica Potuguesa. Without it, the first development stage of this industrial complex could not have been realised so quickly. "Our country can be proud of this project", said Pinho.

In 2006, ENERCON won the bid in a Portuguese Government tender for the installation of 1200 MW of wind energy primarily in the north of the country. As a precondition for winning the contract, the company had to set up in-country manufacturing facilities.

The Portuguese subsidiary ENEOP 3 ("ENERCON Eolicas de Portugal") comprises two sites: Near the harbour of Viana, a 100,000 sqm area houses tower and rotor blade production. 17 km away in Lanhesis, the ENEOP 3 mechatronics building is being erected that will accommodate generator and E-module production and nacelle assembly. This site will also house the administration for ENEOP 3 and the Service department.

On the day of the inauguration, Prime Minister Sócrates, Minister Pinho, and the mayor of Viana do Castelo, Defensor Moura, together with ENERCON Managing Director Aloys Wobben and Mechanic Anlagenbau GmbH Managing Director Klaus Peters, first visited the Lanheses site to see the progress of construction there and to lay a cornerstone. In the plant near the harbour of Viana do Castelo, 250 guests including local and national politicians, supplier representatives, and members of the consortium attended the official inauguration of the rotor blade production facility and witnessed the laying of the cornerstone for tower production. On a walk through the rotor blade facility, Aloys Wobben explained the manufacturing process to the Prime Minister.

There are currently 108 staff employed in rotor blade manufacturing. This figure is expected to rise to 450 by the end of March 2008.

## Andalusia: ENECON repowering older wind farms near Tarifa

Picture: Scanu Martin, Sevilla

*View on Pesur I (Tarifa) and Strait of Gibraltar*

Work to tear down 250 of the 100-150 kW category turbines in the Planta Eólica del Sur (Pesur I) and Energía Eólica del Estrecho (EEE) wind farms near Tarifa is in progress since the end of November. These outdated, 15-year old AWP 56-100, MADE AE-20 and 23 Ecotecnica 20/150 turbines are being replaced by 37 more powerful E-70 plants during the next two years. Rated power will thus rise from the current 30.6 MW to a total of 74 MW.

Sites near the Strait of Gibraltar in Andalusia are some of the windiest in Europe. Here, average wind speeds range between 10 to 11 m/s at hub height. Designed for IEC Wind Class I, the E-70 turbines will be installed on 64 metre steel towers and the forecasted yield of the two farms put together is expected to surpass 250,000 MWh p.a.

Because the Strait of Gibraltar is a crucial stop over for migrating birds, comprehensive reports on how changes in the farm could affect bird life had to be carried out before permission was granted. Several independent surveys, however, convinced the regional nature conservation agency that the new farms with fewer but taller and more powerful turbines would have far less impact on bird migration than their predecessors. Newer wind turbines rotate at a considerably slower speed and are much quieter than the old models. Bird life should scarcely be affected.

"We'll be building in three stages starting in spring 2008", reports ENERCON project manager, Christian Oberbeck. "First of all Pesur I will be installed in two stages and then the EEE wind farm will be completed." Construction is scheduled to be finished by summer 2009. Contractor is the Sociedad Eólica de Andalucía in Tarifa, a subsidiary of Endesa.

This is the first ever repowering project in Spain. Potential for repowering in Andalusia, Galicia and on the Canary Islands is considerable as there is still large number of older wind turbines dating back to the 250-kW generation. Spanish power feed laws now stipulate that wind farms erected before 2001need to be updated. For every MWh of electricity produced from repowered wind turbines, owners will receive an extra premium of 7 euros.

## Costa Rica: First ENERCON wind farm in Central America

Between 2008 and 2009 ENERCON will be installing a total of 55 WECs in Costa Rica. These E-44/900 kW wind turbines will be the first ENERCON wind energy converters installed in Central America. An agreement with the project planers was signed in August. Included in the group are the farm developers, juwi GmbH (Mainz, Germany), Saret in Costa Rica – one of

Central America's largest construction firms, as well as Econergy.

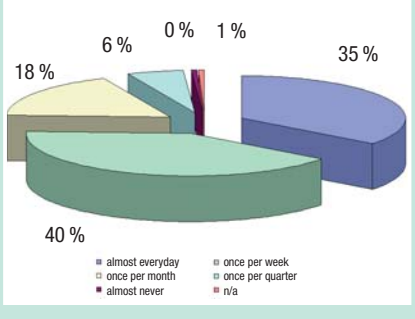
Owner/operators of this project will be Proyecto Eólico Guanacaste S.A. whose main shareholder is the renewable independent power producer, Econergy International PLC (Boulder, Colorado). With a rated power of just under 50 MW and average winds speeds of approx. 12 m/s at hub height, yield is expected to reach 240 GWh p.a. Compared to a coal power plant "La Gloria" will be able to cut annual $CO_2$ emissions by 240,000 tons.

The turbines are sited in the Northwest of Costa Rica near the city of Liberia at an altitude of 600 to 700 metres. ENERCON and the owners also concluded an 11 year EPK agreement. Costa Rica will have its own special maintenance and service company. "We're certain that there will soon be more wind farms to take care of", says ENERCON's sales director Stefan Lütkemeyer.

## ENERCON a competent and reliable partner for suppliers

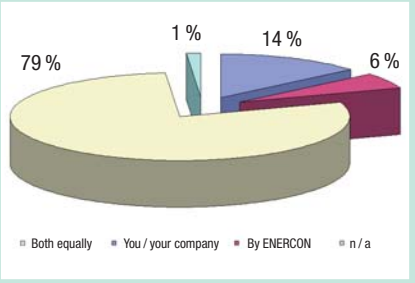
ENERCON plans to continue its growth over the coming years. Successful partnerships with suppliers are a crucial prerequisite for achieving this goal. "The satisfaction of both business partners is the foundation of any successful business relationship", says ENERCON Managing Director Hans-Dieter Kettwig. That is why it was so important for ENERCON to find out how its suppliers were viewing the business relationship.

An online survey conducted earlier this year showed that both domestic and foreign suppliers were very satisfied with the relationship with ENERCON, giving it an overall rating of 1.6 on a scale from 1 ("very satisfied") to 6 ("dissatisfied"). The openness of communication with ENERCON staff and the exchange of information on a partnership relationship basis received particularly good ratings (1.6 and 1.5, respectively).




*Contact frequency.*

ENERCON is viewed as a reliable partner: ENERCON's reliability and follow-through received a 1.6 rating. E-mail and telephone availability were perceived as very satisfactory or satisfactory (1.5 and 1.9). Survey participants praised ENERCON's friendliness (1.5), hospitality during visits (1.4), reliability (1.7), availability of dedicated points of contact (1.6) and professional competence of staff (1.5).




*Contact initiation.*

Most suppliers have a very active relationship with ENERCON: 35 % of survey participants reported that they were in contact with ENERCON almost every day. Another 40 % communicated at least once a week. In this area as well, many answers underlined the partnership relationship on an equal footing. 79 % of participants said that contact was initiated by both sides equally.

But the survey also revealed some weak points and areas where ENERCON needs to consider its supplier relationships. These issues have been analysed and discussed within ENERCON and the results are taken into account for the continued development of supplier business relationships. "We achieved an excellent feedback rate", says ENERCON's Maike Günther who was in charge of conducting the survey. "Many suppliers called to tell us they thought it was great that we asked suppliers their opinion for a change, not just customers." The feedback rate was 80 %, and Günther analysed more than 400 completed questionnaires.

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Prototype of E-126

# World's most powerful wind turbine installed near Emden

*Operation of ENERCON's first E-126/6 MW took off in November this year. Currently the world's most powerful wind turbine, the E-126 is a sophisticated version of the E112/6 MW. A larger swept area, the new ENERCON blade design and a higher tower are intended to greatly enhance performance. To facilitate truck transport to inland sites, the enormous blades are now divided into two sections. And the E-126 produces more electricity than the consumption of 5000 households.*

In November, ENERCON launched operations of its very first E-126/6 MW wind turbine on the Rysumer Nacken in Emden, Lower Saxony. This new addition to ENERCON's product range is a sophisticated version of the E-112 (also with 6 MW rated power since 2005) – the world's most powerful wind turbine to date. To enhance performance, the rotor diameter has been increased to 127 m – 13 m larger than the rotor diameter of the E-112. Not only has the rotor diameter been increased, but the hub height has also been taken up another eleven metres to reach a towering 135 m. In addition to these modifications, the E-126 now features the new ENERCON rotor blade profile with the extended trailing edge designed to boost output now also in the multi-megawatt category. "We've significantly increased the performance of our largest turbine", says Rolf Rohden, Head of the New Technologies department at Wobben Research & Development in Aurich. Compared to the E-112, yield is expected to rise at least another 35 %. On the Rysumer Nacken, the E-126 should produce approx. 20 million kWh p.a. – enough to supply 5000 four person households with clean energy.

*Mounting steel segment of third rotor blade.*

Despite the huge dimensions of the new wind turbine, it is easier to transport than its predecessor. One of the decisive advantages is that the rotor blade is made up of two components, a shorter steel section and a longer GRP section, which can be transported separately. While transportation for the E-112 involved organising complicated road blocks, long stretches with police escorts and special preparation of routes, in particular enlarging curves by laying out steel plates, sawing off branches, delivery of an E-126 is similar to the E-82 series. "Despite their size, we can still transport all E-126 components on trucks measuring a maximum of 4.40 m in width", reports René Wolf from ENERCON Logistics Dept., in charge of the transports to the Emden site.

20 years after the GROWIAN ("**GR**oße **WI**ndkraft **AN**lage" – *big wind turbine*) had to be disassembled following a series of technical problems, the E-126 is the first large wind turbine to again use metallic material for a significant part of its rotor blade design. The GROWIAN had a metallic support structure covered by GRP in order to give the aerodynamic shape. However, in the 1980s the step to a 3 MW wind turbine was too early and inevitably the project failed. Nowaday much more knowledge and experience as well as sophisticated design tools are available to support the R&D engineers and to allow for unconventional designs.

Another première is the fact that ENERCON installed a wind turbine of these dimensions on a precast concrete tower. The E-112 was either mounted on in-situ concrete towers or steel towers. The E-126 tower in Emden is an overwhelming 131 m high and consists of 35 concrete sections manufactured by WEC Turmbau Emden GmbH situated on the South Quai in Emden. Due to the 14.5 m

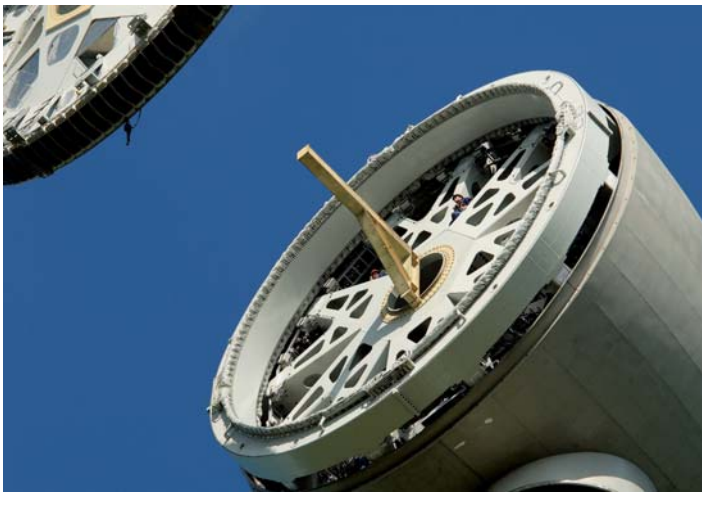
Picture: W. Fricke

*Crane lying on ground on Rysumer Nacken: In upright position, it measures a towering 180 meters and can lift up to 1200 tonnes.*

diameter at the tower's base, the first eight segments are divided into three parts for transport purposes. 22 of the segments are half-divided, and the other five are in one piece. The top segment supporting the nacelle is made of steel. The tower walls are up to 45 cm thick, a new record for ENERCON. And a total of 110 m³ of concrete were used to build the tower. Since the ground along the silty banks of the Ems River is quite soft, a total of 64 fifty-six-centimetre thick piles measuring an average of 25 m had to be rammed into the ground to support the foundation. Another 1500 m³ concrete and 180 t of reinforcing steel were used in the foundation.

The hood on the new nacelle is now made of aluminium instead of the usual GRP. This significantly reduces fire loads. Aluminium also has better cooling properties and is completely recyclable. Metal components are easier to fit which simplifies assembly and saves installation time. Since the Emden site is quite exposed to the wind, it was too risky to hoist the rotor hub completely assembled with blades. Too much surface would have been open to the wind and, for instance, made inserting the bolts quite difficult. So the erection team opted to lift two pre-assembled blades in the horizontal position to mount them on the blade adapters. For the third blade, the steel section was lifted vertically first and mounted. After that the rotor was turned anti-clockwise and then the GRP section hoisted horizontally into position. "We've had good experience with this technique. However, the rotor is normally supposed to be hoisted as one unit", says Jörg Zimmermann, the co-ordinator of the ENERCON installation teams in Aurich.

ENERCON will soon be installing a second E-126 directly next to the first one on the Rysumer Nacken. Both turbines are part of a research and development project in which ENERCON will be testing various storage systems in combination with the multi-megawatt wind turbines. More E-126 are planned to follow: One turbine is to be erected at the DEWI-OCC test site in Cuxhaven this fall. In 2008, five other turbines are scheduled to be installed – in Georgsfeld near Aurich, in Hamburg Altenwerder and in Estiennes in Belgium.



*Moving rotor into place in stator.*

138 metres tower

# High performance turbines towering above treetops

*Germany's low mountain ranges are full of excellent wind sites. Still, most of these remain undeveloped. This is because the windy mountain ranges are generally wooded and in many regions, forests are off limits to wind project planers. But wooded areas are excellent sites for developing wind energy. Conservationists, wind farm owners, forest owners and forest offices are convinced of this – the example being Hilchenbach in the Rothaargebirge. To boost the performance of the five E-82 turbines located there, ENERCON developed a 138 metre precast concrete tower – the tallest to date!*

The first five prototypes of the new 138 metre tower are currently being installed near Hilchenbach in Siegerland on one of the western foothills of the Rothaargebirge. Construction of the E-82/2 MW turbines was initiated by Günther Pulte (farmer, planner and owner of wind farms) and his partner Franz-Josef Ochs. The turbines are scheduled to take up operation at the end of the year at approximately 600 metres above sea level. The average wind speed in the middle of the forest where the community wind farm is located is 6.39 metres per second.

## Avid support from region

Eighty-eight partners joined Pulte in founding the wind farm association – Rothaarwind GmbH & Co KG. Shares in the wind farm range from 3000 euros all the way up to 600,000 euros. "The majority of the company shares are in the five to ten thousand euro range", says Pulte. He is proud of the company's makeup. Two thirds of the shareholders are from the districts of Olpe and Siegen. Twenty-seven shareholders alone are from the community near the site: farmers, craftsmen, businessmen, forest rangers, forest owners, employees, housewives. Not all partners live in the community, though. Some live elsewhere but still have roots in the region. For centuries, the forests in the Sieger- and Sauerland regions have been cultivated for timber. Most of these are owned and farmed by local residents, explains Pulte. Shares in forest cooperatives have been passed on for generations and still belong to the same families. Because of this, Pulte advertised amongst the members of these cooperatives and found interested parties living in Düsseldorf or Hamburg.

Picture: Achim Asbrand

*Günter Pulte (2nd from right) with the directors of two timber co-ops which lease the site.*

## Forests are ideal locations for wind farms

The Hilchenbach wind farm is the result of six years of intensive planning. Until the year 2000, North Rhine Westphalia had a wind power decree in place which ruled out building wind farms in forest areas. However at that time, Pulte and several other regional wind energy planners were able to convince North Rhine Westphalia's former Minister of the Environment, Bärbel Höhn, of the absurdity of these limitations. "Forests at higher regions are often just monoculture woods. What makes these so worth protecting? Sixty-five percent of the district of Siegen is made up of wooded areas. As far as ecology and landscape are concerned, undeveloped spaces are more important than coniferous woodland. Open spaces are more vulnerable and have to be protected", Pulte argues. Convinced by this argument, Ms Höhn amended the decree. Thus in 2001, the way was paved for the wind tur-

Picture: G. Pulte

*Hilchenbach: Tower construction with a 600 ton crawler crane.*

bine "Ewiger Fuhrmann" in Kreuztal-Littfeld which set the example for planning the Hilchenbach wind farm.

"The decisive factor for successful planning was that I not only approached the authorities but also got the local political representatives and residents to jump on the bandwagon", reports Pulte. The wind farm in Hilchenbach even gained the support of the local FDP. With the FDP votes, Hilchenbach's community council decided to chip in on the community wind farm. Pulte: "Despite limited funds, the council still wanted to at least show token support."

## Impetus for 138 metre tower

Before the project took off there was a minor downside. For a while, there were discussions about routing the extension of the A4 motorway across the ridges of the "Lümke" and "Drei Buchen" mountains, exactly where the wind turbines where supposed to be installed. Furthermore, the neighbouring community on the other side of the ridge was starting to have its doubts. So, the site for the turbines had to be moved further down the slope, slightly below the crest. Since, taking the planned hub height into consideration, the mean speed was lower here than on the crest, Pulte put forward the idea of building a taller tower. Instead of the originally planned E-70 machines with 113 metre towers, the E-82 turbines on 138 metre towers are now expected to compensate for the lower amount of wind.

## Sloped site a challenge

The terrain at the Hilchenbach site is rather steep. "To transport the tower and other bulky components to the site, we have to tackle several steep slopes, some up which have an incline of up to 20 %", reports Andreas Giesler, ENERCON project manager. "Not only are the slopes a challenge, but outside of the levelled crane platforms and installation areas, there are no proper storage areas." Installation at Hilchenbach was quite a task for the teams to master. "It takes between four and five days just to shift the 600 tonne crawler crane (total height 150 metres) within the grounds. Another particularity is that the rotor will not be hoisted as one unit, but each blade will have to be mounted individually."

ENERCON has been able to demonstrate that although installing wind energy in forested regions is a challenge, it is not only feasible but also profitable and environmentally friendly. When the new North Rhine-Westphalia (NRW) state government came into power in 2005, they promptly amended the decree and again declared wooded areas as out of bounds for wind developments. In relation to the number of inhabitants, the share of wooded areas in NRW amounts to just about as much as in Berlin argued Eckhard Uhlenberg, Minister of the Environment. Forests are a vital commodity and preserving large contiguous forest tracts, especially in respect of nature and landscape conservation, is essential. As a result, sites in NRW forests remain barred to wind energy. According to the NRW government, a project such as Hilchenbach would have no chance of being approved today.

## Wind power decree conflicts with communal planning authority

Pulte was fortunate that he had already obtained the building permit for Hilchenbach before the change of government. However, he regrets the fact that the immense potential for wind energy in the wooded areas around his home town, Kirchundem, remains untapped.

"The wind power decree encroaches on the communities' planning authority", he feels. He hopes that one of the communities will eventually dare to challenge the decree against wind power in forested areas. Pulte: "I've discussed this with expert attorneys and former employees from the Office of the Environment. Experts argue that the decree encroaches on communal planning authority and that if it came to litigation, the case on the side of the decree would be rather shaky."

Pulte does not feel that installing a community wind farm on the territory of a timber co-op could harm untouched nature but rather sees it as a continuation of preserving the ancient traditions of sustainable forestry operations. "Together, the inhabitants work the land as a means of subsistence." He also points out that in order to compensate for the ecological effects, extensive measures are being taken to create buffer zones, amongst other things by creating five hectares of mixed birch forest. And a third of the cleared areas are also being restored and replanted.

### 3 x E-33 Wind Diesel System

# Wind reduces fuel consumption on Falklands

*On the Falkland Islands, a wind diesel system has been installed that secures the power supply for the Eastern island. The wind energy is generated by three E-33 wind turbines that have been in operation since October. They are located in Sand Bay, 10 km west of the island capital of Stanley; diesel generators located there supply the remaining power. A control system, installed by ENERCON, integrates wind power and diesel equipment and thus minimises fuel consumption. The current system configuration allows the generators to save on average 20 % of fuel, compared to previous consumption.*

*Two out of three E-33 in Sand Bay.*

"In the past, we have worked on individual research and development systems, for instance in Utsira, Norway. But this is the first time ENERCON has implemented central components of its wind diesel technology in a commercial project", says Rolf Rohden, head of New Technologies at Wobben Research & Development (WRD) in Aurich, Germany.

ENERCON combined three E-33/330 kW wind turbines with the existing diesel generators to create a power supply system for the island. A fibre optic cable was installed between the wind park site and the power plant in Stanley to enable the transfer of wind park data within the SCADA monitoring system. "All system components are controlled from a central operating unit in the Stanley power plant", explains Saurav Baidya, developer of the power management system software. It continuously calculates the optimal balance between the diesel generators and the wind energy converters (WEC). "Our target parameters are secure grid operation and minimum fuel consumption", explains Baidya.

## Wind – an infinite energy source on the Falkands

Staff in the Stanley power plant switch on the diesel generators or disconnect them from the grid, according to the stipulated parameters. "The control unit provides staff with full control over all components in the wind diesel system", Baidya emphasises.

The new wind farm is located in Sand Bay, an uninhabited area at the mountain foothills. "With an average wind speed of 10.7 m/s, Sand Bay is an ideal location for a wind farm", says Glenn Ross, Power Station Manager in the Falklands Public Works Department. The Department started taking wind measurements as early as the 1970s. Their goal was to identify sites with particularly strong winds. The Island Government wanted to reduce their dependency on oil imports. "Most energy alternatives are pos-

*Glenn Ross (left) and Prince Edward, Earl of Wessex, talking to the ENERCON team.*

*Generator room in Stanley.*

*Glenn Ross (r.), explaining the ENERCON power management system in Stanley to Councillor Richard Cockwell, Director of Public Works Manfred Keenleyside, and Councillor Mike Summers (from left). The screens on the right display the system's control panel (see below).*

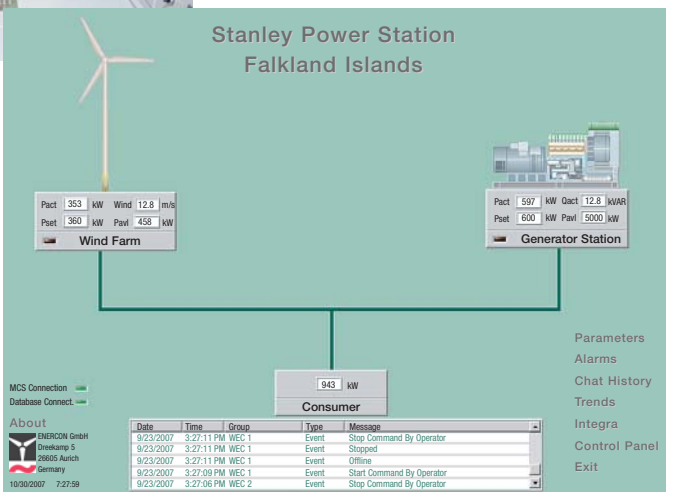
sible, but above all it is very windy here. We always knew that that was the case", explains Ross.

The first measurements in Sand Bay were carried out in 2001. The site is ideal because it is very close to Stanley, whose 2200 inhabitants consume most of the power produced on East Falkland. At the same time, wind speeds in Sand Bay are 2 m/s above the average wind speeds in Stanley. "In the past we have received several bids for the installation of wind farms using asynchronous wind turbines", says Ross. "On each occasion these were turned down as no net fuel saving appeared possible."

## E-33 ideal for small island grids

In early 2005, an ENERCON brochure resurfaced in Ross' office. "The depiction of the turbine control circuit indicated the possibility of curtailing power output at any time." Exactly what he had been looking for: "Only as much wind power would be fed into the system as would effectively displace fuel."

It has taken less than two and a half years for the E-33 turbines in Sand Bay to be up and running. Only the smallest model of the current range of ENERCON turbines could be considered for installation on the Falklands: The island infrastructure does not allow for the transport of components for larger WEC. But in addition, the setup with several small wind turbines ensures a greater system stability, as the failure of one turbine would not immediately cut off the entire wind power supply to the grid.




The successful integration of wind turbines with the existing diesel-powered system was another crucial aspect of project implementation. "ENERCON replaced the mechanical speed governors of the diesel generators with electronic devices", explains Ingo Kleen, responsible for hardware development and commissioning of the system. Faster reaction times improve grid quality, and fluctuations can be accommodated more readily. The greatest power consumer is a quarry gravel mill; when the mill takes up operation, the grid needs to shoulder an additional demand of 300 kW and the load fluctuation range increases to 80 kW. "Before starting up the mill, the quarry manager used to call up the power plant so that they'd be prepared to compensate for the fluctuation. The new control equipment takes care of this automatically", says Kleen.

The Stanley power station has eight diesel generators with rated powers ranging from 300 kW to 1.5 MW. In winter, a maximum grid capacity of 3.2 MW is required; in summer, demand drops to a minimum of 1.1 MW. To meet the demand, the generators output 15 million kWh of power annually and consume 4 million litres of diesel in the process.

## Savings amount to 20 % of fuel

Glenn Ross expects the new wind diesel system in its current configuration to save 20 % of fuel. To achieve this, the three E-33 turbines need to yield an annual output of three million kWh, a goal that has already proven itself to be realistic. Says Ross: "We gradually increased the power set-point on each turbine. During the day, we now have typically around 22 % of our demand met by the wind farm and at night 18 %."

Ross is particularly proud of the fact that the Falklands financed the project wholly independently. Over the coming months, he is going to monitor the performance of the wind diesel system and gather operating data. "In the long term, our goal is to become 100 % renewable", says Ross. In the short term, this will mean installing additional wind turbines. A possible strategy for the future could involve hydrogen production from wind energy.

According to Rolf Rohden, "ENERCON would be very pleased to further support the Falkland Islands in their effort to increase the renewables share in their power supply system". With the current configuration of the wind diesel system in Stanley, the wind energy share on East Falkland could reach 40 %. Rohden: "To go beyond this, energy storage needs to become a part of the solution. Flywheel systems and other so-called stand-alone equipment are a part of ENERCON's portfolio of storage technology offerings." The power management system installed in Stanley is already prepared for this next step.

New ENERCON wind farms in Italy

# First towers made in Bari

*For the first time in Italy, pre-cast concrete towers were used to erect ENERCON turbines in Alberona. IANUS, a concrete firm located in Bari only two hours drive from the site, was commissioned by ENERCON to supply the precast parts. In the meantime, another wind farm was installed in Liguria in combination with an educational tourist trail.*

*Construction of two concrete towers at ENERCON wind farm at Alberona (Province of Apulia).*

"Due to the huge number of projects we have going on in Italy, we decided to work together with a local concrete tower production firm", says Benedetto Gallina, Manager of ENERCON Sales in Frascati, Italy – a 20,000-inhabitant city situated only a few kilometres south east of Rome.

IANUS, a Bari-based firm, successfully won ENERCON's tender for this project. Gallina reported that IANUS is part of the SCAC Group, one of Italy's oldest and most experienced concrete component manufacturers. Their main field of activity is in bridge and tunnel construction usually commissioned by railway companies. ENERCON awarded IANUS a contract for over one hundred concrete towers.

## Factory near harbour

One of ENERCON's main criteria for choosing IANUS was its proximity to the harbour in Bari (only six kilometres away). Bari is ideally situated near the majority of ENERCON's scheduled wind farm projects in Italy. "The harbour is also ideal for exporting the towers", says Gallina.

*Foundation work for one of 13 E-82/2 MW turbines.*

The first project in Italy to utilise concrete towers is located near Alberona in Apulia. Here, ENERCON is installing a farm with 13 E-82/2 MW. At the end of August, half of the foundations were already completed and two towers under construction.

The farm was developed by Fortore Energia, one of ENERCON's largest longest standing Italian customers. Currently, Fortore owns/operates 40 ENERCON wind turbines and other projects are already in the works. Gallina: "It was crucial for ENERCON to make this move on the Italian market. When we supply concrete towers, we are also responsible for the foundations, which means that we will soon be able to offer turnkey wind farm projects."

## Stella St. Martino: Three E-48 turbines and a nature trail

The wind farm ENERCON completed this year along the Ligurian coast is especially appealing to tourists. As an added attraction to the three ENERCON E-48/800 kW machines in "Cinque Stelle", the owners, FERA SRL, have also laid out a nature trail

up to the turbines. Visitors can hike to the farm from Stella St. Martino – 10 kilometres north of Varazze along the Ligurian coast. A tour takes about an hour.

At "Cinque Stelle", the hub height of the turbines is 56 metres: The farm is expected to generate an annual yield of 6100 MWh. "Cinque Stelle" means "Five stars" indicating that two more wind turbines will soon be added to the site. "FERA purchased the land for the wind farm and the community will receive a modest yearly share of the farm's revenue", Gallina reports. These provisions entirely correlate with FERA's philosophy which strives to take into consideration all aspects of the parties involved – administrations, landowners, environment, and the public – and create a good balance.

Initial wind assessments began in 2003. But, although the project description and request ´for permit were submitted in 2004, the authorization process was unfortunately put on ice at the end of 2004. Before granting a permit the authorities argued that information concerning the possible affect the farm could have on migrant birds and bats was missing. So, in cooperation with the regional Ligurian administration and the University of Genoa, FERA launched an exemplary bird and bat monitoring programme in the region surrounding the projected wind farm. The building permit was eventually granted in 2006 and FERA was able to take up construction.

## Popular destination for tourists

Since July, tourists can also make their way up to the turbines on mountain bikes or horseback. Twelve informative signs are posted along the educational trail, 10 of these are directly situated along the access road leading to the wind farm. Two of the signs are in the centre of Stella St. Martino. They provide information about wind energy and renewables, how these influence the landscape, birds and bats, facts about sound emission, details concerning the "Cinque Stelle" wind farm, information concerning the Kyoto Protocol and global warming, guidelines for environment conscious behaviour, and information about flora, fauna and mushrooms.

*"Cinque Stelle": An educational trail leading to the wind farm explains renewable energies.*

"Thanks to the signposts, a lot of people hike up to the wind farm at the weekend", explains Gallina. The information is provided in Italian, English, German, and French. A special character was even created for children: "Eolino" simply explains how wind energy and other renewable energy systems work or what the Kyoto Protocol means. "Most visitors are Italian tourists", adds Gallina. School groups and local residents from towns and villages in the vicinity also enjoy the nature trail.

## Dedicated engineers

FERA SRL stands for *Fabbrica Energie Rinnovabili Alternative*. The firm, with offices in Milan, Albisola (Liguria), Vada (Toscana) and Noto (Sicily), was founded by a group of experienced and dedicated engineers whose objective was to develop wind farms in Italy and promote the use of renewable energy. The company has already installed wind farms in various regions around Italy, a solar power plant with 100 kW rated power in Bergigi (Liguria) as well as a hydropower plant near Milan. Their aim is to install over 100 MW rated power by the year 2010.

*Tower segment production at IANUS, Bari.*

FERA has combined the wind farm construction with a campaign for social welfare: "Each turbine supports a child", is the motto. With each turbine installed, FERA sponsors a child in the third world. The motive states, "Gaining energy from the wind never leads to the type of conflicts people go to war for." If, with every wind turbine installed, at least one child would be offered better living conditions and a good education, millions could soon overcome hardship.

SKF at Schweinfurt/Bavaria

# Bearings for millions of rotations

*Wind energy is the second largest market for roller bearings made at the SKF manufacture in Schweinfurt. Through extreme precision and innovative processes, the enterprise founded in Gothenburg in 1907 by Sven Wingquist (inventor of the roller bearing), provides its steel products with the necessary durability and flexibility. The rotor hubs in ENERCON wind energy converters rotate around the axel pin on roller bearings manufactured by SKF – year after year, with utmost reliability.*


*SKF administrative building in Schweinfurt.*

Roller bearings consist of an inner and outer ring, a number of rolling elements and a cage in which they rotate. Good roller bearings are characterised by their running precision, the smooth operating sound, as well as perfectly calibrated outer, inner, and bore diameters. Each roller bearing has to be exactly of the same size, and the air gap clearance precisely adjusted to specifications.

Before they are placed into the inner and outer rings, the roller bearings are first hardened in furnaces and then shaped with grinders. Next, a ribbon cage made of hardened steel plating is put into position. And finally, the elements are evenly distributed between the rings before the bearings are riveted together.

"At SKF, quality is top priority in all phases of production", says Walter Ragaller, spokesman for the Schweinfurt-based SKF plant. All precision machines used to turn, grind and hone rings are equipped with the appropriate test measurement systems. "Quality is achieved through systematic tests carried out between each step as well as other inspections.

The Swedish firm, SKF, is represented in more than 130 countries. In 1929, Norma, the German plant, merged with other roller bearing manufacturers to form the "Vereinigten Kugellagerfabriken" (United ball bearing manufacturers). And in 1953 the company was renamed SKF Kugellagerfabriken (SKF ball bearing manufacturers). Since then, the multinational company has evolved into a one stop provider of sophisticated moving element technology with 41,000 employees worldwide. In addition to roller bearings, SKF also offers lubrication systems, seals, mechatronics, and technical support service. Their principle customers, besides the energy sector, are heavy industry and machine and vehicle construction.

*A new metal working lathe prepairs rings for the bearings.*

ENERCON has been an SKF customer ever since it was founded. "Roller bearings play a decisive roll in ENERCON's gearless system. Quality and durability have to meet the ENERCON standard. SKF has always ensured quality on a long term basis and for large quantities", says Oliver Smidt, Purchase Manager at ENERCON Mechanic in Aurich.

The two firms have also cooperated in special developments. For all turbines larger than the E-40, SKF optimised their bearings according to ENERCON specifications. "Today we use the specially designed double row tapered roller bearings to fit the axial thrust into the rotor hub. This component just barely resembles the original SKF roller bearings", reports Ragaller. Due to a huge demand from the wind energy industry, SKF has launched a four year expansion programme for their roller bearing production. Investments have reached the multi-million Euro mark.

Miyako Island/Japan

# Rebuilding of a wind farm destroyed by a typhoon

*In November, ENERCON finished rebuilding a wind farm which was destroyed by typhoon Maemi on the Japanese Island of Miyako in September 2003. The new farm consists of four E-44 wind class I turbines, helping the regional utility Okinawa Electrical Power Company to fulfil its goals for renewable energy.*

*Karimata, Miyako Island: three out of four E-44 turbines.*

Okinawa is Japan's island prefecture. It consists of a string of coral islands 3 hours flight south west of Tokyo, with Yunaguni Island being the most western point located only 100 km from the coast of Taiwan. The islands are beautiful holiday resorts. But every summer Japan is hit by 15-25 typhoons of various strengths. Most of these pass over or affect the islands in some way. Several of the strongest typhoons in the world have hit the islands within the past decade.

For nearly ten years now, ENERCON wind turbines have been in operation on several of the islands. The installed models range from the E-26/E-30/280 kW through the E-40/500 or 600 kW, to the E-66/1.8 MW. "In November, we finished installing four E-44/900 kW on Miyako Island", reports Jørn Kristensen, ENERCON Sales Manager for East Asia. "These are the latest models of the medium size wind energy converters for IEC Wind Class I, using the new and very efficient ENERCON rotor blade design."

Because of the typhoons, wind energy is a complicated issue on the islands. The Japanese Renewable Portfolio Standard provides renewable energy quotas. Thus, Okinawa Electrical Power Company (OEPC) has an obligation to generate a certain amount of electricity from renewable resources. And for the island's geography, without possibilities to use hydro- and geothermal power, wind energy is the most obvious source. The target for wind energy is a capacity of 3 GW for all of Japan by 2010. OEPC is expected to install 50 to 60 MW. Most of the capacity will be installed on the main island. Second comes Miyako Island.

The main power supply on Miyako Island comes from two oil fuelled power plants. "There is one station with a total capacity of 21.5 MW, consisting of generators ranging from 2.5 to 5.5 MW. A second station has four 10 MW generators", says Kristensen. Thus, the total capacity on the island until November was 61.5 MW. After the installation of the ENERCON turbines the installed wind energy rose to 4 MW corresponding to 6.5 % of the total capacity. "Today, the renewable quota on Miyako is higher than in most other parts of the country."

After Maemi, a one-in-hundred-year typhoon, destroyed the entire island's wind energy converters four years ago, this new farm now consists of ENERCON turbines only. "The reason for this is that ENERCON's technology is well-suited for island grids – due to its high class grid performance", explains Kristensen. By using ENERCON Grid Data Acquisition and the SCADA system, a closed-loop control regulates phase angle/reactive power, active power, voltage and other features that help to stabilise weak island grids. Additionally, the power from the wind turbines can be regulated not to exceed electricity consumption.

In Japan, there are 50 Islands with their own grid ranging from 100 kW to more than 60 MW of installed capacity. Only 16 of these islands make limited use of wind energy. "If all the islands used ENERCON Wind Diesel/Stand Alone systems or made maximum utilisation of ENERCON grid control features, there would be significant savings in fuel consumption", states Kristensen. As experience in other parts of the world has shown, under Okinawa wind conditions at least 20 % fuel could be saved by installing wind turbines and appropriately integrating them into the grids. Kristensen: "Japan could produce much more electricity than today, without any $CO_2$."

ENERCON
ENERGY FOR THE WORLD
WINDBLATT

# Åland: ENERCON wind turbines onshore offshore

*Between Sweden and Finland lie the Åland islands, consisting of over 6,500 skerries and islands. Leovind AB chose four perimeter islands to install six E-70 turbines. In October, inauguration took place on a museum ship anchored at the capital Mariehamn. The "Båtskär" wind farm is planted on rock islands, the smallest being no larger than the size of one and a half football fields. Situated 6 km away from the main island "Fasta Åland", material and components had to be brought over to the sites on pontoons.*

Picture: Henrik Lindqvist

*With an average wind speed of 9.4 m/s (at 65 m hub height), Båtskär is an ideal site for wind energy use.*

Members of the operating association, Leovind AB, named the wind farm "Båtskär" after two of the four islands – Stora and Lilla Båtskär meaning "Big" and "Small prow". The name alone already suggests the challenge the assembly teams had to meet: How to get the building materials to the sharp craggy skerries with no jetties?

ENERCON first transported the E-70/2.3 MW turbines to Mariehamn by ship. From there, direction was taken over by Åland's Vindernegi Andelslag, an association holding 20 % shares in "Båtskär" with approximately 1350 investors. Managing director Henrik Lindqvist found an Åland shipping company with extensive experience in transport around the archipelago. They were able to ferry all the material ranging from concrete all the way to the rotor blades to the islands on pontoons. "Construction was only held up two or three times when the pontoons had to turn back due to rough seas", reports ENERCON project manager, Sven Dressler.

One of the main conditions for the construction of the turbines was that no rock was allowed to be dynamited. So in order to obtain an even surface, foundation builders had to pour a layer of concrete up to 80 cm thick on the rock. Once levelled, a special foundation requiring much less concrete was built on these surfaces. The procedure used less than a third of the usual amount of concrete needed for a gravity foundation. To balance out the foundation, 14 post-tensioned tendons were then installed and secured in the underlying rock.

ENERCON's project in Valsneset, Norway served as a model for Båtskär. However, here the foundation has been even further optimised: "Amongst other things, we replaced the cast-in-place steel ring with a bolt basket so we needed one third less concrete than in Norway", says Dressler. The advantage of rock anchoring is that when the turbine has reached the end of its lifespan, the terrain can easily be restored. Dressler: "We remove the concrete and only leave behind the holes which are filled with soil."

Finland provides no power purchase price. Investment grants of approx. 30 % are only available for projects on the Finnish mainland. "The only support we get from there is a negative energy tax of 6.9 €/MWh. That's why our turbines are only cost-effective at semi-offshore sites such as Båtskär", explains Lindqvist. Roughly 16 km of deep sea cables had to be laid. According to Lindqvist, the increased yield will compensate for the extra expenses for cable and sea transport.

Åland's grid has two connections to the mainland: a 110 kV cable to Sweden and a 45 kV cable to Finland. Including Båtskär, there are now 22 WEC on the archipelago. "We already meet a quarter of our energy demand with wind energy", says Lindqvist. "With our next project, a 20-MW farm planned for the southwest tip of the main island, we're going to lift up this share to 45 %."