Report of Site Visits to Wind Turbine Manufacturers for NSB Wind Development



Vestas V27 wind turbine, D. Vaught photo

Respectfully submitted to Hattenberg Dilley and Linnell , LLC and North Slope Borough

March 31, 2014

Douglas Vaught, P.E. dvaught@v3energy.com V3 Energy, LLC Eagle River, Alaska



This report documents visits in March, 2014 by two North Slope Borough personnel (Max Ahgeak and Richard SanJose) and a V3 Energy, LLC wind consultant (Douglas Vaught, P.E.) to three United Statesbased wind turbine manufacturers: Aeronautica Windpower, Halus Power Systems, and Northern Power Systems. These manufacturers are likely suppliers of wind turbines for pending North Slope Borough wind power projects in Kaktovik, Point Hope, Point Lay, and Wainwright. Also briefly discussed in this report are two manufacturers not visited: EWT of The Netherlands and Vergnet of France. This site visit was funded by Alaska Energy Authority, sponsored by North Slope Borough, and administered by HDL, LLC of Anchorage, Alaska through their contract with North Slope Borough for conceptual design of wind power for the village of Kaktovik.

Contents

NSB Wind Project History	2
Purpose of Visits	3
Participants and Itinerary	3
Turbine Manufacturers Visited	3
Aeronautica Windpower, LLC	4
Siva 250/50 Wind Turbine	4
Mita-Teknik	5
ABB	5
Warranty and Alaska Support	5
Site Visit, Plymouth, MA	5
Halus Power Systems	6
Vestas V27 Wind Turbine	7
ABB	7
Warranty and Alaska Support	8
Site Visit, Rio Vista, Calif	8
Northern Power Systems	8
Northern Power Systems NPS 100 Wind Turbine	9
Storage and Control	. 10
Warranty and Alaska Support	. 10
Site Visit, Barre, Vermont	. 10
Other Turbine Manufacturers (not visited)	. 11
EWT	11
Vergnet	11
Siva 250/50 Technical Description (Aeronautica Windpower)	А



Vestas V27 General Specification (Halus Power Systems)	.В
Northern Power 100 ARCTIC brochure (Northern Power Systems)	. C
Mita-Teknik brochure	.D
PowerStore renewable microgrid stabilization brochure	. E
EWT Direct Drive Wind Turbines brochure (EWT B.V.)	. F
Vergnet MP R Technical Description (Vergnet)	G

NSB Wind Project History

North Slope Borough (NSB) is the electric utility for all communities of the borough except Barrow. NSB initiated its wind power investigation efforts in 2007 with a contract to Powercorp Alaska to consider wind power options for the villages of Atqasuk, Kaktovik, Point Hope and Point Lay. This project culminated in feasibility study reports in November 2007. Subcontractors were ABR (biological resources survey), Michael Minor & Associates (noise assessment), Mistaya Engineering (wind energy and economic modeling), and V3 Energy (wind energy and economic modeling).

In 2009 NSB contracted WHPacific to install met towers and perform wind resource assessment analyses for Point Hope, Wainwright, Atqasuk, Kaktovik, and Anaktuvuk Pass. A wind resource assessment had been previously completed by the U.S. Department of Energy's Tribal Energy Program for Point Lay, and Nuiqsut is powered by natural gas and hence was excluded from the wind study. This project culminated in wind resource assessment reports for each village, including a re-evaluation of the Point Lay wind information. Subcontractors were Echelon Energy (met tower installation/removal) and V3 Energy (wind resource analysis and assessment).

In 2011 NSB contracted WHPacific to identify wind turbine sites, perform geotechnical investigations, and prepare feasibility reports for the villages of Point Hope, Point Lay and Wainwright. This project culminated in wind-diesel hybrid feasibility study reports for each of the three communities. Subcontractors were Golder Associates (geotechnical) and V3 Energy (wind-diesel system modeling and feasibility study preparation).

In 2012 NSB contracted Hattenburg Dilley and Linnell (HDL) to conduct geotechnical investigation and assess the feasibility of wind generation for the village of Kaktovik. This project culminated in a conceptual design report. A subcontractor was V3 Energy (wind-diesel system modeling and feasibility analysis).

In 2012 NSB contracted ABR to conduct a biological resources site characterization and avian field study for the proposed wind power projects Point Hope, Point Lay and Wainwright. This project culminated in a report site characterization report in 2014.

In 2013 NSB contracted WHPacific Solutions Group (WHPSG) to complete the conceptual designequivalent work in anticipation of Alaska Energy Authority's release of previously-awarded funding for wind system design for Point Hope, Point Lay, and Wainwright. A subcontractor was V3 Energy (winddiesel system modeling and report preparation).



In 2013, in an addendum to the Kaktovik contract, NSB requested HDL to arrange for Borough personnel to visit the three turbine manufacturers identified in the Kaktovik conceptual design report. This project culminated in this site visit report. A subcontractor was V3 Energy (accompanied NSB personnel on the visits and prepared this report).

Purpose of Visits

Development of wind power in the Borough villages will require a significant commitment of money and a long-term commitment with the wind turbine manufacturers given the planned 20 year life of the machines. For NSB, the choice of wind turbine for the projects is dictated not only by technical suitability and economic factors, but also by the long-term relationship that NSB will have with the manufacturer. For this reason, NSB felt that is was important to visit each prospective supplier of wind turbines personally to meet the owners and sales and technical staff, receive briefings on the turbines and the manufacturer's favored integration options, tour the factories, and visit an operational wind turbine of the manufacturer.

Participants and Itinerary

Participating in the site visit trip were Max Ahgeak, NSB Utility manager; Richard SanJose, NSB Dept. of Public Works program administrator; and Douglas Vaught, P.E., V3 Energy consulting engineer. Mark Swenson of HDL managed the contract.

The site visits were compressed within one calendar work week in order to minimize the time away from work for the participants. With this goal, the travel schedule was ambitious with the following itinerary:

- Saturday, March 1: Max and Richard flew from Barrow to Anchorage
- Sunday, March 2: Max, Richard, and Douglas flew from Anchorage to San Francisco and then traveled by automobile to San Leandro
- Monday, March 3: Visited Halus Power Systems in San Leandro, Calif.
- Tuesday, March 4: Inspected an operational Vestas V17 wind turbine in Rio Vista, Calif.
- Wednesday, March 5: Max, Richard and Douglas flew from San Francisco to Boston and then traveled by automobile to Plymouth, Massachusetts
- Thursday, March 6: Visited Aeronautica Windpower in Plymouth, Mass.; inspected a Siva 250 wind turbine in Plymouth; traveled by automobile to Montpelier, Vermont
- Friday, March 7: Visited Northern Power Systems in Barre, Vermont; inspected an NPS 100 wind turbine in Barre
- Saturday, March 8: Returned to Boston by automobile
- Sunday, March 9: Began return travel to Barrow (Max and Richard) and Anchorage (Douglas)

Turbine Manufacturers Visited

The three turbine manufacturers visited were chosen due to their inclusion in the Kaktovik conceptual design report completed in September 2013. They are Aeronautica Windpower, LLC of Plymouth, Massachusetts; Halus Power Systems of San Leandro, California; and Northern Power Systems, Inc. of Barre, Vermont. All three manufacture or re-manufacture wind turbines suitable for cold climate, village-scale (approximately 100 kW to 700 kW rated output) application in northern Alaska.



Aeronautica Windpower, LLC

Aeronautica Windpower, LLC is located at 11 Resnik Road in Plymouth, Massachusetts. Following is introductory information from Aeronautica's website (<u>http://www.aeronauticawind.com/</u>):

"Aeronautica Windpower is a sales, marketing, manufacturing, and O&M service company that builds and markets mid-scale commercial and industrial (225 to 750 Kw) wind turbines primarily for behind-themeter and net-metered applications. Aeronautica Windpower was incorporated in 2008 as a turbine refurbishment organization. In 2010, the organization acquired an exclusive license to manufacture and sell the Norwin A/S 225 and 750 kW turbines in the United States and Canada with the ability to sell globally with permission from our licensor.

We sell to both end users as well as developers and contractors in the wind energy industry. Through our network of developers, dealers and distributors, we can assist with a full range of engineering, feasibility and support services in order to provide turnkey projects where needed. If you have the land and the wind, we are able to provide some or all of the remaining supply components you need for your project."

The following Aeronautica representatives were present during the visit:

- Walt Wunder President
- Tim Stearns Chief Operating Officer
- Brian Kuhn former President of Aeronautica, now President of Associated Energy Developers
- Joshua Glynn Sales Associate
- Martin Rasmussen Senior Account Manager at Mita-Teknik, Chicago office (by telephone)

Siva 250/50 Wind Turbine

The Aeronautica wind turbine of most interest to NSB – modeled for energy production and economic feasibility in the Kaktovik, Point Hope, Point Lay, and Wainwright conceptual design reports – was the AW 225, a 225 kW stall-controlled, gearbox-type drive system, asynchronous generator wind turbine licensed from Norwin of Denmark. Unfortunately, due to a licensing issue with Norwin, Aeronautica has decided to no longer manufacture and sell the AW 225 turbine. V3 Energy and NSB were informed of this turn of events prior to the visit to Aeronautica's offices in Plymouth, but wished to meet with the Aeronautica staff anyway to learn more about the Siva 250, which will replace Norwin-designed AW 225 in Aeronautica's product line-up.

The Siva 250/50 is a 250 kW rated output, three-blade, stall-regulated, up-wind, gearbox-type turbine manufactured in India. The rotor blades are equipped with pivotable tips, acting as primary brakes, to aerodynamically slow the turbine during shutdown. The secondary brake is a disc brake system situated on the high speed shaft. Either brake can decelerate the turbine independent of the other. Both braked systems are fail-safe and automatically deploy with loss of power. The Siva 250 is available on 30, 40, 45, or 50 meter tubular towers, or a 50 meter lattice tower. A Siva 250 brochure is attached to this report.

Siva Windturbine was founded in 2005 in India as a member of the diversified Siva Group. Aeronautica's plan with Siva is to market the turbine in North America, not manufacture it under license as they had with the Norwin-based AW 225 (and still do for the larger Norwin-designed AW 750 wind turbine). Aeronautica stated that they will stock a supply of spare parts, depending on number of turbines



deployed, at or near the client's location, and also at Aeronautica's Portsmouth, New Hampshire factory (where they assemble the AW 750 turbine).

Aeronautica representatives stated that a commissioning agent would be onsite in the NSB village(s) for installation and start-up of a Siva turbine. Depending on number of turbines deployed, the length of stay and involvement of the agent could shorten as the turbine installation contractor and the Borough itself gain experience and expertise with the turbine.

At present there are no Siva 250 wind turbines in Alaska and only three are operational in the United States; all in the Northeastern states. The Siva 250 turbine presently is operational in cool climate environments, but there are no arctic or severe cold climate installations. Aeronautica stated that with acquisition of North American distribution rights for the Siva 250 turbine, they will design a cold climate package that will include heaters, insulation, special lubricants, etc.

Mita-Teknik

Discussed at length during the visit to Plymouth was Aeronautica's relationship with Mita-Teknik, an automation and control company founded in 1969 in Denmark and presently with offices in Denmark, Ukraine, China, and the United States. Aeronautica would work with Mita-Teknik to provide a turbine control package suitable for use of the Siva 250 turbine in the NSB. Beyond the turbine itself, according to Brian Kuhn, Mita-Teknik can provide control solutions for secondary (thermal) loads, which could include not only a centralized secondary load controller/boiler, but also decentralized secondary load nodes in individual households to augment hydronic heating systems with excess wind energy produced by wind turbines. A Mita-Teknik brochure is attached to this report.

ABB

Also discussed was Aeronautica's relationship with ABB, the Switzerland-based robotics, power, and automation technology giant. Of interest to NSB, ABB acquired the Darwin, Australia-based Powercorp, Pty. several years ago. Powercorp had many years' experience with isolated grid control and integration and developed a flywheel energy storage device, marketed as the PowerStore. The PowerStore is a "magic bullet" integration feature, in the words of Powercorp's founder Alan Langworthy, which enables wind only, diesels-off operation with stable and precise power quality control. ABB microgrid and renewable energy integration division is headquartered in Spain with offices in the United States and Australia.

Warranty and Alaska Support

The standard warranty of an Aeronautica-supplied Siva 250 wind turbine is two years; extendable to five years. Support of Aeronautica-supplied wind turbines in Alaska would be accomplished by Aeronautica personnel during the warranty period. Training of client technical personnel to operate and maintain the Siva 250 turbine can be accomplished at Aeronautica's assembly facility in Portsmouth, New Hampshire.

Site Visit, Plymouth, MA

Following the visit with Aeronautica personnel at their office in Plymouth, a site visit to an operational Siva 250 wind turbine in Plymouth was arranged. Accompanying Max, Richard, and Douglas was Tim Stearns of Aeronautica. This turbine is mounted on a 50 meter field-constructed tubular tower.



Siva 250 wind turbine in Plymouth, Mass.



Halus Power Systems

Halus Power Systems is located at 2539 Grant Avenue in San Leandro, California (near Oakland). Following is introductory information from Halus' website (<u>http://www.halus.com/</u>):

"Halus Power Systems is a renewable energy products and services company. We help people produce electricity that is both environmentally sound and economical. We are North America's leading supplier of remanufactured wind turbines and have supplied projects with the largest and widest capacity range of remanufactured wind turbines available anywhere. We also design and manufacture many new wind turbine components including control systems. We stock many wind turbines from 90 kW to 500 kW at our 5 acre facility in San Leandro, California."

The following Halus Power System representatives were present during the visit:

- Louis Rigaud Owner
- John Lyons Power Systems Division Manager of Marsh Creek, LLC (Alaska representative for Halus Power Systems)
- Kenneth Fries Technical Services Manager

Halus Power Systems is the only company of the three visited that remanufactures previously-deployed wind turbines. Halus remanufactures only Vestas wind turbines from relatively low energy wind locations, although Louis Rigaud stated that he has on occasion remanufactured Micon turbines. This was presented as advantageous for NSB due to the inherent robustness and engineering integrity of Vestas turbine designs, which allows for effective remanufacturing and many more years of successful operation. For this reason, Louis Rigaud stated that he will not rebuild turbines of lesser design quality (in his opinion) such as the Windmatic, nor will he remanufacture Vestas wind turbines that had been deployed to highly energetic wind regimes such as Tehachapi Pass, California.



Halus' preferred source for all of their Vestas wind turbine models is Denmark and Germany, and these two countries are essentially the only location sources for the larger V27 and V39 turbines as the turbines are popular in the United States and still operational. Due to limited space for wind power development in Denmark and Germany, wind developers must replace smaller wind turbines in order to install large, new multi-megawatt models, hence the periodic availability of the V27 and V39.

Vestas V27 Wind Turbine

Halus remanufactures the older (or legacy) suite of Vestas wind turbines, rated from 65 kW (the V15) to 600 kW (the V44). Of most interest to NSB is the V27, a 27 meter rotor diameter, 225 kW rated output, pitch-controlled, gearbox-type drive system, asynchronous double-wound generator wind turbine originally built by Vestas A/S in Denmark. Also of possible interest to NSB is the 500 kW V39, a larger output version of the V27. The V27 has active yaw control and is available with 30, 40, and 50 meter tubular steel towers. The V27 nacelle, tower, and blades can be shipped in standard shipping containers, eliminating the expense and risk of damage with break bulk shipping.

Braking and stopping of the turbine is accomplished by full feathering of the rotor blades, which is a desirable feature of pitch-controlled wind turbines. An emergency stop activates the hydraulic disk brake, which is fitted to the high speed shaft of the gearbox. All functions of the turbine are monitored and controlled by the microprocessor-based control unit. Blade position (pitch angle) is performed by the hydraulic system, which also delivers hydraulic pressure to the brake system. Both are fail-safe in the sense that loss of hydraulic pressure results in feathering of the rotor blades and activation of the disk brake. Of interest with respect to the pitch system is the mechanical interlink of the three rotor blades contained in the hub nose cone. With this simple but ingenious design, it is not possible for the turbine blades to pitch differently from each other.

The V27 was Vestas' workhorse turbine for many years and thousands were installed worldwide. Design of the turbine pre-dates the IEC 61400-1 standards, but by present criteria the turbine can be considered Class II-A and possibly even Class I-A. The V27 is well regarded as a rugged, tough turbine with an outstanding operational history. Four V27 wind turbines are operational in Alaska: three on Saint Paul Island and one at the Air Force's Tin City Long Range Radar Site. Additionally, two V39 wind turbines are were installed by TDX Power in Sandpoint, Alaska and are operational. Because of the large numbers of Vestas turbines (legacy and new) deployed in North America, Vestas continues to maintain multiple facilities in the United States including a large manufacturing facility in Colorado and an office in Portland, Oregon. Vestas can provide technical support and spare parts for their legacy turbines (from V17 through V44) as needed. In addition, due to the large number of deployed turbines in North America and worldwide, spare parts are widely available from many suppliers.

ABB

Briefly discussed was Marsh Creek's relationship with ABB. ABB, as mentioned above, is the Switzerland-based robotics, power, and automation technology giant and supplier of the PowerStore flywheel.



Warranty and Alaska Support

The standard warranty of a Halus-remanufactured Vestas wind turbine is one year, with options to extend. Support of Halus-supplied wind turbines in Alaska would be accomplished by Marsh Creek, LLC in Anchorage and Halus Power Systems itself.

Site Visit, Rio Vista, Calif.

Following the visit with Halus personnel at their office in San Leandro, a site visit to an operational Vestas V17 (90 kW) wind turbine in a behind-the-meter connection at a recreational vehicle park in Rio Vista (California's central valley) was arranged. Accompanying Max, Richard, and Douglas was Louis Rigaud of Halus. The turbine is mounted on a 23 meter tubular steel tower and is located in an energetic wind environment along a stretch of the Sacramento River very popular with wind surfing enthusiasts.

Vestas V17 wind turbine in Rio Vista, Calif.



Northern Power Systems

Northern Power Systems is located at 29 Pitman Road in Barre, Vermont. Following is introductory information from Northern Power's website (<u>http://www.northernpower.com/</u>):

"Northern Power Systems has been delivering innovative wind energy solutions in a changing landscape for over 34 years. Our partnerships with the Department of Energy and the National Renewable Energy Laboratory (NREL) have helped lay the foundation for Northern Power's advanced wind turbine technology. From Alaska to Malaysia, our installed base of wind turbines has logged millions of kilowatthours of production to date, demonstrating our commitment to performance and reliability.

Our advanced Permanent Magnet Direct Drive technology is opening a new market for wind power solutions beyond the traditional large wind farm applications that have dominated the recent wave of wind turbine development. Today businesses, municipalities, schools and universities, commercial farms, and other mid-sized power users can harness wind power for their own facilities – without having to become experts in wind power generation. Our NPS 100 and NPS 60 wind turbines are designed to be



low maintenance and community friendly – making it perfectly suited to bring power that is clean and renewable and lower in cost to mainstream applications across the country."

The following Northern Power Systems representatives were present during the visit:

- Craig Giles Vice President, Global Services and Operations
- Trevor Atkinson BD & Sales Manager, Applications Engineer
- Alan Axworthy Applications Engineer
- Chris McKay Product Director
- Stan Brinkerhoff Global Fleet Services Manager
- Kiran Kumar Team Head, Software & Controls
- Lynda Engler Marketing Communications Specialist
- Jeff Petter Principal Engineer
- David Bullis Project Manager
- Thomas Hirschfeld Director, Quality Assurance

Northern Power Systems (NPS) has a long history of providing wind turbines in Alaska, with 39 turbines (both A and B models) operational in fourteen communities and two new turbines on order for a community that will have wind power for the first time. The first NPS turbine was installed in Kotzebue, Alaska in 2000, and the latest NPS turbine was erected recently in Bethel, Alaska. Alaska Village Electric Cooperative is Northern Power's largest Alaska customer with thirty NPS 100 wind turbines in operation. AVEC's first installed Northern Power wind turbine was 2004 in Kasigluk and the most recent was 2010 in Shaktoolik.

Northern Power Systems NPS 100 Wind Turbine

At 100 kilowatts of rated power, the Northern Power 100 (previously known as the Northwind 100) is an innovative wind turbine with gearless direct drive design, permanent magnet generator, best-in-class reliability, and pleasing aesthetics. The turbine is marketed in two versions: the NPS 100 for temperature climates and the NPS 100 Arctic for cold climates such as Alaska. Differences between the two include heaters and insulation for the Arctic version, plus certification that metal used in the tower and nacelle frame are appropriate for operation to -40° C (-40° F).

Basic NPS 100 turbine features, beyond those noted above, are a 21 meter rotor for IEC Class II wind environments and a 24 meter rotor (21 meter rotor blades with blade root extenders) for IEC Class III/s wind environments. In a suitable wind regime, the NPS 100-24 can generate 10 to 15 percent more energy per year than the NPS 100-21. Northern Power noted that new full span blades (no blade extenders) for the NPS 100-24 will be available soon that will boost energy production even further, perhaps by additional 12 percent over the present NPS 100-24 configuration. The NPS 100 turbine is normally available on 23, 30 and 37 meter tubular towers. A future option of a 48 meter lattice tower is planned.

The generator and rotor of the NPS 100 are directly coupled and rotate at the same speed. By eliminating the gearbox, Northern Power has simplified the drivetrain design by significantly reducing the number of moving parts and wear items. This gearless design results in a high reliability turbine with lower operating costs. The turbine's relatively simple design allows owners and operators to perform



their own O&M functions (with factory training), saving service calls and increasing wind plant availability and performance.

The proprietary permanent magnet generator is central to the design of the NPS 100 drivetrain. Permanent magnet generators offer high efficiency energy conversion, particularly at partial load, and require no separate field excitation system. Permanent magnet generators are lighter, more efficient, and require less assembly labor than competing designs.

The Northern Power permanent magnet generator was designed in conjunction with its power converter to create an optimized solution tailored for high energy capture and low operating costs. The NPS 100-21 generator is passively cooled directly by the wind with no requirement for auxiliary fans or air transfer through the generator. The new NPS 100-24 configuration uses active fan cooling to ensure full system output during the warmer summer months, and/or during extended periods of high energy production.

A key element of Northern Power's direct drive wind turbine design is the power converter used to connect the permanent magnet generator output to the local power system. Northern Power designs and manufactures power converters for its wind turbines in-house, with complete hardware, control design, and software capabilities.

In 2006, the American Wind Energy Association (AWEA) awarded its annual Technical Achievement Award to Northern Power's Chief Engineer, Jeff Petter. It recognized his expertise and leadership in the development of Northern Power Systems' FlexPhase[™] power converter for mega-watt scale wind turbine applications. The FlexPhase power converter combines a unique, patent-pending circuit design with a high bandwidth control system to provide unique generator management, power quality, and grid support features. The FlexPhase converter platform offers a modular approach with a very small footprint and 20-year design life.

Storage and Control

Storage and integration options were discussed, including batteries, flywheel and compressed air. Northern Power is technology-neutral regarding energy storage but noted that battery systems with a few hundred kilowatt-hours of discharge capacity, combined with static inverters or flywheel systems, can yield 10 to 15 minutes of power bridging energy, enough time to start and bring online a diesel generator. This configuration enables diesels-off capability similar to the PowerStore approach.

Warranty and Alaska Support

The standard warranty of a Northern Power NPS 100 wind turbine is two years parts and labor with an optional 3 year extension for parts coverage. Responding to market demand, NPS is exploring longer warranty options. Long-term service contracts are possible and adapted to customer needs. Support of NPS 100 wind turbines in Alaska would be accomplished by Northern Power Systems personnel, or NPS-trained partners. Training of client technical personnel to operate and maintain the NPS 100 turbine can be accomplished at Northern's assembly facility in Barre, Vermont.

Site Visit, Barre, Vermont

During the visit with Northern Power System's personnel at their office and factory in Barre, a site visit to an operational NPS 100 wind turbine at Rock of Ages quarry in Barre was arranged. Accompanying



Max, Richard, and Douglas were Trevor Atkinson and Thomas Hirschfeld of Northern. This turbine is mounted on a 37 meter tubular tower.





Other Turbine Manufacturers (not visited)

Although the factories and/or offices were not visited, two other wind turbines are potentially suitable for NSB villages: the 900 kW DirectWind DW 52/54-900 manufactured by EWT Holdings N.V. in Amersfoort, The Netherlands; and the 275 kW GEV MP C and GEV MP R manufactured by Vergnet in Ormes, France.

EWT

Five DW 52-900 wind turbines are presently operational in Alaska: one in Delta Junction, two in Kotzebue and two in Nome. The DW 52/54-900 is a direct-drive turbine with a synchronous generator and inverter-conditioned power output. Design-wise, this is very similar to the NPS 100 wind turbine, although EWT's DW turbine is pitch-regulated, and much higher energy output. More information regarding the EWT DW 52/54-900 wind turbine is attached and available on EWT's website: http://www.ewtdirectwind.com/.

Vergnet

Vergnet (pronounced VER-NAY) has a long history of wind turbine manufacturing and installation in isolated (islanded, or non-utility) grid applications worldwide, but is new to the Alaska market. Vergnet was a sponsor of the recent Wind Integration Workshop in Fairbanks and is actively designing cold climate capability into their 275 kW turbine. The Vergnet GEV MP has an innovative tilt-up capability, designed for use in hurricane-prone locations, which negates the need for a crane. More information regarding the Vergnet GEV MP wind turbine is attached and available on Vergnet's website: http://www.vergnet.com/en/accueil.php.



Siva 250/50 Technical Description (Aeronautica Windpower)





Technical Description

DESIGN

The Siva 250/50 is a windturbine with a rotor diameter of 30 m and a nominal power of 250 kW. The rotor is a three-bladed, horizontal-axisdesign and is mounted up-wind. It is yawed actively. Its compact layout and price-performance ratio make it particularly attractive for international projects. All technical data of this document, if not mentioned especially, are valid for the 50 Hz and 60 Hz machine as well as for the different climate versions. All SIVA wind turbines are manufactured according to ISO 9001 quality standards. For all main components SIVA co-operates with several qualified suppliers.

ROTOR

The Siva 250/50 is a stall-regulated turbine. The rotor blades are made of high-quality glass fibre-reinforced plastic (GRP). The blade tips are pivotable by 75 degree relative to the blade and act as aerodynamic brakes in this position.

MAIN SHAFT

The main shaft is forged from high-quality heat-treatable steel and it is supported by two solid self-aligning roller bearings. The supports of the main shaft bearing and gearbox are made of spheroidal graphite cast iron, which is optimal with respect to structural strength and absorption of vibrations and at the same time reduces the overall noise emission of the wind turbine.

GEARBOX

The gearbox is a three-stage design. The helical design of all stages, reduces the noise emission from the gearbox. The gearbox is fitted with an external oil cooler in order to ensure optimal operation also under conditions with high ambient temperatures. The gearbox is supported by strong rubber pads fixed to the nacelle frame structure. This way a mechanical de-coupling and thus a reduction of noise emission is attained and torsional peaks are reduced.

GENERATOR

The generator is a double-winding, 4/6 pole asynchronous squirrel cage generator. In periods with low wind speeds the generator operates on the 6 pole 50kW winding and at high wind speeds it operates on the 4 pole 250 kW winding. The generator is connected to the gearbox via a flexible coupling, capable of absorbing torque fluctuations. In order to guarantee trouble-free operation at high power output the generator is cooled with environmental air by an electrical fan. The solid rubber mounting of the generator on the nacelle frame reduces machine noises from being transferred.



SIVA 250/50 installed on Tubular tower, 30m hub height.





Technical Description

BRAKING SYSTEM

The primary brake system of the SIVA 250/50 is the aerodynamic blade tip brake. The secondary brake is a disc brake situated on the high-speed shaft. Both systems are able to decelerate the wind turbine from any state in order to reach a safe status independent from each other. Both braking systems are fail-safe, i.e. braking is guaranteed even if components, systems or power supply should fail. Aerodynamic brake: The centrifugal force causes the blade tips to swivel to their braking position. Disc brake: The brake will operate automatically by its spring unit in case of a power or a system failure. For a normal braking the blade tips are rotated to their braking position by reduction of the hydraulic pressure. When the rotating speed is at about 350-400 rpm the disc brake is activated and brings the wind turbine to a standstill. The braking procedure without load peaks. Only in case of an emergency braking both braking systems are activated at once.

YAW SYSTEM

The wind direction and wind speed are constantly monitored by a wind sensor system above the nacelle. When the wind direction is different from the direction of the wind turbine, the wind turbine is yawed actively. The yaw system is based on a ball-bearing type yaw ring between the tower and nacelle. The active yawing is effected by two electrical drives connecting to the gearing of the yaw ring by pinions. Magnetic brakes are integrated into the drives. The yaw system is additionally fitted with a disc callipers.

TOWER AND FOUNDATION

The SIVA 250/50 wind turbine is erected on a tubular tower for 30m,40m,45m,50m and Lattice tower for 50m hub height. The ladder and safety rope, resting and working landings are located inside the tower. The foundation of the SIVA 250/50 depends on the ground conditions at the intended site.

CONTROLLER

The controller of the SIVA 250/50, together with switchgear and safety facilities, is located in the switchboard in the bottom part of the tower. On a control screen placed at the switchboard all operational data can be monitored and checked. Also a number of functions, such as starting, stopping and yawing, can be controlled. In addition, the SIVA 250/50 is equipped with a remote monitoring system that only requires a telephone connection (GSM or ISDN). The controller records all the operational parameters and environmental conditions (temperatures of the components, hydraulic pressure, network connection, energy production, etc., wind velocity and direction, environmental temperature. The necessary parameters for operation are calculated from this values by the controller. In case of a failure, an alarm is sent via the remote monitoring system. An event log is saved that can be retrieved for fault analysis.



SIVA 250/50 installed on Lattice tower, 50m hub height.





SIVA is a global supplier of wind turbines. Siva has dealers in more than 10 countries all over the world and an international network of partners and agents, which makes SIVA a truly global player offering services worldwide. *Right to changes are reserved* Vestas V27 General Specification (Halus Power Systems)



GENERAL SPECIFICATION

VESTAS V27-225 kW, 60 Hz WINDTURBINE - (US)

with

TUBULAR/LATTICE TOWER

ITEM no.: 941130

VERSION 1.2.1. 25

VESTAS 4. Jan 1995

GENERAL SPECIFICATION VERSION 1.2.0.

TYPE: <u>VESTAS V27 - 225 kW windturbine</u>, 60 Hz with tubular/lattice tower

CONTENTS:

SPEC. NO.: DESCRIPTION OF: PAGE:

1.0	WINDTURBINE DESCRIPTION	4
2.0.	SPECIFICATIONS:	
2.1.	ROTOR	5
2.2.	BLADES	5
2.3.	TUBULAR/LATTICE TOWER	5
2.4.	WEIGHTS and HEIGHTS	5
2.5.	OPERATIONAL DATA	6
2.6.	POWER CURVE	6
2.7.	YEARLY OUTPUT	6
3.0.	COMPONENTS OF THE WINDTU	RBINE:
3.1.	BLADES	7
3.2.	BLADEBEARING	7
3.3.	BLADE CONSOLE	7
3.4.	MAIN SHAFT	7
3.5.	BEARING HOUSING	7
3.6.	MAIN BEARING	7
3.7.	MACHINEFOUNDATION	7
3.8.	YAWING SYSTEM	8
3.8.1.	YAWING GEAR	8

0
8
9
9
9
10
10
10

VESTAS 17. Jan 1994

3.16.	WIND VANE	10
3.17.	CONTROL UNIT	10
3.18.	MEASURING DEVICE	11
4.0.	INSTALLATION:	
4.1.	TERRAIN	12
4.2.	CLIMATIC CONDITIONS	12
4.3.	GRID CONNECTION	12

VESTAS 17. Jan 1994

1.0. WINDTURBINE DESCRIPTION.

The VESTAS V27 is a pitchregulated upwind windturbine with active yaw and a high speed rotor with three blades.

The blades are made of glassfibre reinforced polyester each consisting of two bladeshells, glued on a supporting beam. By special glued in threadrods the blades are fastened to a 4 points bearing, which again is bolted on to the blade console.

Through an independently supported main shaft, the power is transmitted to the generator through a two stage gearbox. The generator is changeable between 8 poles as "generator 1" and 6 poles as "generator 2". The generator is asynchronous and is directly connected to the grid. The rotor has two different speeds depending on which number of poles, there are connected. This is done to achieve a maximum performance both at low and high wind speeds.

From the gearbox to the generator the power is transmitted through a transmission shaft with a build in friction clutch.

Braking of the turbine is done by full feathering. Emergency stop activates the hydraulic disc brake, which is fitted to the high speed shaft of the gearbox.

All functions of the turbine are monitored and controlled by a microprocessor based control unit, and variations in the bladeposition are performed by a hydraulic system, which also delivers pressure to the brake system.

Yawing is done by two yawing motors, which meshes with a big toothed wheel mounted on the top of the tower. The system is a slide system with built-in friction.

The turbine nacelle is fully closed in a glassfibre reinforced nacellecover. There is access through a central opening independent of the orientation of the nacelle in relation to the tower.

The tower is delivered matallized and painted white. It is with an internal ladder. Normally the tower is delivered in one or two sections.

The lattice tower is delivered galvanized.

VESTAS 17. Jan 1994

2.0. SPECIFICATIONS

2.1. <u>ROTOR:</u>

Diameter: Swept area: Rotational speed, generator 1: Rotational speed, generator 2: Rotational direction: Orientation: Number of blades: Aerodynamic brakes:

2.2. <u>BLADES:</u>

Air foil:	NACA 63.214-63.235	
Length:	13 m	
Width:	1,3m/0,5 m	
Twist:	13°	
Weight:	600 kg/pcs.	

27 m

573 m²

43 RPM

33 RPM

Upwind

3

Clockwise

Full feathering

2.3. <u>TUBULAR TOWER</u>

Height:	30 m
Diameter Top:	1,4 m
Diameter Bottom:	2,4 m

LATTICE TOWER:

Height: 30 m

2.4. WEIGHTS and HEIGHTS:

Tubular Tower (excl. foundationsbolts):	12.000 kg
Lattice Tower (excl. foundationsbolts):	9.000 kg

Turbine:	7.900 kg
Rotor:	2.900 kg
TOTAL:	<u>19.800 kg</u>
Hub height:	31,5 m
Free height:	18,0 m
Highest point:	45,0 m

VESTAS 17. Jan 1994

2.5. OPERATIONAL DATA:

Cut-in wind speed:	8 mph
Rated wind speed (225 kW):	31 mph
Cut-off wind speed:	56 mph
Survival wind speed:	129 mph

2.6. <u>POWER CURVE:</u> (air density 1.225 kg/m³, 10% turbulence)

WINDSPEED mph	OUTPUT kW	
8.0	1.5	· · · · · · · · · · · · · · · · · · ·
9.0	4.7	
10.0	9.4	
11.0	15.0	
12.0	22.0	
13.0	29.0	
14.0	36.0	
15.0	45.0	
16.0	57.0	
17.0	70.0	
18.0	84.0	
19.0	98.0	
20.0	113.0	
21.0	127.0	
22.0	140.0	
23.0	157.0	
24.0	172.0	
25.0	187.0	
26.0	198.0	
27.0	206.0	
28.0	212.0	
29.0	217.0	
30.0	222.0	
31> 56	225.0 kW	

2.7. <u>YEARLY OUTPUT:</u> (Acc. to Beldringe Site, Denmark)

Roughness class 0:	808.000 kWh
Roughness class 1:	517.000 kWh
Roughness class 2:	415.000 kWh
Roughness class 3:	275.000 kWh

VESTAS 17. Jan 1994

3.0. COMPONENTS OF THE WINDTURBINE

- 3.1. <u>BLADES:</u>
- 3.1. Manufacturer: Material: Principle:

Bolts connection:

3.2. **BLADEBEARING:**

Manufacturer: Type:

3.3. BLADE CONSOLE:

Manufacturer: Type: Material:

3.4. MAIN SHAFT:

Manufacturer: Material: Type: Shaft/console connection:

3.5. **BEARING HOUSING:**

Manufacturer: Type: Material:

3.6. MAIN BEARINGS:

Manufacturer: Type: VESTAS GRP Supporting beam with glued on shells Threadrods

Rothe Erde or corresponding 4 points bearing

VESTAS Casted SG-iron,GGG403,DIN1693

VESTAS CrNiMo₆ Forged with flange Bolts 10.9

VESTAS Welded tubular construction. Steel 37.2, DIN 17100

SKF or corresponding Spherical roller bearing

3.7. MACHINEFOUNDATION:

Manufacturer: Type: Material: VESTAS Tubular construction Steel 44.2, DIN 17100

VESTAS 17. Jan 1994

3.8. <u>YAWING SYSTEM:</u>

Manufacturer: Type:

3.8.1. YAWING GEAR, 2 UNITS:

Type: Rated torque: Manufacturer:

3.8.2. YAWING MOTORS:

Type: Rotational speed: Rated power:

3.9. <u>TOWER:</u>

Type: Height: Manufacturer: Surface treatment: Weight:

Paintsystem, Outside: Sandblasting: Metallizing: Epoxy paint: Polyurethane paint:

Paintsystem, Inside: Sandblasting: Zinxiferous first coat: Epoxy paint: VESTAS Slideblocksystem with build in friction

Planetary- and reductiongear 2 x 5500 Nm Bonfiglioli/Transmittal or corresponding

Induction/Asynchronous 1140 RPM 0,66 kW

Tubular 30 m VESTAS/Roug Metallized + Paint 12.000 kg

SA3 (DS2019) DSI/ISO 2063 Zn80 Min. 120 μ m (2 coats) UV resistant min. 40 μ m (1 coat)

SA2.5 (DS2019) Min. 50 μm (1 coat) Min. 100 μm (1 coat)

Type: Height: Manufacturer: Surface treatment: Weight: Lattice 30 m Carl C. Jensen, DK Galvanized 9.000 kg

VESTAS 17. Jan 1994

	Nominal power:	433 kW
	Ratio:	1:27.6
	Туре:	Two stage, parallel shafts
	Oilquantity:	70 1
	Slowspeed shaft:	Hollow shaft
	Manufacturer:	Hansen, Flender or correspon- ding
3.11.	COUPLINGS:	
	Main shaft, gearbox:	
	Туре:	Conical shrink disc
	Gearbox, generator:	
	Туре:	Transmission shaft with friction clutch
3.12.	GENERATOR:	
	Туре:	Doublewinding, asynchronous
	Manufacturer:	Siemens, AEG, ABB or cor- responding
	Rated power:	225 kW
	Voltage:	480 VAC
	Rated current:	335 A
	Frequency:	60 Hz
	Class of insolation:	F
	Rotational speed (225 kW):	1209 RPM
	Consumed reactive power:	163 kVAr at 1/1 load

Rated power: Voltage: Rated current:

Frequency: Class of insolation: Rotational speed (50 kW): Consumed reactive power: 60 Hz F 906 RPM 48 kVAr at 1/1 load

50 kW

85 A

480 VAC

VESTAS 17. Jan 1994

3.13. BRAKE UNIT:

Туре:	
Diameter:	
Calipers:	
Manufacturer,	Calipers:
Disc material:	

3.14 HYDRAULIC UNIT:

Pump capacity: Max. pressure: Brake pressure: Pressure switches: Oil quantity:

3.15 ANEMOMETER:

Type: Manufacturer:

3.16. **WINDVANE**:

Type: Manufacturer:

3.17. CONTROL UNIT:

Heavy current:

Voltage: Max. power: Lockable circuit breaker: Power supply for light: Generator cut in: Power factor correction: Disc brake 600 mm 2 hydraulic activated Brembo SG-iron, GGG50,DIN 1693

4,5 l/min. 100 bar 25 bar Piezoelectrical 30 l

Optoelectrical VESTAS

Optoelectrical VESTAS

3x480 V, 60 Hz 400 A 360 A/(320-400 A) 1x10 A By thyristors 2 stages : 112,5/37,5 kVAr

Computer:

CPU: Programming language: Build up: Operation:

Showing:

2 x 8086 Modula-2 Module builded up Numeric keyboard + functionkeys Display 4x40 characters

VESTAS 4. Jan 1995

Supervision/Control:

Yawing Hydraulic Surroundings (Wind-Temp.) Rotation Generator Pitch system

Grid Phasecompensation Thyristors

Operation data Production Operation Log Alarm Log

Operation/Pause Man. Yaw start/stop Maintenance routine Possibility of connection of serial communication

43.800 hours

Can be supplied for build together with the control unit.

Productionsmeasuring or Sale/Purchase measure.

Bottom processor:

Supervision/Control:

Operator panel:

Information:

Commands:

Remote supervision:

MTBF for Computer:

3.18 MEASURING DEVICE:

Measuring type:

VESTAS 17. Jan 1994

4.0. **INSTALLATION:**

4.1. <u>TERRAIN:</u>

If the terrain within a 100 m radius of the turbine has a slope of more than 10° or 18%, there must be taken particularly considerations.

4.2. <u>CLIMATIC CONDITIONS:</u>

The turbine is designed for an ambient temperature range from -20° C to $+40^{\circ}$ C. Outside this range special precautions must be taken.

In regard to wind the turbine is designed in accordance with Danish conditions (roughness class 0, 1, 2 and 3).

The windturbine is designed for a mean air density of 1.225 kg m^3 . Operational data and the power curve are given at this air density. If the mean air density differs from this value the data as well as the power curve will be changed.

4.3. <u>GRID CONNECTION:</u>

Intermittent or rapid fluctuations of utility grid frequencies may cause serious damage to the wind turbine. Steady variations within $\pm 1/-3$ Hz are acceptable. The voltage may have a variation of $\pm 10\%$ as the highest.

The short circuit power must in most cases be at least 10 times the rated power of the generator in order to fulfill this requirement.

Grid drop out must only take place 1 time per week in the lifetime of the turbine.

A groundconnection of max. 10 Ω must be present.

In the case of small independent grids it is necessary to check the actual conditions.

Furthermore please see the electrical installation instruction for VESTAS V27.

In consequence of our current continuing development and updating of our products, we reserve the right to change in the specifications.

VESTAS 17. Jan 1994

Northern Power 100 ARCTIC brochure (Northern Power Systems)



Northern Power® 100 ARCTIC Community Scale Wind Turbine for Cold Climates



Not all turbines operate well in extreme environments. The **Northern Power** 100 Arctic is designed for them.



Superior by design-Proven through experience

Northern Power Systems knows extreme environments. Our early HR3 turbine model has survived 198 mph winds and -60° C temperatures in Antarctica and still continues to operate. We have shipped more than 20 turbines into Alaska and have produced over 3.8 million kilowatt hours to date. Based on over 30 years of proven wind experience, the Northern Power team has created an arctic turbine model that is truly best in class for cold and icy environments.

The Northern Power 100 (NPS 100) Arctic turbine shares a number of the advanced design elements that make Northern Power's standard NPS 100 the ideal turbine choice in mainstream markets. Additional features and design enhancements in this specialized model ensure optimum performance for your wind project no matter the frigid conditions—so that you can achieve your renewable energy goals whether you are located in the tundra or the Alps.

Military Bases • Universities • Corporations • Hotels & Resorts • Libraries



Direct. To Cold Climates Everywhere.

Wind power has been in use around the world for decades. Even so, the mainstream technology used in most wind turbines today is not always the best fit for specialized environments. Arctic conditions where temperatures reach below -20° C (-4° F) and ice buildup is common, can negatively impact wind turbine operations. Demanding environments require specialized solutions and that is why Northern Power Systems has designed the state-of-the-art Northern Power 100 Arctic turbine.

Public Schools • Small Businesses • Greenhouses • Municipal Buildings



Our Design

The right technology: Permanent Magnet Direct Drive (PMDD)

Northern Power's PMDD technology is designed for superior performance in all environments, but it also forms the basis of our superior performance in Arctic conditions.

- >> Low maintenance: Our PMDD technology and simple design architecture are why the NPS 100 Arctic requires only minimal preventative maintenance—once per year. In this way you can set your maintenance schedule to avoid particularly harsh seasons. Additionally, the gearless technology bypasses much of the long-term maintenance issues that are associated with the more conventionally designed gearbox turbines.
- >> Better energy capture: All turbines can make more power in cold environments, but Northern Power has developed an advanced design and control system that takes advantage of the high air densities associated with very cold temperatures.

The Right Options

Aside from the obvious benefits of choosing a turbine that has been optimized to operate specifically for your cold weather region, we also offer remote monitoring and wind diesel options.

- SmartView Products: Our web based monitoring and reporting platform supports a range of options—from reporting, supervisory controls, and turbine monitoring from your PC to remote diagnostics services from Northern Power Systems—to ensure optimum turbine performance and avoiding unnecessary service calls.
- >> Wind Diesel: Our state-of-the-art turbine combined with our advanced control systems and years of expertise allow for the seamless integration into your diesel grid, enabling utilities to save fuel, cut emissions, and reduce diesel maintenance.

Island Communities • Ski Resorts • Auto Dealerships • Rural Utilities • Farms



Your Solution

Customized blades for icy conditions

Like most other turbines, the Northern Power 100 Arctic has a safety feature that automatically shuts the turbine off when too much ice has built up on the

blades. But each moment that turbines are not operating translates to lost power and money. To maximize uptime in cold and icy environments, our blades come with a specially formulated **hydro phobic polymer coating** ensuring a **smooth surface** so ice cannot easily build up on the blades. If ice does form, our **black blades** absorb the sun's heat and allow for ice to be shed easily.

Advanced turbine design for arctic conditions: Ensuring reliability and accessibility

- >> Blades: Fiberglass reinforced and unique aerodynamic design
- >> Materials: Low temperature castings ensure safe operation of the turbine to -40° C
- >> Heating: Power converter and controls cabinet are heated to maximize operation, expanding possible operating temperatures
- >> **Controls:** Air density compensation enables maximum energy capture in cold environments
- >> Tubular Tower & Enclosed Heated Nacelle: Maintenance and service personnel are protected from uncomfortable and often dangerous conditions

Manufacturing Facilities • Remote Villages • Hospitals • Sports Facilities

Annual Energy Production: 21-Meter Rotor

Standard Air Density, Rayleigh Wind Speed Distribution



Specifications

Model	Northern Power 100 ARCTIC
Design Class	Class S (air density 1.34 kg/m³, average annual wind below 8.3 m/s, 50-yr peak gust below 56 m/s)
Design Life	20 years
Hub Height	37 m (121 ft)
Rotor Diameter	21 m (69 ft)
Rated Electrical Power	100 kW, 3 Phase, 480 VAC, 60 Hz
Cut-In Wind Speed	3.5 m/s (7.8 mph)
Gearbox Type	No gearbox (direct drive)
Generator Type	Permanent magnet, passively cooled
Apparent Noise Level	55 dBA at 30 meters (98 ft)

For more information, see the Northern Power 100 ARCTIC Specifications Sheet.

All specifications subject to change without notice.



Northern Power Systems has over 30 years of experience in developing advanced, innovative wind turbines. The company's next generation wind turbine technology is based on a vastly simplified architecture that utilizes a unique combination of permanent magnet generators and direct-drive design. This revolutionary new approach delivers higher energy capture, eliminates drive-train noise, and significantly reduces maintenance and downtime costs. Northern Power Systems is a fully integrated company that designs, manufactures, and sells wind turbines into the global marketplace.

29 Pitman Road Barre, VT 05641 USA

222 Third Street, Suite 3300 Cambridge, MA 02141 USA

1375 South 25th Street Saginaw, MI 48601 USA Thurgauerstrasse 40 8050 Zurich, Switzerland

© 2011 Northern Power Systems. All Rights Reserved. Northern Power and NPS are registered trademarks of Northern Power Systems.

Printed in the USA with soy based inks on recycled paper containing post consumer fiber. Printed by Phoenix Press, proud owner of a Northern Power 100 wind turbine.

Mita-Teknik brochure


We Make Wind Competitive



Contents

We Make Wind Competitive

We Make Wind Competitive Experience at Work Think Quality

Complete Solutions

Your Solution Turbine Control WP100 Platform Turbine Control WP4100 Platform Turbine Control WP4200 Platform Turbine Load & Control Optimization Wind Park Control Condition Monitoring (CMS) Electrical Pitch (MDS) Electrical Pitch (MDS) Gateway SCADA System MiScout Web SCADA System Communication Network Grid Connection Power Panels Mita-Teknik Accessories

Control Components

WP4100 WP4200 WP130 WP-Line 111 WP-Line 151 WP-Line 351 WP-Line 4xx WP-Line 511 WP4052 Touch Display ER1000 Router and ES1000 Switch

Take Control

Take Control Programming Options PEPTOOL Development Tool CoDeSys Development Tool

Customer Partnering

Customer Partnering Training at Mita



13-14 15-16 17-18 19-20 21-22 23-26 27-30 31-34 35-36 37-38 39-42 43-44 45-46 47-48 51 52 53 54 55 56 57 58 59 60 63-64 65-66 67-68 69-70

5-6 7-8

9-10

73-74 75-76

We Make Wind Competitive

The future of the wind industry depends on making wind competitive and that is why we made it our mission.





"We want to be the preferred partner in the wind industry and we constantly work at optimizing the way *We Make Wind Competitive*."

Jesper Andersen, CEO

We Make Wind Competitive

Making Wind Competitive

'We Make Wind Competitive' is a promise to our customers and to the wind industry. Our focus is to develop solutions and services that combined, will help us solve some of the challeges we face in the wind industry.

We aim to:

- > Reduce the overall cost of energy
- > Secure our customers a positive return on investment
- Reduce the capital and operational expenditures (Capex and Opex)

We effectively bring down the cost of energy by providing the wind industry with cost-efficient solutions that offer quick and easy installation, the shortest possible learning curve, and stand out when it comes to performance and reliability. We reduce both your Capex and Opex, and ensure that you in a short time will be able to see a return on your investment.

We minimize your development time and bring down your time-to-market by supplying the customized solutions you are looking for. Whatever your challenge – we are confident that we can provide a solution.

At Mita-Teknik there is never just one answer. We can combine and customize our products to fit your specific needs and our extensive know-how and experience ensures the reliability and performance you need.

ne left: Jesper Andersen, CEO and Thomas Andersen, CTO.

As preferred One-Stop-Shop to the wind industry we provide services in all stages of your project, from design to commissioning and optimizing.

All products are produced in accordance to ISO9001:2008 and are rigorously tested with automated testing systems, guaranteeing unsurpassed quality and reliability.

Add to that all of our solutions offer scalable and flexible open platforms, made for easy integration with utility companies and third party hardware/software – securing your position when negotiating with sub-suppliers in the market, making you more competitive.





As the wind industry - we adapt and evolve, and we continuously strive to be at the absolute forefront of control automation in order to meet the market's demands - present and future.

Jesper Andersen, CEO

Experience at Work

Global Trendsetter

Mita-Teknik has been in the business of control automation since 1969. Our track record is continuously proven, as more than 45,000 wind turbines equipped with our control systems, daily deliver optimal performance and unsurpassed reliability.

Our engagement in wind energy started in the 1980s when the Danish Wind Industry started exporting to the US. Since then we have expanded with divisions in both Europe, USA and Asia, gaining global experience that enables us to deliver intelligent, customized solutions as global market leader in the industry for control automation solutions.



Four decades of experience in successfully delivering on- and offshore projects on time and within budget, Mita-Teknik knows exactly what it takes.

We continue to maximize the value of each link in the supply chain by thoroughly understanding the complexity and challenges in the wind industry, and by developing the best technology available.



Mita-Teknik



Great people and great systems yield great results. It is one of the key drivers to our success and continued development.

Think Quality

Quality is, and has always been a key factor in Mita-Teknik and *Think Quality* is one of our core values. As a proof of this dedication to quality, our Quality Management System has been certified by renowned certification body TÜV NORD according to the ISO 9001:2008 Standard.

Quality Policy

It is the Quality Policy of Mita-Teknik to continuously optimize the experience of our customers. We aim to meet our customers' expectations and requirements by building our solutions on Know-How and Experience and working with a high level of integrity.





Quality Goals

In order to live by our Quality Policy we have set ourselves three objectives that correspond to each of the three elements in the Quality Policy. Each objective is measured on a monthly basis and current status is shown on the front page of our internal Quality Management System, Q|Net. **Optimize Experience** – on a regular basis we survey our customers in order to understand their most important needs and requirements better, and measure how well we are performing in meeting those needs. These surveys form an important basis for internal improvement action plans and Suggestions for Improvement from our customers.

We meet Customer Expectations & Requirements – we also measure our own Security of Supply in order to ensure that 98% of our orders are delivered on time in the right quantity and quality. And that is with one of the market's shortest lead times.

We work with Integrity – working with a high level of integrity on a global scale is of the highest importance to us. This also means continuously improving and listening to all the feedback we get – from customers and employees alike.

To ensure this, we measure number of Suggestions for Improvement processed and decided upon within 3 months of being submitted. We also monitor that all NCR's (Non Conformance Reports) are processed and acted upon, with corrective and preventive actions.

In order for us to continuously develop and improve on the way we work, all of our employees contribute to the Quality Management System as it is continuously updated with our employee's know-how, expertise and best-practices.



Complete Solutions

We cover everything from Complete Control Solutions and Systems to individual Components - all made to optimize your setup.





We believe in flexibility and we deliver everything from complete turnkey solutions to individual components - so whatever your setup needs we can provide.



Your Solution

Since 1969 our ambition has been to create the market's best and most flexible solutions, and we have worked hard for the past 40+ years to fulfill this ambition. Today our comprehensive experience and product portfolio enables us to make any solution come to life, no matter the scale and complexity.

We cover everything in terms of hardware and software and combined with our extensive Customer Partnering Services you are guaranteed the best solutions in the business.

Your Solution

We can first create the solution when we understand the challenge - that is a fact. Getting to know you, and being able to share insights means that we get a deeper understanding of your specific situation, and in the end create the best solution for you.



Our mission to Make Wind Competitive applies to everything we do, and every product and service in our portfolio is designed with the primary objective to optimize your production, improve your bottom line and make you more competitive.

Your Choice

The flexibility of our open-platform products, and their ability to blend seamlessly into any existing setup gives you the opportunity to "mix & match", and create your own individual solution. Or you can choose to go with a complete solution where we deliver everything you need - the choice is yours.





Our extensive know-how is a result of more than 30 years of experience in the wind industry and more than 45,000 installed systems.

Turbine Control WP100 Platform

WP100 Control System Platform

The WP100 Control System Platform is designed especially for control of small and medium sized wind turbines with a production capacity of up to 1.5 MW, making it the optimal control solution choice if you are looking to retrofit older turbines. It features:

- > Advanced Control
- > Onboard Grid Interface (WP130)
- Dualport Gigabit Ethernet
- Graphic HMI Interfaces
- > Onboard I/O
- > Onboard CAN/CANopen
- > Mobile App's Interface
- Backward Compatibility
- > Multiple Programming Options

The WP100 Control Unit is built with a focus on compatibility and flexibility and has various on-board I/O channels that makes it possible to use the controller as standalone (without additional I/O modules) to control systems with limited complexity. At the same time it is possible to connect up to 3 WP-Line I/O modules when more I/O channels are needed.

With the WP100, the user gets access to 2 Gigabit Ethernet interfaces with separate network functionality. The interfaces may be used in any desirable way. Additionally, there is one serial interface (RS232/RS422/RS485) and one CAN interface available, which can be used e.g. for communicating with the pitch or inverter systems.

The OS1xx Operating System API is 100% backwards compatible with the OS4x00 operating systems family – this ensures that existing applications that run on WP4x00 Platforms can be used with the WP100 Platform without any modification or recompilation when the hardware setup is compatible.

The WP130 Controller is furthermore equipped with onboard grid interface, which makes it possible to calculate main grid parameters by precise and reliable DSP algorithms according to the IEC 61400-21 standard.

- > Powerful processor
- > FAILSAFE FLASH file system
- > Gigabit Ethernet Communication
- > 1 Grid Interface (3 current and 3 voltage inputs)
- > 1 CAN Interface
- > Cost efficient
- Maintenance free no batteries or fans that needs replacing





The controller is the brain of the operation. It handles all the other components of the wind turbine or wind park and is the cornerstone of any setup.



Turbine Control WP4100 Platform

WP4100 Control System Platform

The WP4100 Control System Platform is a field-proven, competitve and very powerful control system, designed to handle on- and offshore megawatt wind turbines. It features:

- > Modular and pluggable design
- > Powerful distributed CPU
- Ready for harsh environment use
- > Maintenance free design
- > Very user-friendly
- Plug-and-play technology

The WP4100 Control System Platform comes with a realtime operation system and is capable of handling up to 10 simultaneous - independent or synchronized - application programs controlling the wind turbine, handling data collection for condition monitoring, communication protocols according to IEC norms and customer-specifications, alarm handling, run time system for standard PLC programming according to IEC61131-3.

These features place the WP4100 Control System Platform at the forefront of wind turbine automation, and makes it an obvious choice when deciding how to control your wind turbines.

The WP4100 Control System Platform is, as all of our control systems, delivered as a turnkey solution, featuring a wide selection of standard and customized operating programs created to suit your particular needs to ensure optimal and effective operation.

The controller logs all data and makes it available for onsite surveillance or by remote access through your preferred SCADA System. All relevant data and information is logged and stored for use in the daily optimization of the wind turbine or for easy call-back for historical performance review.

WP4100 users benefit from a short learning curve and a quick return on investment.

- > Several communication possibilities
- > Internal maintenance-free power CAP back-up
- > Event-based control and communication
- > Plug-and-play configuration of all WP-Line modules
- > Optional redundant configuration and function based redundancy
- Collection and storage of life-time statistics up to 30 years
- > Status-code system
- > Advanced oscilloscope logging system
- Two 230kBit/s RS232/RS485/RS422 COM-ports for UPS, GPRS-modem connection
- 10/100Mbit Ethernet port for park communication as well as backbone connection via WP-Line 111
- > PC-Compatible file system on USB optional





Total control of wind turbines in all weather conditions is vital in supplying reliable and high quality renewable energy.



Turbine Control WP4200 Platform

WP4200 Control System Platform

The WP4200 Control System Platform offers superior performance and is perfectly suited for use in all large on- and offshore megawatt wind turbines. The Control System has two primary functions:

- Ensure safe and reliable automatic operation and optimize output by regulation of yaw and pitch according to real weather conditions
- Handle all communication interfaces and make collected and stored operation data available for further analysis and optimization

The WP4200 Control System Platform benefits from the experience of more than 45,000 installed systems, and incorporates a number of enhanced features, such as:

- > Onboard Condition Monitoring System (WP4208/WP4216)
- > Onboard I/O Extension
- Backward Compatibility
- > Graphic HMI Interfaces
- Grid Quality Analyzer
- > Ethernet Port (10/100/1000 Mbit/s)
- > Possibility for Onboard Grid Measurement
- > Multiple Programming Options

These enhanced features make the WP4200 Control System Platform our most powerful and advanced control system to date. It allows us to incorporate new wind turbine optimization technologies, such as advanced load and control algorithms, which ensure that your turbines operate at their best at all times. The WP4200 Control System Platform is delivered as a turnkey solution, featuring a wide selection of standard and customized operating programs created to suit your particular needs to ensure optimal and effective operation.

The WP4200 controller logs all data and makes it available for onsite surveillance or by remote access through your preferred SCADA System. All relevant data and information is logged and stored for use in the daily optimization of the wind turbine or for easy call-back for historical performance review.

- > High-speed multi core processor (CPU & DSP)
- > Well suited for Individual Pitch Control
- > FAILSAFE FLASH file system
- > Gigabit Ethernet Communication
- > Fast floating points for running advanced algorithms
- High level of HW/SW flexibility
- > Tailor-made for wind turbines
- Maintenance free no batteries or fans that needs replacing





We strive to improve the competitiveness of our customers by contributing with essential turbine optimization know-how.



Turbine Load & Control Optimization

Turbine Load & Control Optimization

Our experts in Load- and Control Optimization engage in close dialogue and interactive process with our customers in order to take all factors and possibilities into account. Incorporating this tactic while also including the customer we find the optimal turbine level solution tailored to your specific need and market.

Our combined efforts will systematically optimize and streamline your product setup. In order to find the best possible solution, several parameters have to be taken into consideration. Technical and economic models are used to simulate the results of implementing a given solution, thus providing the best possible basis for your decision before changing a process.

Load Optimization

Wind turbines are exposed to high static- and dynamic loads during their service life. The nature of the load state depends highly on the design and layout of the wind turbine as well as the often complex site and soil conditions both on- and offshore. The ability to forecast and simulate these loads is key in any successful wind turbine development.

Our Load Optimization services include:

- > Load integrity via aero elastic calculations/analysis
- > Design load spectrums according to IEC, GL etc.
- > Stability- and system frequency analysis
- Fast prototyping
- > Safety strategy

Control Optimization

With our experience in the wind industry we know the potential challenges your equipment will face and we have most likely already developed metods for handling them. Our competent engineers and technicians are dedicated to ensure that your final product is of high innovative quality, always cost-effective, easy to incorporate and maintenance friendly.

Our Control Optimization services include:

- Load mitigation through advanced condition adaptive control
- > Power and load optimal turbine operation
- State of the art individual pitch control for blade load reduction
- Embedded coherence with aerodynamic and structural optimization
- High fidelity signal processing, state estimation, event detection and safety chain





Mita-Teknik Wind Park Control Concept enables you to control and monitor up to 2500 wind turbines as a single unit.

Wind Park Control

Today's wind turbines and wind parks grow increasingly larger as the demand for flexible controlled power in the grid increases. In order to control these wind parks and ensure that they are balanced and able to comply with the grid codes all over the world, Mita-Teknik offers an open, reliable, flexible and intelligent Wind Park Control Solution that gives our customers the edge when selling their wind turbines for wind parks.

What Do You Get?

Our Wind Park Control Solution consists of our field-proven hardware, developed for harsh on- and offshore environments, as well as multiple software packages optimized specifically to your location. All units are interconnected by an Ethernet network running the reliable M-Link protocol.

How It Works

The wind park is controlled by a Park Controller that dispatches the active and reactive power set points as ordered by the Transmission System Operator (TSO) either directly to the Wind Turbine unit or via a Cluster Controller that can be introduced in large wind parks.

A Grid Monitor is used for accurately measuring the grid, for precise control and monitoring. A Weather Monitor can be installed to supply the system with meteorological data as well.

Complete Solution or Tailor-made

We have compiled a Wind Park Control Solution that will fit most grid codes and needs concerning e.g.:

- > Park/Cluster Controller
- > Grid/Weather Monitor
- Fully tested software for controlling the individual wind park components
- > Installation and commissioning services
- > Integration services
- > Training services
- > Accessories

However, should you require solutions for special purposes we are always prepared to compile a tailor-made solution that fits your specific needs.





In a wind park in Palm Springs, 400 wind turbines are equipped with our CS System. The wind turbines have been in operation for more than 25 years and are still producing power.

TRESPASS

LOITERINA

Wind Park Control SetupTransmission System Operator (TSO) interfaces to the park via
Modbus TCP, digtial in- and outputs, analog in- and outputs.The Park Controller handles up to 50 turbines or up to 50
Cluster Controllers (which handles up to 50 turbines each).
Grid Monitor is available as a combined Park Controller and
measurement unit or as a remote substation Grid Monitor.

The Cluster Controller handles up to 50 turbines. The Grid Monitor is available as a combined Cluster Controller and measurement unit or as a remote substation Grid Monitor.

Wind Park

Control

A Weather Monitor can be added either on park or cluster level to supply the system with meteorological data.



- > Long lifespan no moving parts ensures high reliability
- Open and flexible supporting open configurable standards for control and supervision
- > Control of 2 to 2500 wind turbines in 0 to 50 clusters
- Our SCADA system enables you to control and monitor all local, regional and global wind parks from the same office





Advanced analysis of wind turbine condition data is the best way to optimize production and reduce service maintenance costs.

Condition Monitoring (CMS)

Wind turbines are remote power plants, which unlike conventional power stations, are very much exposed to highly variable, harsh weather conditions both on- and offshore. Moreover, wind turbines are unmanned and often located in remote locations; therefore, it is critical to detect and service faulty equipment in time. A broken gear tooth or a metal fatigue ridden bearing can cause irreparable damage if not fixed in time.

What Do You Get?

Our Allianz approved Condition Monitoring System consists of the remotely operated WP4086 CMS controller and our SCADA system, Gateway. With up to 8 accelerometers (WP4088 or ICP 786A) strategically placed on the drive train, our Condition Monitoring System monitors the drive train components, such as the gearbox, generator, main bearings as well as the tower.

One of the advantages of using vibration monitoring is that you are able to pinpoint exactly the defected component within e.g. the gearbox. Our WP4086 Condition Monitoring System provides visual indication of the wind turbine's current condition and can be installed as part of the wind turbine control system or as a stand-alone system.

SCADA Integration

The WP4086 Condition Monitoring System is an integrated part of the Gateway program, the Mita-Teknik SCADA system used for complete monitoring and operation of wind turbines

and wind parks. Combined with weather forecasts, the WP4086 Condition Monitoring System allows you to plan onsite maintenance visits most optimally making predictive maintenance easier than ever before.

The WP4086 system eliminates equipment run-to-failure situations and allows you to perform predictive maintenance - effectively optimizing the overall output of the turbine.

An updated predictive maintenance strategy, using state-ofthe-art sensors and tests, minimizes unplanned wind turbine outages and maximizes wind turbine energy output and revenue generation.

- > Remote access for monitoring and reporting
- > Remote configuration
- > Reduce wind turbine down-time
- > Lower maintenance costs
- > Prevent damages
- > Optimize wind turbine efficiency
- > Maximize revenue generation





Predictive maintenance strategy, using state-ofthe-art sensors and tests, minimizes unplanned wind turbine outages and maximizes wind turbine energy output and revenue generation.



Condition Monitoring (CMS)

Live Data Storage and Visualization

The WP4086 CMS is used for vibration analysis. It surveys predetermined critical vibration levels. The frequency range is 0.1-5000 Hz and the vibration range is 0.01-5000 g. When using 786A ICP accelerometer, the ranges are up to 10,000 Hz and 15 g.

The measurement of vibrations is performed by up to 8 external accelerometers. The real-time measurement of vibrations is controlled by a flexible measurement task scheduler, which can be individually configured with time and frequency domain calculations.

When the WP4086 is connected to the controller it is possible to receive wind turbine real-time data

Measure acceleration from main bearing, gearbox, shaft and generator and deliver a raw vibration signal to the WP4086.

WP4088 Accelerometers

The WP4086 controller is the key component. WP4086 generates a raw time domain signal and a frequency domain signal (Raw FFT). A pre-alarm on the FFT can be transmitted to turbine controller or SCADA system.

WP4086 CMS Controller

Loaded with Features

- > The WP4086 CMS System surveys vibrations with up to 8 external accelerometers
- > Real-time sample, calculation and storage of vibration signals, including wind turbine operation parameters
- Calculation of time domain characteristics: >
 - Broad band characteristics
 - · Vibrovelocity calculation
- > Calculation of frequency domain characteristics - FFT Amplitude Spectra
 - FFT Envelope Spectra
- Frequency selective characteristics
- > Advanced warning and alarm handling
- > Automatic storage of daily set and raw data

The Gateway and CMS Toolbox analysing system is capable of trending and databrowsing.

The Gateway software will access the WP4086 CMS controller through the internet or modem connection.

Downloaded data from the WP4086 is stored in a central database in the surveillance center. The database can be shared.







Precise control of the angle position of each rotor blade - ensuring maximum security and efficiency.



Electrical Pitch (MDS)

The Mita-Teknik Drive System (MDS) is a combined hardware and software pitch solution that precisely controls the angle position of each rotor blade as determined by the overall control system. The pitch system has three primary functions;

- > Ensure optimal pitch angle during operation
- > Ensure output and minimum load
- > Function as the main brake system

To optimize the wind turbine power curve and to apply minimum load to the structure, it is necessary to regulate the aerodynamic power. This is done by pitching the rotor blades so that the rotor speed is maintained at optimum and always kept below the maximum allowed rotor speed. The blades can be pitched at such an angle that the blades come to a full stop, which for larger wind turbines is often the only way to stop safely.

Safe and Efficient

Maximum safety and efficiency is achieved with three independent systems, where each blade has a separate and independent MDS. The MDS continuously monitor the communication status, motor temperature, power supply, limit switches, motor brake status and a number of other parameters.

Should anything fail, the MDS controller takes immediate action and automatically moves the blade to the Safety Stop position stopping the wind turbine. Simultaneously, the two other MDS controllers will be notified to move their blades to the Safety Stop position as well, effectively bringing the wind turbine to a halt. In case of grid fault or loss of power, the MDS will be powered by the backup power - batteries or capacitors - and position the blades on Safety Stop position.

During a LVRT situation the MDS will continue normal operation powered from the backup power.

Our MDS requires a minimum of maintenance, a claim we are willing to back with a 20 year product support guarantee.

- > Cost-competitive solution
- > Higher availability for the wind turbine
- > Sturdy design
- > Integrated hardware and software solution
- > Flexible hardware configuration
- > Easy to install and configure
- > Build-in self-test procedure
- > Optimal motor control
- > Optimal blade positioning
- > Optimal fault tracing via log functionality
- > Easy to maintain







Electrical Pitch (MDS)

Customizable, Strong and Durable - Guaranteed

The MDS can be customized to fit into any type of wind turbine, and the design allows for a quick and easy installation.

The immensely sturdy design of the MDS enables it to resist severe vibrations and forces induced during constant rotation, as well as withstand the weight of the service personnel. Combined with optimal blade-positioning and individual blade-control this makes it a perfect fit for the modern wind turbine.



Loaded with Features

- > Adaptation to all types and sizes of wind turbines
- > Integration with either Mita-Teknik or 3rd party control system
- > Control logic PID control, independent for each blade
- > Easy settings of parameters
- > Performance monitoring
- Communication to main control system via field buses >
- > Expandable I/O boards







Gateway collects, handles, analyzes and illustrates the data from any number of wind parks and turbines with intuitive graphics and text.



Gateway SCADA System

Gateway SCADA System

Gateway offers remote access to the controller(s) of a single wind turbine, several clusters of turbines or one or more wind parks. It offers an intuitive overview of the current state, productivity and the availability regardless of physical location.

The Gateway system is directly connected to the CMS system of each turbine, constantly monitoring the health of the turbine and immediately sends a notification to the service technician in case of faults. This allows for pre-emptive planning of maintenance, which is cost saving - especially for offshore installations and wind turbines situated in remote locations with costly travel expenditures.

Control

Gateway can be integrated into any system you desire through open communication protocols OPC DA and MODBUS. Combined with customizable screens that make data available in a user friendly format, Gateway stands out as a very powerful tool for managing and monitoring wind turbines and parks.

Gateway is capable of both starting and stopping wind turbines, as well as applying individual parameters from one turbine to another, regardless of the physical distance between them. This makes testing new algorithms easy, and quick to implement across a large number of wind turbines.

In addition, the Gateway system can be fully integrated with local utility companies, allowing them to better control the flow of production from your wind park to the grid.

The latest version of Gateway offers extended report functionality that gives you the complete overview of the performance of each individual wind turbine. The data is continuously accumulated, and can be illustrated through intuitive graphics, making analysis of historical production output across clusters very easy. Reports can be extended or created by the customers using Report Designer Tool, which is also part of Gateway system.

Gateway can be scheduled to automatically generate and dispatch this data as reports to any number of specified recipients. When you acquire the Gateway system we will customize each system's functionality to match your setup, needs and expectations.

- > Complete Information Access
- > Customization on all levels
- > Alarm Management
- > Performance Monitoring
- > Availability Monitoring
- > User-friendly Operation
- > Data Export/Import
- > Easy and quick to setup in both small and large setups
- > Packages for individual groups and end users





Our SCADA solutions provides you with the features, flexibility and services you need to gain greater control of your wind park.

MiScout Web SCADA System

24/7 SCADA Solution

MiScout Web enable you to connect to your turbine or wind park and monitor production, availability, alarms, weather conditions and more via a standard web-browser. It allows you to instantly react to alarms and shifts in weather conditions – ensuring you increased availability, decreased OPEX and ultimately, higher profits.

MiScout Web

MiScout Web is a Cloud solution for our SCADA system, Gateway. You can choose MiScout Web as a hosted solution or host the solution yourself.

The customer-hosted solution is ideal for customers with large setups that require complete control and therefore need the full Gateway SCADA system installed on their local server. This solution offers the utmost in flexibility and usercustomization.

Having Mita-Teknik host the solution means that Mita-Teknik provides access to the Gateway SCADA system through the Cloud. This solution is well-suited for customers with smaller setups, who value cost-efficiency over in-depth surveillance. We want to ensure that our customers get the highest possible ROI when investing in our solutions, and with MiScout Web we provide a very powerful tool to help achieve this.

MiScout Web is designed to provide useful information to turbine owners, turbine operators and engineers, with these key features;

- > Power curve and wind distribution view
- > Current park status view
- > Production and availability view
- > Wind rose view
- > Live turbine status
- > Instant alarm handling
- > Live data trends and comparison of trends between units
- > 5 min log/24h log and 36h log
- > User-friendly interface
- > User customized solution
- > Remote start, stop and reset of your wind turbine





Connecting wind turbines and wind parks to the internet is a security risk. Our ER1000 makes it secure to connect wind turbines and wind parks to the internet.

Network

Reliable Communication

Connecting wind turbines and wind parks to the Internet is a security risk. Our ER1000 makes it secure to connect wind turbines and wind parks to the Internet. Our SCADA system, Gateway combined with ER1000 and ES1000 makes park monitoring safe, easy and secure.

ER1000 VPN protects your wind turbine and wind park from unauthorized access. ES1000 is especially designed for creating a communication network between the wind turbines in a wind park. The redundant concept and the option for battery backup, ensure reliable communication in the wind park despite ongoing service or installations.

Ethernet has become a standard for communication between devices in the industry today. Especially fiber optic Ethernet switches are used. More and more switches are used for both communication in the wind turbine, between wind turbines (park communication) and as connection point to the Internet.

Mita-Teknik's ES1000 (Managed Ethernet switch) and ER1000 (Managed Ethernet router) switches are robust and highly optimized for the harsh environmental challenges of todays wind industry.

ES/ER1000 has 12 10/100/1000 MBit Ethernet ports where 4 ports are fiber optic ports. Fiber optic ports are either with SC connector multi-mode or SFP module with LC connector. SFP modules are delivered as default for multi-mode cable, but can easily be exchanged to be used with single-mode cables.

Communication

Multi-mode fiber optic cable length can be up to 2000 meters - while the single mode cable length can be up to 80 kilometers.

ER1000 and ES1000 gives you the benefit of connecting wind turbines in a wind park and via Internet making them accessible from anywhere in the world.

- > Handle all past, current and future controller needs
- > Connects your wind turbine safely to the Internet
- > Ensure reliable communication in the park
- > Improved safety with Access Control List (ACL)
- > Ultra fast network recovery with R3 Ring Protection
- > Cut Through Switch/Non blocking
- Web Configuration for remote managing of status, software updates and fast servicing
- > Bandwith Management
- > Battery backup ensures reliable operation





The ER1000/ES1000 setup supports remote managing for remote status, software updates and fast servicing.

Communication Network

Connection Stability

The ER1000/ES1000 setup ensures optimal operation, great security and advanced data collection.

Internet Connection

The setup supports several redundant connections to the Internet, which are activated if the main Internet connection is lost. This ensures a more reliable connection to the wind park.

The ER1000 can detect Internet connection loss and will in such an event fall-back to a modem to restore connection to the Internet.

Wireless Access

The setup supports IEEE 802.11 b/g/n standards and allows you to securely access Wind Park LAN via Wi-Fi.



The ER1000/ES1000 setup supports remote managing for remote status, software updates and fast servicing.

Serial COM-ports

ER1000 and ES1000 are both equipped with two serial COM-Ports ensuring communication with Mita-Teknik controllers, meters and sensors, e.g. WP4086 (CMS).

Mita-Teknik R3 Ring Protection

Specifically designed to handle the demands of the wind industry, the R3 Ring Protection protocol offer ultra fast network recovery (faster than 10 ms) with no limitations to wind park size.





Our WP4060 Connection Module is developed for soft connection of wind turbine generators to the grid.

Grid Connection

Advanced Grid Connection

Our patented Grid Connection Module WP4060 is developed for soft connection of asynchronous wind turbine generators to the grid. The WP4060 ensures effective current control before, during and after the synchronous point. The soft connection principle ensures a remarkable reduction in net disturbances and wind turbine wear and the controlled connection can be configured for both strong and weak net conditions.

The connection current is chosen as a parameter on the control unit and the thyristors can be connected during low production. The parameters for the opening of the thyristors are set on the control unit and the WP4060 measures whether the generator consumes or produces power. Furthermore, the module has a built-in phase detecting circuit which prevents connection if the phase sequence is incorrect.

0303030

1112131310

0

- > Soft connection of generators to the grid
- WP4060 measures whether the generator consumes or produces power
- Ensures effective current control before, during and after the synchronous point
- > Extends the gearbox life-time
- > Reduces load on the drive train





We know what potential challenges your equipment will face and we have developed methods for handling those challenges.



Power Panels

High Quality and Cost-effective

With our experience in power panels we know what potential challenges your equipment will face and we have developed methods for handling those challenges. Our competent engineers, technicians and production staff are dedicated to ensure that the final product is of high quality and cost-effective.

- > Control panels for wind turbines
- LVDP-Low voltage distribution panels for wind turbines
- > Specialized pitch panel for wind turbines
- > Rugged battery boxes for backup in wind turbines
- > Wind park control panels
- > PC climate racks for filed applications

We design and produce our panels according to international standards and we always deliver updated documentation such as:

- > Electrical diagrams and parts lists
- > Installation manual
- > Safety manual
- > Maintenance manual
- > Operation manual
- > CE and/or UL Certificate

- > Designed for the wind industry
- > Automatically tested
- > Full lightning protection concept
- > Developed on the latest tools
- > Includes high quality components





We find the accessories necessary to ensure that your wind turbine is stable and efficient, based on your specifications.



Mita-Teknik Accessories

High Quality and Reliable Accessories

Mita-Teknik offers a range of accessories designed for the wind industry. We find the accessories necessary to ensure that your wind turbine is stable and efficient, based on your specifications and experience. The accessories from Mita-Teknik are all developed, tested and certified for the wind industry and are fully integratable with all Mita-Teknik Control Systems.

Proximity Sensors

The inductive proximity sensor is typically used for measuring the speed of the wind turbine rotor and generator, but can also be used to measure other moving components such as yaw and pitch.

Temperature Sensors

Our PT100 temperature sensors are available in various mechanical designs for easy mounting on generators, bearings, gear box etc. The sensors have the ability to compensate for the cable length to achieve an accurate temperature measurement.

Weather Measurement

Our weather measurement accessories consist of wind direction sensors, wind speed sensors, temperature measurement, precipitation sensors, humidity measurement and air pressure. The sensors comes in versions for cold climate, on- and offshore.

Vibration Sensors

We have a wide range of vibration sensors to survey the magnitude and frequency of vibration in wind turbines and other applications.

Safety Devices

In order to ensure safe and reliable operation of the wind turbine, we deliver a wide range of safety devices.

With accessories from Mita-Teknik, we ensure you the highest reliability and a perfect fit to our control solutions.

Fiber Optic Communication

We deliver the necessary equipment, e.g. fiber optic cables, converters, switches etc., for fiber optic communication, within the wind turbine as well as for wind park networks.

Specialized Accessories

We customize our products to fit individual client needs. Upon request, we deliver specialized accessories to fit your specific applications.



Control Components

We believe in flexibility and deliver everything from complete solutions and systems to individual components - whatever your setup needs we can provide.





WP4100



- Open and intelligent CPU for all types of wind turbines
- > Completely integrated onboard webserver
- > Complete park communication via Ethernet
- > Data up/download storage via USB disk
- > 1 Ethernet interface 10/100 Mbits/s
- > 2 pc. 230 kBAUD RS232/RS485/RS422 COM-ports
- > Intelligent thermal control
- > Fully maintenance-free

WP4200



The WP4200 Controller

The WP4200 controller offers superior performance and with its built-in floating point unit it is perfectly suited for high demanding control- and regulation applications. Furthermore, the controller is equipped with two high-speed gigabit interfaces, one for communication in the wind farm and one for backbone communication to the distributed I/O modules. It also features safety chain relay logic that integrates with the safety system to fulfill the requirements in the ISO 13849-1 standard.

The controller uses the advanced OS42xx Operating System software, featuring the FAILSAFE FLASH file system, TCP/ IP protocol stack, WEB-server, plug-and-play identification/ configuration of all WP-Line modules, status code system, 30-year summation structure, menu system and log systems.

The OS42xx Operating System API is 100% backwards compatible with the OS4000 and OS4100 operating systems – this ensures that existing applications can be used with the WP4200 controller without any modification or recompilation.

The WP4100 Controller

The WP4100 controller is equipped with two 230kBit/s RS232 COM-ports for modem connection and for other purposes, e.g. UPS. Furthermore, the WP4100 equipped with 10/100Mbit Ethernet COM-port for park communication as well as backbone connection via WP-Line 111.

The WP4100 controller is part of- and surveys the "hardwired" safety chain. The WP4100 controller contains internal maintenance-free power back-up, so essential data will not be lost in case of system power failure. WP4100 is based on a high-speed CPU. The WP4100 controller contains an advanced OS4000 operation system software that has the TCP/IP protocol stack, web server, PC-compatible file system on an USB disk, plug-and-play identification/ configuration of all WP-Line modules, status code system, a 30-year summation structure, and a total log system.

It is easy to up-/download data/programs via an USB flash drive. The USB disk can also be used as storage for extended data collection. It can handle up to 10 simultaneous/ independent application programs in the turbine control, park power management, dump-load control, condition monitoring, camera control, customer-adapted communication protocols etc. The WP4100 controller is using event-based communication, which means that only changed values are transmitted via the network.

Processors CPU 520 MHz XSCALE DSP 200 MHz ~ 400 MMACS Memory DRAM, onboard 128 MB Flash Disk, onboard 256 MB USB, optional External Supply Voltage 24 VDC Nominal Allowed range 18 to 30 VDC Port for RS232 Communication (Modem) No of ports 300 BAUD to 230.4 kBAUD Communication speed Port for RS232 Communication with RTS/CTS No of ports 300 BAUD to 230.4 kBAUD Communication speed Port for Ethernet Communication 10/100 Mbit/s Communication speed Permissible Ambient Conditions -30 to +60 °C Operation temperture -40 to +85 °C Transportation temperature Max. relative humidity (non-condensing at 40 °C) Max 95 % RH 2000 m above sea level Max operation height Standards

EN61000-6-2 (CE) EN61000-6-4 (CE) EN61000-4-5 (Surge)

Test Standards

HW verification, EMC, Vibration, Climate and HALT tests.

Programming standards

The WP4100 CPU supports the IEC61131-3 PLC programming standard as well as programming in ANSI C.

- High performing controller designed for large wind turbines
- > Safe operation in harsh environments
- Maintenance free no fans and no batteries that needs replacing
- > Advanced event based data logging and storage
- > Direct integration with safety system
- > Integrated FAILSAFE FLASH file system
- > High-speed multi-core processor (CPU and DSP)
- Built-in floating point unit (FPU) for fast advanced mathematical calculations
- Gigabit Ethernet, Serial RS232/RS422/RS485 and USB 2.0 port

Processors CPU DSP	1.2 GHz ARM A8 1GHz ~ 12,000 MMACS
Memory DRAM, onboard Flash Disk, onboard USB, optional	256 ME 512 ME
External Supply Voltage Nominal Allowed range	24 VDC 19 to 30 VDC
Port for RS232 Communication (Mod No of ports Communication speed	em) 300 BAUD to 230.4 kBAUD
Port for RS232 Communication with No of ports Communication speed	RTS/CTS 300 BAUD to 230.4 kBAUE
Port for Ethernet Communication Communication speed	10/100/1000 Mbit/s
Permissible Ambient Conditions Operation temperture Transportation temperature Max. relative humidity (non-condensing at 40 °C Max operation height	-30 to +60 °C -40 to +85 °C Max. 95 % RH 2000 m above sea level
Standards EN61000-6-2 (CE) EN61000-6-4 (CE) EN61000-4-5 (Surge)	

Test Standards

HW verification, EMC, Vibration, Climate and HALT tests.

Programming standards

The WP4200 CPU supports the IEC61131-3 PLC programming standard as well as programming in ANSI C and C++.

WP1xx (WP130)



The WP130 Controller

The WP130 Controller is specially designed for control of small and medium sized systems and wind turbines with a production capacity up to 1.5 MW.

The unit has a set of various on-board I/O channels that makes it possible to use the controller as standalone (w/o additional I/O modules) to control less complex systems. At the same time, it is possible to connect up to 3 WP-Line I/O modules when more I/O channels needed. The on-board grid interface makes it possible to calculate main grid parameters by precise and reliable DSP algorithms according to IEC 61400-21 standard.

The controller is equipped with two high-speed gigabit interfaces that work as an internal network switch. The controller also features safety chain relay logic.

The OS1xx Operating System API is 100% backwards compatible with the OS4x00 operating systems family – this ensures that existing applications that run on WP4x00 platforms can be used with the WP130 controller without any modification or recompilation when the hardware setup is compatible.

> CPU module for all types of wind turbines up to 1.5 MW

- Maintenance free no fans and no batteries that needs replacing
- > Integrated FAILSAFE FLASH file system
- > Advanced event based data logging and storage
- Gigabit Ethernet, Serial RS232/RS422/RS485 and USB 2.0 port
- > 16 digital inputs and 16 digital outputs
- > 4 high speed digital counters
- > 4 PT100 inputs, 4 analog inputs and 1 analog output
- > Onboard grid interface
- > 1 CAN interface
- > Direct integration with safety system

Processors

CPU	720 MHz ARM A8
Memory DRAM, onboard Flash Disk, onboard USB, optional	128 MB 512 MB
External Supply Voltage Nominal Allowed range	24 VDC 19 to 30 VDC
Port for RS232 Communication (Mod No of ports Communication speed	em) 1 300 BAUD to 230.4 kBAUD
Port for RS232 Communication with No of ports Communication speed	RTS/CTS 1 300 BAUD to 230.4 kBAUD
Port for Ethernet Communication Communication speed	10/100/1000 Mbit/s
Permissible Ambient Conditions Operation temperture Transportation temperature Max. relative humidity (non-condensing at 40 °C Max operation height	-30 to +60 °C -40 to +85 °C Max. 95 % RH 2000 m above sea level
Stalladias	

Standards EN61000-6-2 (CE)

EN61000-6-2 (CE) EN61000-6-4 (CE) EN61000-4-5 (Surge)

Test Standards

HW verification, EMC, Vibration, Climate and HALT tests.

Programming standards

The WP1xx CPU supports the IEC61131-3 PLC programming standard as well as programming in ANSI C and C++.

WP-Line 111 Power Supply/Backbone



The WP-Line 111 Power Supply/Backbone

The WP-Line 111 Power Supply/Backbone module is an upgrade from the well-proven WP-Line 110 and functions as power supply for the single module blocks in the WP4x00 Control Concept. The inter-block communication (backbone) in the WP4x00 Control Concept is carried out by the WP-Line 111 via an optical Ethernet. The backbone Ethernet communication can be connected with fiber optic cables as double ring. The fiber optic type is 62.5/125µm.

Furthermore, the WP-Line 111 is equipped with 2 x 100Mbit Ethernet RJ45 plugs for connection of a graphical display/ keypad or PC. This enables operating the complete WP4x00 Control System at all available module blocks.

- High-efficiency power supply for the WP4x00 Control Concept
- > Optical redundant Ethernet backbone
- > 2 RJ45 Ethernet plugs for display and service
- > Activity LED showing operational status
- > Supports removable LED matrix display
- > New flexible serial COM-Port
- > Intelligent thermal control
- > Fast and easy DIN-rail mounting

Supply Voltage Nominal Allowed range	24 VDC 18 to 30 VDC
WP-Line BUS Supply Communication speed Allowed range	12 VDC 11.5 to 12.75 VDC VDC
Ethernet RJ45 Communica	tion Port
Communication speed	10/100 Mbit/s
Range, maximum recommend	led 50 m
Ethernet Optical Communi	cation Port
Communication speed	100 Mbit/s
Range, maximum recommend	led 2000 m
Port for RS232/RS422/RS4	485 Communication
No of ports	1
Isolation	Digital isolator (4000-Vpeak isolation, 560-V)
Communication speed	300 BAUD to 230.4 kBAUD
Permissible Ambient Conc	litions
Operation temperture	-30 to +60 °C
Transportation temperature	-40 to +85 °C
Max. relative humidity (non-conc	densing at 40 °C) Max. 95 % RH
Max operation height	2000 m above sea level
Standards EN61000-6-2 (CE) EN61000-6-4 (CE) EN61000-4-5 (Surge)	

Test Standards

HW verification, EMC, Vibration, Climate and HALT tests.

WP-Line 151 Grid Measurement

The WP-Line 151 Grid Measurement

The WP-Line 151 module has three voltage and three current analog inputs. The module is powered from the WP-Line BUS. The WP4x00 controller can automatically update the programs via the network. The communication to the WP4x00 controller is event-based, which means that only changed values are transmitted via the network. Analog part is based on 16bit precision ADC.

The WP-Line 151 module performs three basic functions:

- > Calculates main grid parameters
- Calculates grid quality parameters
- Provides WP4x00 controller with these data

Main grid parameters like voltage, current, active and reactive powers, etc. are used by WP4x00 control application for turbine overall control. Calculation of main grid parameters by precise and reliable DSP algorithms has the following features:

- Frequency calculation algorithm assures measurement accuracy 0.01 Hz and higher
- > Voltage and currents are calculated using FFT algorithms
- Powers and energies are measured according to IEC 61400-21 standard

- > Realtime DSP grid measurement module
- Surveillance of 3 currents and 3 voltages
- New, improved algorithms for more precise, faster and reliable grid measurements
- > Calculation of all grid data
- > Measures grid quality data
- > Supports FRT/LVRT
- > Supplies data for machine control
- > Supplies data for production statistics
- > Intelligent thermal control
- Configurable measuring modes to present Power, Energy and Powerfactor

Supply Voltage Nominal Allowed range	12 VDC 10.5 to 13.5 VDC
Current Comsumption (WP-Line BUS) Typical Maximum Standard module load	0.40 A 0.45 A 2
Module Power Dissipation Typical	4.6 W
Relay Output Max. switching current Max. switching voltage Max. response time	1A 125 VDC/AC 20 ms
Permissible Ambient Conditions Operation temperture Transportation temperature Max. relative humidity (non-condensing at 40 °C) Max operation height	-30 to +60 °C -40 to +85 °C Max. 95 % RH 2000 m above sea level
Standards EN61000-6-2 (CE) EN61000-6-4 (CE) EN61000-4-5 (CE)	

Test Standards

HW verification, EMC, Vibration, Climate and HALT tests.

WP-Line 351



The WP-Line 351 Combi I/O

The WP-Line 351 is a Combi I/O module developed to optimize the competitiveness and signal handling of the control system. The WP-Line 351 Combi I/O module is equipped with 2 flexible COM-ports that can be configured to RS232/422/485 or SSI via the software - as per requirement. The module also consists of various I/O's.

The digital I/O's are based on 24 Volt and consist of the following:

- > 16 high current digital solid state outputs
- 26 digital inputs
- > 4 high-speed counter inputs to 10 kHz

The analog section is based on 12 bit analog convertion and contains:

- 4 flexible analog outputs that can be configured to -/+ 10
 V or 0-20 mA as per requirement
- 4 analog inputs, -/+10 V
- > 4 analog inputs, 0-20 mA
- > 8 PT100 inputs, 60° to +230 °C
- 2 thermistor inputs, with the possibility of connecting more thermistors in series

All I/O's are galvanic separated and all outputs are short-circuit protected.

- > Cost optimized I/O Combi module
- > Flexible and easy to replace
- > 2 serial COM-ports
- 16 digital outputs/26 digital inputs/4 high-speed counter inputs
- 4 analog outputs/8 analog inputs/8 PT100 inputs/ 2 thermistor inputs
- > Compact design
- > Improved PT100 temperature range
- > Improved PT100 accuracy
- > Accurate and intelligent thermal control

External Supply Voltage

Typical Maximum

Digital Input

No. of points Isolation Nominal voltage Signal "1" Signal "0" Frequency

High Speed Input

No. of points Isolation Nominal voltage Signal "1" Signal "0" Indput current/signal "1" Indput impedance Input Frequency

COM-Ports

Port for RS232/RS422/RS485 Communication Port for RS422/RS485 Communication

Permissible Ambient Conditions

Operation temperture Transportation temperature Max. relative humidity (non-condensing at 40 °C) Max operation height

Standards

EN61000-6-2 (CE) EN61000-6-4 (CE) EN61000-4-5 (Surge)

Test Standards

HW verification, EMC, Vibration, Climate and HALT tests.

24 VDC 18 to 30 VDC

26 Optocoupler 24 VDC 15 to 30 VDC 0 to 5 VDC 0 to 50 Hz

4 Optocoupler 24 VDC 15 to 30 VDC 0 to 5 VDC -/+ 16mA(@ 24 Vin) 1.5 kΩ

0 to 10 kHz

1

-30 to +60 °C -40 to +85 °C Max. 95 % RH 2000 m above sea level

WP-Line 4xx



> Cost optimized I/O Combi module

- > Flexible and easy to service
- Integrated Condition Monitoring
- > Customized Configuration
- > Clear LED status indication
- > Data processing on module

The WP-Line 4xx Module Range

The WP-Line 411

The WP-Line 411 PT100/PT1000 Input module has 16 x PT1000/PT100 inputs with extended temperature measuring range from -60 to +230 $^{\circ}$ C. PT1000 or PT100 sensor mode is configured with software.

The WP-Line 412

The WP-Line 412 PT100/PT1000 Input module has 32 x PT1000/PT100 inputs with extended temperature measuring range from -60 to +230 $^{\circ}$ C. PT1000 or PT100 sensor mode is configured with software.

The WP-Line 413

The WP-Line 413 Analog Current Output module manages 16 x 0-20 mA software calibrated outputs.

The WP-Line 414

The WP-Line 414 Digital Input/Output, PT100/PT1000 Input module is equipped with both digital input/outputs and PT100/PT1000 inputs. The digital I/O's are based on 24 Volt and consist of the following:

- 32 digital input
- > 16 digital output
- Digital output: 24 VDC/0.5 Amp
- Digital input: 24 VDC

The analog section contains:

- > 8 PT100/PT1000 inputs
- > Temperature masuring range from -60 to +230 °C
- > PT100 or PT1000 sensor mode is configured by software
- > Data processing on module

The WP-Line 415

The WP-Line 415 Analog Input module manages 16x 0 - 20 mA and 16x 0 - 10V software calibrated inputs.

The WP-Line 416

The WP-Line 416 Digital Input module is equipped with 64 digital inputs. Digital inputs are based on 24 Volt.

The WP-Line 417

The WP-Line 417 Digital Output module is equipped with 64 digital outputs. Digital outputs are based on 24 Volt.

The WP-Line 418

The WP-Line 418 module is equipped with digital inputs, digital outputs, analog current inputs and PT100/PT1000 inputs. The digital I/O's consist of the following:

- > 16 digital inputs
- > Digital inputs: 24 VDC
- > 16 digital outputs
- > Digital outputs: 24 VDC/0.5 A

The analog section contains of:

- > 16 analog current inputs
- > 0-20 mA, with an accuracy better than $\pm 0.15\%$ of full scale
- > 8 PT100/PT1000 inputs
- > Temperature measuring range -60 to +230 °C
- > PT100 or PT1000 sensor mode is configured by software

WP-Line 511 CANopen Interface



The WP-Line 511 CANopen Interface

The WP-Line 511 is designed for stand alone operation and as a part of the WP4x00 Control Concept.

Internal 10/100 Ethernet switch for routing and interfacing. Backbone Ethernet communication can be connected with fiber optic cables as double ring with one spare fiber cable for backup. This setup provides high communication safety, as this configuration allows operation despite of a defect optic fiber. The fiber optic cable type is $62.5/125\mu$ m or $50/125\mu$ m. Additional 2 x 10/100 Ethernet (RJ45) are on the module.

Up to 1MBit/s CANopen Master communication to other CANopen based devices. Galvanic isolated CANbus interface.

Internal condition monitoring, 7-segment display showing group number and 3-LED status indication facilitates fast servicing.

The module can easily be programmed as a CANopen Master, interfacing WP4x00 controller to any CANopen device (frequency Converter, Pitch controller, etc.). Via generic CANopen application (in compliance with CiA301 and CiA DSP 302 specification standards) and user-friendly interface of Mita-Teknik "CANopen Configuration Tool" all CANopen network parameters can be easily configured and adjusted to meet the preset requirements.

- Stand-alone Ethernet to CANopen Master Interface, designed for the WP4x00 concept
- > Up to 1Mbit/s CANopen
- 2 x Ethernet 100 Base-FX (SC Optic Backbone with redundant option)
- > 2 x RJ45 Ethernet 10/100 for display and service
- > Flexible serial COM-Port (RS232/RS422/RS485)
- > Supports removable LED matrix display
- > Intelligent thermal control
- +24 VDC supply voltage

Supply Voltage	
Typical	24 VDC
Maximum	18 to 30 VD0
Power comsumption	max. 7.2 W
BUS Port Connectors	
CANopen	1
Ethernet	2 x RJ45
Ethernet	2 x SC
Serial COM-port	1
Ethernet RJ45 Communication Port	10/100 mbit/s
Max. cable lenght	50 m
Port for RS232/RS422/RS485 Comm	nunication
Isolation	Digital isolato
Communication speed	9.6 kBAUD to 115.2 kBAUD
Permissible Ambient Conditions	
Operation temperture	-30 to +60 °C
Transportation tomporature	40 to .05 °C

Transportation temperature Max. relative humidity (non-condensing at 40 °C) Max operation height -30 to +60 °C -40 to +85 °C Max. 95 % RH 2000 m above sea level

Standards

EN61000-6-2 (CE) EN61000-6-4 (CE) EN61000-4-5 (Surge)

Test Standards

HW verification, EMC, Vibration, Climate and HALT tests.

WP4052 Touch Display



The WP4052 Touch Display

The WP4052 Graphic Color Touch Screen Display is used with the WP4x00 Control Concept and provide access to the wind turbine.

A touch screen with the possibility of on screen keyboard and a display with resolution of 1024 x 768, 16 bit colors. Operating system with web browser for fast and user-friendly operation. The panel is mainly designed for panel mount application. It is also possible to connecting more displays per controller.

Furthermore, the WP4052 display offers:

- > Ethernet system connection
- > USB port in front
- Sleepmode/screen saver
- Condensation and salt resistant
- Degree of protection IP55 >
- > User-friendly 3 LED status
- > Maintenance free (no fan or batterv)
- > Fast response time

The WP4052 is also available in a cold climate version with internal heater for cold climate operation.

- Touch screen graphic display for the WP4x00 Control > Concept
- > 15" TFT with 1024 x 768 resolution, 16 bit colors
- > USB Port in front
- > Quick and reliable survey of functions and data in the wind turbine
- Maximum user comfort via the HMI principle >
- User-friendly menu structure >
- > Designed for easy mounting
- > Pressure sensitive touch screen; responds to finger, gloved hand or pen

External Supply Voltage Nominal Maximum	24 VDC 19 to 30 VDC
Current Comsumption (External 24 V) Typical Maximum	1.0 A 1.3 A at 19 VDC
Module Power Dissipation Typical	24 W
Display Size Resolution Color resolution	15 " 1024 x 768 16 bit
Permissible Ambient Conditions Operation temperture - Basic version Front (outside control panel) Back (inside control panel) Operation temperture - cold climate version Transportation temperature Max. relative humidity (non-condensing at 40 °C) Max operation height	-30 to +60 °C 0 to +60 °C -40 to +85 °C -40 to +85 °C Max. 95 % RH 2000 m above sea level

Standards

EN61000-6-2 (CE) EN61000-6-4 (CE) EN61000-4-5 (Surge)

Test Standards

HW verification, EMC, Vibration, Climate and HALT tests.

ES1000 & ER1000 Gigabit Managed Ethernet Switch and Router



The ES1000 Gigabit Managed Ethernet Switch

The ES1000 is perfect for communication with wind turbine controllers. It can be combined with all types of controllers that communicate with Serial or Ethernet standards.

The backbone redundant fiber optic Ethernet Switch is designed for stand-alone operation and constructed for high reliability. The redundant fiber optic pair is connected for long range communication in a double ring with one spare fiber optic for backup. This setup provides high communication safety, as this configuration allows operation despite of a defect fiber optic.

ES1000 supports remote managing for remote status and fast servicing.

The ER1000 Gigabit Managed Ethernet Router

The ER1000 allows you to connect the wind park to the Internet and communicate securely with the turbines.

You can build a firewall on the ER1000 which will protect the local network from unauthorized access from the Internet.

The backbone redundant fiber optic Ethernet Router is designed for stand-alone operation and is constructed for high reliability. The ER1000 can detect Internet connection loss and will in such an event fall-back to a modem to restore connection to the Internet.

ER1000 supports remote managing for remote status and fast servicing.

- > Industrial 12 Port Gigabit managed switch and router with Wi-Fi (optional)
- > 12 x 10/100/1000 Mbps ports (4 fiber optics)
- Cut through/Non blocking (ES1000) >
- > Mita-Teknik R3 Ring Protection Protocol
- 2 x Serial COM-ports RS232/485 (ER1000 also RS422) >
- Supports: RSTP, LACP, VLAN (IEEE 802.1Q), LLDP, ICMP, > DHCP, DNS, SNMP, HTTP, FTP, SNTP, IGMP, FC2217, RMON
- > 3 x digital inputs/outputs
- > Web Configuration
- > Support ACL (Access Control List)
- Bandwith Management >
- > Direct connection of backup battery

Supply Voltage

Nominal Allowed range

Current Consumption

Typical Maximum

Power Consumption

Typical Maximum

RS232 Communication Port

No. of ports Communication speed Max. cable length Recommend cabe type Connector

Wi-Fi Communication Port

Communication speed Frequency range Supported modes Output power Input sensitivity

Permissible Ambient Conditions

Operation temperature Transportation temperature Max. relative humidity (non-condensing at 40 °C)

Standards

EN61000-6-2 (CE Generic Immunity) EN61000-6-4 (CE Generic Emission) EN61000-4-5 (Surge)

Test Standards

HW verification, EMC, Vibration, Climate and HALT tests

24 VDC 19 to 30 VDC

> 850 mA 1900 mA

> > 20 W 25 W

2

1200 - 115200 BAUD 30 m 2 x 2 x 0.25 w/shield 9-pin sub D connector

> 108 Mhit/s 2400 - 2483.5 MHz IEEE 802.11b/g/n 18 dBm -80 dBm

> > -30 to 60 °C -40 to 85 °C Max. 95 % RH

Take Control

The power is yours. Take control of your investment and we guarantee that you will become Great at Control.





Access to the source code grants you complete control of the system, and will let you customize its functionality to fit into any product mix.



Take Control

With the WP4x00 system, Mita-Teknik offer an open platform system where we can provide the customer with access to the application source code. This grants you complete control over the system, and will let you customize its functionality to fit into any product mix, regardless if your setup is produced by Mita-Teknik or another manufacturer.

The source code is a compilation of software objects, where each object represents a particular function in the application:

- > Operate object
- > Pitch control object
- > Torque control object
- > Yaw control object
- > Power curve object
- > Wind rose object

These objects can be changed, either partially or completely, compiled and linked into an application and then uploaded to the WP4x00 controller. The WP4x00 product line offers compatibility with a long range of industry standard simulation- and development tools, including:

- > PEPTOOL
- > Eclipse
- > CoDeSys® (IEC61131-3)
- > Bladed
- > Simulink®
- > SIMPACK
- > Genlogic

Applications for WP4x00 controllers can be built from scratch or adapted from already existing IEC61131-3 compliant PLC's, making the WP4x00 Control Systems fit into any current or future wind turbine setup.

Programming Options

We offer five different options tailored to your particular needs, ranging from no- to full source code access, depending on our customers decision for involvement. This is done to allow for maximum flexibility and to make sure that our customers get the optimal value from their investment:

- > No programming
- > Modifications
- > Develop new objects
- > You get the Source Code
- > You program all





Regardless of which option you find most suitable, you always retain the option of handing over control of development and maintenance to Mita-Teknik, should it become necessary.



Programming Options

Option 1 – No Programming

With option 1 we partner up with you to identify your specific needs. Mita-Teknik will then program and test the software, which, along with all software documentation and manuals, will be handed over to you. The application will be delivered in a binary format (.crc) and you are free to install it on any number of WP4x00 systems.

Option 2 - Modifications

Option 2 expands upon option 1 by providing you with the PEPTOOL software. PEPTOOL is our own proprietary compiler for the different WP4x00 systems. Mita-Teknik will provide you with training in the use of PEPTOOL to make sure you get the optimal output from your investment. Furthermore, you will be given access to all objects available for PEPTOOL which can be used to modify default values and user access levels of the application. With option 2 you have access to everything needed to build, test and release updated application programs as well as automated manual generation and translation into other languages.

Option 3 – Develop New Objects

With option 3 we offer even more in-depth training courses on the use of PEPTOOL, extensively covering the aspect of creating your own specific applications. You can pick and choose which parts of the development process you want to manage in-house, and which parts you want Mita-Teknik to control - the decision is entirely up to you.

Option 4 – You Get the Source Code

With option 4 you will be given access to the source code of one or more objects developed by Mita-Teknik. This means that you will be able to:

- > Change everything regarding the object
- > Create new versions of an object
- Add new features and functionalities to the objects
- Import source code created by simulation tools directly to > the application
- > Make new objects by copying source code from other objects

Option 4 is bound by the license agreement issued by Mita-Teknik, specifying in detail the exact agreement.

Option 5 - You Program All

With option 5 you are in charge of creating your own software for the WP4x00 system based on new or existing source code. You will receive the PEPTOOL tool, receive training in its use, as well as one basic sample object and one basic sample project.

Regardless of which option you find most suitable to your organization, you always retain the option of handing over control of development and maintenance to Mita-Teknik, should it become necessary. You can also get additional objects and source code on other objects after your project has started. If you choose to program your own objects or applications, you can keep the source code a secret to Mita-Teknik, and still retain your maintenance agreement with us.





PEPTOOL ensures that key information is retained in your organization, and allows for collaboration with your external partners on developing and optimizing your application.



PEPTOOL Development Tool

While WP4x00 solutions are often delivered as turnkey packages, future modifications or expansions of your wind turbine or wind park, might require changes or enhancements in the application software. To this end we provide our unique and open development environment, the PEPTOOL software suite.

With PEPTOOL you assume complete control of your wind turbine and wind park and gain the power to rapidly change the application source code controlling the behavior of the WP4x00 controller. This lets you respond quickly to changes and new requirements and lets you continuously expand your facility extending the potential and life-time of your investment.

Development

PEPTOOL allows your engineers and technicians to customize the software controlling the behavior of the WP4x00 applications - in an intuitive environment built around the standard Microsoft Windows platform.

In addition, PEPTOOL allows you to create new additional applications for the WP4x00 controller including generation of detailed documentation.

PEPTOOL supports the programming languages ANSI C/C++ and Structured Text and compiles ready to use applications for the WP4x00 and DLL's for the WP4x00 Emulator and simulation tools. PEPTOOL supports the generation of application manuals in pdf-format and is based on the advanced document preparation system LaTeX.

Testing and Translation

PEPTOOL enables you to design your own test module where you can perform tests without affecting the development process. With PEPTOOL, testing becomes more efficient and adds value to your overall investment.

PEPTOOL enables you to translate all WP4x00 applications into many different languages – including Chinese, Korean and Japanese – enabling the user of the touch display to work in his or her native language.

Free up time from mundane tasks, reduce programming mistakes and have development in control with PEPTOOL.

- > Auto-generation of the source code
- > Auto-generation of documentation
- > Well-structured repository
- > Supports many programming languages
- The ability to emulate WP4x00 Control System on PC running Microsoft Windows
- > Integrated testing module
- Translation of the applications and manuals into multiple languages
- > Decreased development time
- > Added value to the investment





We offer an open development environment and give you the freedom to develop your own know-how.



CoDeSys Development Tool

CoDeSys Toolbox

The Mita-Teknik WP4x00 Control System combines unique technical and financial advantages - all in one solution. Unlike other controllers that include all functions in a single cabinet, the WP4x00 system is divided into several modules and you can select different modules according to the specific task.

The WP4x00 comes with advanced operation system software (OS4000) that has advanced data collection storage, web server and the possibility of handling up to 10 simultaneous - independent or dependent synchronous - application programs.

Basically it consists of two parts; the programming system CoDeSys and the run-time system CoDeSys RTS. The runtime system turns the WP4x00 controller into an IEC61131-3 controller programmable with CoDeSys. Integrated compilers in the CoDeSys ensure that the program code is processed with optimal speed.

High User-friendliness

The WP4x00 CoDeSys Toolbox is delivered with Mita-Teknik's WP4x00 system-specific hardware files to build a complete CoDeSys application for the WP4x00 control system. The application can be built from scratch or migrated from other IEC61131-3 control systems and adapted to the WP4x00 control system.

The CoDeSys application can be packed in an easy way to Gateway firmware upload packets and tested on a CoDeSys

Development Kit, before releasing and publishing to the final target control system.

With CoDeSys, we offer you an open development environment and give you the freedom to develop your own know-how. With interfaces to all common standards, CoDeSys provides you with a high level of user-friendliness.

CoDeSys is a comprehensive software tool for industrial automation technology.

- Complete support of the standard IEC61131-3 (IL, ST, LD, SPC, FBD & CPC)
- > Simple interface
- > Targets specific files for a WP4x00 system
- > Full development documentation
- > Easy programming
- > High compatibility
- > Powerful IEC61161-3 programming tool
- > Platform (hardware) independent
- > Integrated compiler for CPU platforms
- > Future safe programming
- > Possibility of test on WP4x00 CoDeSys Development Kit


Customer Partnering

Cooperating with our customers helps us stay on top of our game, it inspires us and it guarantees that we think customer benefits into every solution.





"We think the customer's needs and demands into every solution – from development and onsite installation to after sale support. Every layer of the organization is dedicated to always deliver best-in-class products and services."

Jesper Andersen, CEO

Customer Partnering

Partnering with our Customers

The best solutions are created when we join forces and design and customize a solution that fits your individual needs perfectly. With a wide range of different services we provide professional support for our customers as a part of our Customer Partnering Concept. We take our customers' needs into consideration before, during and after the deal.

Project Start

Know-how Based Needs Assessment

Choosing the right system design is the basis for safe and reliable operation of your wind turbines. Through open communication we advise our customers in the fields of both hardware and software.

Design & Engineering

We offer consultancy in the fields of both hardware and software. The flexibility of our module-based, plug-and-play system makes it possible to customize solutions for your specific needs. Through close dialog, we offer you solutions for safe and reliable operation of your wind turbines. With our advanced testing system, all of our products are fully tested in-house before delivery.

Project Execution

Side-by-side Development

We offer complete software support. You can choose different approaches; either we build the complete software for you or we do it in cooperation - or you do it yourself. Whatever you prefer, we offer our full support.

Service & Support

World Wide Field Service

We have a team of highly-skilled engineers ready to service you with onsite participation during various jobs like; application development, workshop test, commissioning, performance analysis, LVRT test, upgrades, support and troubleshooting.

Building customer knowledge is a key point in ensuring optimal performance and earnings of the solutions from Mita-Teknik. With a wide range of different services we always seek to provide professional support for our customers.

Repair & Service

Fast and competent repair and service is crucial for optimal operation and reliability, in order for you to get the maximum output from your investment. All of our repairs are carried out in our in-house service facilities available in both Denmark, China and India.

Customer Support

With our special Customer Support team we support you in all matters of hardware and software problems. Our Customer Support team can be reached by phone, Skype or e-mail.





We offer a range of extensive training courses specifically designed to ensure you get optimal performance from your wind turbine.

Training at Mita

Learn More

We offer a range of extensive training courses specifically designed to ensure you get optimal performance from your wind turbine and the best return on your investment.

As a part of our Customer Partnering Concept we offer our customers and suppliers a range of training courses in the use of our products.

Our experienced instructors will take your employees through useful tools, best practice cases and frequently asked questions, all aimed at making you Great at Control. This is done in order to ensure you get the most out of your wind turbine and the best return on your investment.

We provide tailor-made courses in:

- > WP4x00 Control System
- Electrical Pitch System (MDS)
- > Condition Monitoring System (CMS)
- > Wind Park Control Concept
- > Power Panel System
- > Commissioning Training
- > SCADA Systems, Gateway and MiScout Web
- > Application Development with PEPTOOL

We provide both in-depth training as well as broad introductions to general wind turbine control; regardless of your needs, we are capable of delivering exactly what you require. We can go into the specific technical details and show you how to work and operate our advanced control systems, or we can take a field trip and visit a real, live wind turbine for a first-hand experience. It's all up to you.

Our experienced instructors take your employees through useful tools, best practice cases and frequently asked questions, aimed at making you Great at Control.

Training - Worldwide

Our training facilities are located at our headquarters in Rødkærsbro, Denmark, where we can teach classes of up to 8 people. Our skilled instructors can also host the training event at a location of your choosing.

Regardless of what you choose, our training sessions will directly benefit your setup and organization. Please consult your Mita-Teknik sales representative for more information.



Contact Mita-Teknik

Denmark (HQ)

Mita-Teknik Håndværkervej 1 DK-8840 Rødkærsbro Denmark

Tel: +45 8665 8600 Fax: +45 8665 9290 mail@mita-teknik.com www.mita-teknik.com

We Make Wind Competitive





PowerStore renewable microgrid stabilization brochure





Power Generation

PowerStore Renewable microgrid stabilization



PowerStore Renewable microgrid stabilization

ABB's microgrids and renewable integration platform provides a modular and scalable solution that integrates renewable power generation into microgrids that previously operated solely on fossil fuel. The key is to design a renewable power plant that can maximize return on investment, while delivering a stable, safe and reliable power supply. ABB's solution includes grid stabilization technology that enables high penetration of renewable power generation, and distributed control systems that provide intelligent power management and efficient hybrid power plant operation. Our solution achieves 100% peak penetration of renewables in wind/diesel and solar/diesel power systems, maximizing fuel savings and supplying reliable, grid-quality power in remote off-grid locations.

The PowerStore[™] is a compact and versatile grid stabilizing generator. Its main purpose is to stabilize power systems against fluctuations in frequency and voltage. Stabilizing the grid needs highly dynamic power injection and absorption for short amount of time, while common energy storage solutions require slower response and discharge over longer time. It combines a 18 MWs low speed flywheel with solid state converters to provide reliable and high-performance grid stabilization.

The PowerStore is able to inject and absorb power up to its nominal power rating and it is available in a range of models from 500 kW to 1.5 MW and can be configured to operate in either a grid support mode for use in multimegawatt grids, or as a virtual generator for use in smaller isolated microgrids.

Main components

The PowerStore consists of:

- Flywheel spinning mass including motor/generator
- AC-DC-AC converter system
- Operator interface
- Container-based building (optional)

Flywheel spinning mass

The PowerStore is a flywheel based technology that provides grid stabilization and uses a pressurized helium environment to reduce frictional losses. The unit has a lifting magnet that holds the weight of the 3,000 kg flywheel during operation, ensuring a long bearing life, reduced losses and low maintenance.

Oversized primary mechanical bearings are also included to hold the weight of the flywheel while it is stationary and below operational speed while catch bearings are installed to provide a fail-safe system.

The design incorporates proven technologies in order to deliver worry free years of operation.



ABB solutions enable the maximum utilization of renewable energy in remote or isolated areas - enabling efficient, reliable and high quality power supply, while minimizing the fuel consumption.

Converter system

The AC-DC-AC converter system hardware is based on customized PCS100 insulated gate bipolar transistor (IGBT) power converters from ABB. Using these proven modules results in a highly reliable design with an installed base of thousands of units worldwide.

The use of back-to-back IGBT converter pairs allows the flywheel to rotate at variable speed enabling the injection and absorption of power. Multiple converter pairs are paralleled to achieve the desired model rating. The PowerStore is able to export and import at maximum power ratings regardless of the state of charge, from 0% to 100% capacity; there is no need to derate the PowerStore for lower state of charge. For example, 100% of power injection until the PowerStore is completely empty, or 100% power absorption until the PowerStore is completely full is possible. This gives the PowerStore its unique fully symmetric power ratings, and the ability to charge with as much power as it can discharge.

The converter modules are configured for redundancy which means that the PowerStore will continue to operate despite the failure of one module.

Operator interface

An operator interface is used to monitor the flywheel and converter components and to provide access to historical data. Historical data recording is provided at two levels: a high resolution (down to 100 ms) recording system for response and performance analysis, and a low resolution (10 minutes) recording system for asset management.

A number of variables are recorded such as:

- PowerStore active and reactive power
- PowerStore state of charge
- Mains 3-phase voltage
- Mains 3-phase current
- Flywheel, container and converter temperatures
- Alarms, status and operation mode
- Next PowerStore service time
- Mains frequency

This data can be exported into a wide range of software, including Microsoft Excel for further analysis. The information is also available to be exported to upper level SCADA systems through a MODBUS/TCP communications interface.



PowerStore overview schematic

Through the operator web interface the PowerStore can be remotely started and stopped and alarms remotely monitored and reset.

Furthermore, the trending system is capable of displaying multiple types of data at different resolutions simultaneously. The trending package is able to access data from a remote system across a telecommunications path (such as an ordinary modem or a 3G wireless connection) and can display user-defined periods of larger portions of data with ease.

Container building (optional)

The PowerStore can be factory installed into a purpose built 20 or 40 foot shipping container. The container building includes a fan forced cooling system and other necessary building auxiliaries. These units can be transported and installed on site with a minimum of installation work.

PowerStore models

The PowerStore can be configured in three different sizes: 500, 1,000 and 1,500 kW. The energy content of the flywheel remains 18 MWs for all three models (see data sheet for dimensions and ratings).

PowerStore How it works

PowerStore operation Charge control

The charge level at which the PowerStore normally operates can be set between full and empty during commissioning.

The normal charge level is set to ensure there is both sufficient energy and headroom to carry out the required grid stabilization. Recharging or discharging back to the idle energy level is controlled by a maximum power level that the PowerStore will consume or generate. The maximum power level can be set as a fixed parameter for charging or discharging or adjusted dynamically by an external power management system during operation (eg, the external power management system may only want to recharge, if renewable power is available).

Protection

The PowerStore has a number of protection systems in place including but not limited to:

- Mains overvoltage
- Flywheel and converter overtemperature
- Flywheel overspeed
- Flywheel over/undercharging
- Converter overcurrent

The PowerStore automatically adjusts its rating in the event the converter system detects a temperature overload. This ensures ongoing operation even during high temperatures.

Backup power supply

In the event of a mains failure (black station) the flywheel will slowly spin down until standstill. While it is spinning down it provides power to keep the control and operator interfaces alive to monitor the controlled shutdown process. No external UPS backup is required.

PowerStore operating modes and applications

The PowerStore can be configured according to the special requirements of each site. It is able to operate in either Grid Support Mode (GSM) for large networks or Virtual Generator Mode (VGM) for isolated microgrids.

The value of the PowerStore can be increased further through the introduction of the Microgrid Controller (MGC600) - the control system especially designed to match the needs of microgrids - which can enable additional features, including:

- Spinning reserve reduction (generator overload support)
- Renewable Only Mode



Inside view of PowerStore with inverters and flywheel

Grid interface cabinet with operator controls



PowerStore PS 12 scheme

Grid support mode

The PowerStore supports the grid by providing three support functions:

- Frequency support
- Voltage support
- Disturbance feed-forward

Frequency support reduces the disturbance in grid frequency by injecting active power based on the grid's frequency deviation from nominal. If the grid frequency is below nominal then power is injected into the grid, while power is absorbed from the grid if the frequency is above nominal; the magnitude of the injected power is a function of the size of the deviation. A zone or dead-band has been included to allow for a variety of primary grid frequency controllers; the dead-band size and position is adjustable.

Voltage support is a method of reducing grid voltage disturbance similar to that of a STATCOM. The PowerStore voltage support function implements a form of reactive droop control. Capacitive VArs (volt-ampere reactive) are injected into the grid if the voltage is lower than desired and inductive VArs if the grid voltage is higher.

Changes to the average or nominal system frequency or voltage are allowed to occur to accommodate operation in voltage and/or frequency droop and allow for the presence of a time correction system.

The disturbance feed-forward function reduces system disturbances, both in voltage and frequency, by injecting real and reactive power proactively based on fluctuating load or renewable energy source measurements. In essence this function counteracts the effects of a disturbance before it affects the grid frequency and voltage.

The above grid support functions are parameter-adjustable to allow for optimization of the system and tuning to the particular application and power system dynamics.

Virtual generator mode – Renewable Only Mode

In Virtual Generator Mode (VGM) the PowerStore operates as a generator and is especially suited to small isolated grids with a large amount of renewable energy connected. In this mode of operation the PowerStore is capable of operating as the only generator on the grid. For both modes in GSM or VGM in case of loss of plant within a power system (eg, a generator has tripped offline) usually a step in the system load appears which results in a large frequency deviation. Such changes can cause load shedding of consumer feeders. The PowerStore is capable of compensating for this step load by discharging up to its nominal power rating with a fast response. After the PowerStore has picked up the load and discharged its energy into the power system it gradually reduces its power output to pass the load back to the power system. In this event the PowerStore acts like a shock absorber to dampen the step load impact on the system's frequency and voltage.

In the above case a power management system coordinating the schedule of generation plant needs to call replacement capacity to ensure the PowerStore can pass the additional load back to the generators. For this purpose the PowerStore provides an interface that allows other controllers to monitor its status.

PowerStore works like an electrical noise filter to smooth power fluctuations and also has the ability to minimize the impact from loss of plant through the shock absorber, making PowerStore the ideal technology to manage the start of large loads, smoothing renewable energy fluctuations, or support system stability after a reclosing event.

Spinning reserve reduction

Isolated power systems require the provision of spinning reserve to allow for the sudden increase in load or the sudden loss of generation plant. Spinning reserve is usually provided by conventional generators such as diesel or gas-fuelled reciprocating engines. As a result generators are not operated at their rated power output where the fuel efficiency is usually the highest.

The PowerStore is able to provide the spinning reserve for the power system and allow generation plant to operate closer to their rated power output.

Generator overload support

The PowerStore can prevent the diesel/heavy fuel oil (HFO)/ gas generators from going into overload by monitoring their power output. This measurement can be provided by the ABB's microgrid controllers or a third party upper level control system.

In case the charge level of the PowerStore falls below a set parameter, the supervising power management system schedules additional generating capacity to start.

Fault ride through

The PowerStore is able to ride through faults, providing grid stability in case of a loss of a generator or large system disturbance.

The PowerStore is capable of providing real and reactive power to support the system

- When the system voltage is depressed
- During a fast rate of system frequency change
- During an instantaneous voltage phase shift

The above events usually occur during line faults within the distribution system. The PowerStore has been designed to ride through those distribution faults, provide system stability and support the system recovery after the fault has been cleared. The PowerStore remains connected to the network during line faults.

Power management system

The PowerStore is able to interface to external power management systems to receive power and reactive power set points that are independent of the voltage and frequency fluctuations of the connected grid.

The PowerStore comes with a dedicated interface to the control system from ABB. This allows the PowerStore to

interact with the whole power system not only based on electrical fluctuations but also on communication to other equipment like wind turbine generators or solar power plants.

Typical use cases/applications

- Isolated grids with high renewable energy input
 - The virtual generator mode provides additional inertia to the network to reduce frequency and voltage disturbances at high renewable penetration levels and power quality
 - The virtual generator mode allows the network to run without diesel generators
- Power systems with huge periodical scheduled loads that cause instabilities
 - The PowerStore is able to supply nearly limitless short period, high power cycling without detrimental effect on its life-span
- Reactive power balancing
- The PowerStore is able to inject and absorb reactive power independently of the real power behaviour
- General smoothing of load and generation fluctuations
- 100% renewable energy microgrids
 - Stabilization
 - Management of power flow
- Frequency master
- Larger grid stabilization
- End of grid support applications

Frequency variations and PowerStore power output in a high penetration wind diesel system



PowerStore Data sheet

Specifications		
Design life	20 years	
Nominal supply voltage	3 ph, 380 - 440 Vac	
Supply frequency	50/60 Hz	
Max. mains voltage	480 Vac	
Aux. AC supply	3 ph + N, 380 - 480 Vac, 50/60 Hz,50 A	
Under-voltage fault ride through	Yes	
Output short circuit protection	Yes	
Fault current available	Yes	
Paralleling of units	Yes	
Unbalanced current	Optional	
Technical data		
Nominal kVA rating	See table below	
Overload kVA rating	150% for 30 sec	
	175% for 2 sec	
	200% for 2 sec (75% pre-load)	
Nominal kW rating	See table below (max. 1,500 kW)	
Nominal kVAr rating	See table below	
(Power factor from 0 leading to 0 lagging is possible)		
Nominal current unbalance	100 A/phase	
Flywheel energy stored (@3,600 rpm)	18 MWs	
Estimated discharge/charge time @100 kW	150 s	
Estimated discharge/charge time @500 kW	30 s	
Estimated discharge/charge time @1,000 kW	18 s	
Estimated discharge/charge time @1,500 kW	12 s	
Flywheel operating speed range	1,800 – 3,600 rpm	
Minimum power to maintain SOC	15 kW	
Flywheel power losses	12 kW	
Power conversion efficiency charge or discharge	> 90%	
Min. charging power spin-up	35 kW	
Nominal DC-link voltage	750 VDC	
Altitude above sea level	< 1,000 m without derating	
Communication		
Supported protocols	Modbus TCP/IP	

Model	Nominal Rating (+/-kVA)	Building size (optional)	Approximate weight (incl. building)
	@440 VAC		Tonnes
PS04	458	20 ft	11.47
PS08	915	40 ft	11.96
PS12	1,372	40 ft	14.19

Contact us

ABB S.A. **Power Generation** Microgrids and Renewable Energy Integration C/ San Romualdo, 13 28037, Madrid Spain Phone: +34 91 581 938 6

ABB Inc.

Power Generation Microgrid and Renewable Energy Integration 1021 Main Campus Drive Raleigh, NC 27606

USA Phone: +011 919 856 2448

ABB Australia Pty Limited

Power Generation Microgrids and Renewable Energy Integration Export Drive Darwin Business Park Berrimah NT 0828 Australia Phone: +61 (0)8 8947 0933

www.abb.com/powergeneration

© Copyright 2013 ABB

All rights reserved. Specifications subject to change without notice. Pictures, schematics, and other graphics contained herein are published for illustration purposes only and do not represent product configurations or functionality.



EWT Direct Drive Wind Turbines brochure (EWT B.V.)







Proven robust 900kW Direct Drive Wind Turbine

The DIRECT**WIND** 52/54 – 900kW is a pitch controlled variable speed wind turbine that combines continuous market driven innovation with highly advanced direct drive technology. The DIRECT**WIND** 52/54 – 900kW turbine boasts a track record over 400 operating turbines in many different wind climates.

Specifications

Rotor diameter
IEC Wind Class
Rotor speed
Nominal power output
Hub heights

Cut-in wind speed Rated wind speed Cut-out wind speed Survival wind speed

Power output control Generator Power converter 52 or 54m IIA & IIIA Variable, 12 - 28 rpm 900 kW 35, 40, 50 and 75 m

2.5 m/s 13.5 m/s 25 m/s, 10 min. avg. 59.5 m/s

Pitch controlled variable speed Synchronous multi-pole wound-rotor IGBT-controlled





www.ewtdirectwind.com



Direct Drive Wind Technology

In EWT turbines the rotor directly drives the synchronous generator, without the use of a gearbox. This is important because various studies have concluded that the dominant cause of downtime is malfunctioning of gearboxes. The generated energy is fed into the grid via a modern back-to-back full-power converter which controls the output, so grid requirements can be met. This makes the *DIRECTWIND* turbine suitable to operate in weak grids.

Advantages of EWT's Direct Drive Technology:

- Superior availability levels
- No need to replace gearboxes
- High yields / return on investment
- Reduced noise levels

· Low cost of ownership

Low maintenance costs

Power quality & Site conditions

The *DIRECTWIND* turbine feeds generator power into the grid by means of a modern 'back-to-back' type full-converter system. This converter contains a number of programmable functions like a capability to control the reactive power output. Built-in grid-fault-ride-through technology is available on demand.

All the advanced grid-connection features combined make the *DIRECTWIND* the perfect choice for solitary applications, weak grids and demanding locations with constrains in site access.

The combination of advanced control features and proven wind technology makes the DIRECTWIND also a first-class choice with regard to energy yield. Fewer components, high reliability, reduced maintenance and excellent energy yield ensure an optimal return on investment. We are looking forward to showing you what our *DIRECTWIND* systems can offer.

DSP - DIRECTWIND Service Program

EWT stands for high-quality direct drive turbines characterized by reliability and cost efficiency. To ensure optimal performance and trouble-free operation of our DIRECTWIND turbines, we have a extensive service and maintenance program in place. The DIRECTWIND Service Program offers:

- Preventive maintenance
- Availability guarantee
- Extended product warranty
- Corrective maintenance
- Power curve guarantee
- Business Interruption compensation

The company

EWT is a designer and manufacturer of direct drive wind turbines active in Europe, North America and Asia. EWT was established in 2004 and is based in the Netherlands. The company has an extensive product line, an engineering department covering all relevant disciplines and a dedicated service and maintenance organisation.

Disclaimer: The information included herein is provided to you for general information purposes only. Although every effort has been made to ensure the accuracy of such information, EWT makes no representation or warranty of any kind, express or implied, as to the correctness, accuracy, reliability or completeness of the information.



EWT B.V.

Lindeboomseweg 51 3825 AL Amersfoort The Netherlands T +31 (0)33 454 05 20 F +31 (0)33 456 30 92 sales@ewtdirectwind.com www.ewtdirecwind.com

www.ewtdirectwind.com

Vergnet MP R Technical Description (Vergnet)





TECHNICAL DESCRIPTION



GEV MP R - TECHNICAL DESCRIPTION





TURBINE CONCEPT

• Rated Power	200-250-275 kW
Rotor diameter	30 - 32 m (98' - 105')
• Class (IEC 61 400-1)	30 m ll A or 32 m lll A
• Blades	2 blades - downwind
• Gearbox	2-stage planetary
• Hub height	32 m (105')
• Hub	Teetering hub
• Pitch	Hydraulic pitch
• Generator	2 speed, asynchronous,
	squirrel cage generator
• Tower	Tubular
	3 sections of 11.8 m (38'9'')
• Yaw	Hydraulic active yaw
• Output Voltage & Frequency	400 V - 50 Hz or 460 / 480 V - 60 Hz
• Power control	Pitch
• Reactive power control	Capacitor bank
·	
PACKING & INSTALLATION	
• Nacelle weight	9 t (19 841 lb)
• Tower weight	12 t (26 455 lb)
• Packing	• 2 x 40' containers + 1 x 20'
	+ blades (1 load)
	• For road transport : conventional
	flatbed trucks of equivalent length.
Concrete	50 m ³ (65 cu.yd)
• Erection	6o t crane

OPERATION

• Cut in speed 3.5 m/s Cut out speed

•	Max wind speed		
	Operation	32 m :	37.5 m/s (10 min avg.)
			52.5 m/s (3 s gust)
		30 m :	42.5 m/s (10 min avg.) 59.5 m/s (3 s gust)
	Temperature		
	Operation Survival	From -1 -20°C (-	2°C to + 50°C (10°F to 122°F) 4°F)

SCADA

Monitoring, remote diagnosis and maintenance, power control.

POWER CURVE

Hub height Wind speed	Power d=1.22	r (kW) 5kg/m³
(m/s)	Rotor 32m	Rotor 30m
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 5	0 3 17.9 36.5 58.4 98.1 141.1 188.7 242.8 271.7 275 275 275 275 275 275 275 27	0 3 14 28 51 80 113 151 192 238 270 275 275 275 275 275 275 275 275

AEP - ANNUAL ENERGY PRODUCTION

Hub height Wind speed	Annual gross production (MWh/year)	
(m/s)	Rotor 32m	Rotor 30m
4	164	133
4.5	246	200
5	342	281
5.5	449	372
6	560	470
6.5	673	572
7	785	676
7.5	893	778
8	994	876
8.5	1089	969
9	1176	1056
9.5	1254	1136
10	1324	1207
10.5	1385	1271
11	1436	1325

Weibull k=2 ; d=1.225 kg/m³

CERTIFICATION

- CENER : Sound level curve.
- DEWI : Power curve & power quality.
- APAVE : Safety systems.
- HEIGHTEC : Conformity to access regulations and work in height for the UK market.

and omissions , printing errors a Prod - P. Heitz This brochure is not contractual. Subject to technical alterations, Graphisme Emilie JACKOW 06 62 25 63 70 - Photo credits: Quasar I

1, rue des Châtaigniers - 45140 Ormes - FRANCE Tel. +33 (0)2 38 52 35 60 - Fax +33 (0)2 38 52 35 83 - export@vergnet.fr