Superwind Technology & Capabilities in the Arctic and Near Artic Regions.

Overview:

superwind GmbH (Germany) was established in 2002 after years of successful research, design and testing of its now internationally patented micro-turbine technology. Since then, thousands of commercially rated Superwind 350 (350 watts) turbines have been quietly providing reliable, autonomous wind generated electricity to users in remote locations under harsh conditions on both land and at sea, world-wide. In 2006 **superwind GmbH** created a long-term joint venture partnership with Mission Critical Energy Inc., (USA).

How is our company different?

1. We are not looking for investors and we do not sell stock. We are a self-sustaining, privately owned company managed by experienced wind industry leaders.

2. We sell fully developed, real-world tested products of the highest quality; this accomplished with no government funding or subsidies. We do not experiment on our customers.

3. Our products are made with pride in Germany and the USA. None are ITAR (International Traffic in Arms Regulations) restricted.

How are Superwind turbines different?

Superwind turbines were originally developed for marine applications and other remote, harsh environments, such as deserts, mountaintops and arctic regions. While we state we have an operating temperature range of **- 40 C° to + 55 °C**, our clients will readily confirm they have not only confirmed these limits, but often exceed them under real world conditions.

Over-speed control strategies: The Autonomous Furling Pitch Blade Mechanism

Like all wind turbines, ***Superwind*** turbines use the kinetic energy of the wind to generate electricity. The power generated is approximately proportional to the cube of the wind speed – i.e. doubling the wind speed results in eight times the power output. This means that while relatively little energy will be generated in light winds, a heavy storm contains such a high quantity of energy that the wind generator must be protected against overstress and damage.

Conventional small wind turbine technology provides only three options for dealing with high wind events. Stopping the turbine by electronic means as soon as it reaches its maximum output, having the turbine assume an ever increasing “helicopter position” (to reduce the surface area of the blades) or by entering into an “over-speed” condition, a situation that damages both internal electrical components as well as the blades themselves – not so with a ***Superwind***!

Part of the game changing innovation of a ***Superwind*** is its unique, aerodynamic rotor control system. Similar to large wind turbines, this system adjusts the pitch angle of the rotor blades. Unlike large turbines however, the ***Superwind*** reacts in milliseconds to avoid damage.

Our patented, rotor blade pitch control technology was developed to accommodate this special autonomous operation. The mechanical controller is fully integrated into the hub and works without the use of expensive, failure-prone electrical or hydraulic components. Instead, the

controller is actuated by forces arising during operation of the wind turbine and are generated by the geometric and kinematic lay-out of the rotor and controller mechanism. Aerodynamic force acts as a control variable to adjust the rotor blades for power regulation above nominal wind speed.

Centrifugal force is the second control variable for rotor blade adjustment. Due to the special arrangement of both force components, the mechanical controller automatically limits rotor speed (even at extreme wind velocities) and protects the wind turbine from over speed or during no-load operation. As a result, the controller significantly limits mechanical loads at high wind speed, guarantying smooth operation under all weather conditions. In the SW 350 turbine, the blade pitch is a function of combination forces on the hub and blade set, meaning the blades adjust in real time to create an operation nearly free of noise and vibration.

Ever-Loaded ™ Generator Control

When a small wind turbine is allowed to spin free without a proper electrical connection or load, dangerous RPM and high voltage and amperage spikes can result. This in turn can lead to the damage and eventual destruction of the turbine, as well as other key components such as charge controllers and batteries.

For five decades, most of the small wind industry called for the wind turbine be turned off when there was "too much wind' (typically about 12 to 14 m/s). In commercial applications, particularly those on high towers or in remote locations, these typical instructions are completely inappropriate. For lack of proper solutions, inexpensive wind turbine manufacturers then began the practice of "artificially loading" their wind turbines to bring them to a stop in high winds. A low cost, low technology solution that repeatedly fails in the real world, this practice not only damages the wind turbine components in the long run, but also wastes precious battery power while endangering the battery bank itself. The end result is a cheap, poorly designed solution for stopping low quality wind turbines in high wind. Superwind turbines DO NOT use this dangerous method!

***Superwind*'s** Integrated Concept Strategy (ICS) approach enables us to not only keep the turbine loaded at all wind speeds, but also allows it to safely charge and maintain all types of commercially available battery types (including Lithium) efficiently. By designing our turbines with mechanical over-speed controls, we limit how much energy can be sent to the charge regulation system. This "whole system" approach provides accurate, precise battery charging regardless of how much wind is impacting the mechanical power generation system.

More importantly, this means that the ***Superwind*** provides truly autonomous service and never has to be "turned off" once properly installed. The turbine can remain in the "run" condition at all times, staying connected to the battery bank while under charge controller management to protect against battery overcharging.

Temperature Compensated Charge Control & Diversion Control

Wind turbine charge controllers are very different from solar panel charge controllers in that they are designed to electrically maintain the load correlation with the battery bank, while simultaneously producing power above the ever-changing battery state of charge. This design allows the batteries to be properly charged based on ideal temperature compensated charging rates.

The ***Superwind*** Charge Controller Diversion mode engages when the batteries have reached their maximum charging voltage. When this occurs, the ***Superwind*** Charge Controller's PWM circuit automatically diverts the wind turbine´s surplus power to the diversion load /power resistor bank. With this technology, even when the batteries are fully charged the wind turbine continues to generate usable power (while there is ample wind) providing real time power to other electric consumers (loads) as they are automatically or manually brought online.

For our commercial customers located in extremely cold climates, our diversion system can also provide an additional heat source, allowing the batteries to be either in a state of charge or potentially "warmed" by the diversion load.

Non-ITAR Innovations for use in Rime Ice Areas:

In 2015, the leadership of SOCOM (United States Special Operations Command) publicly expressed concerns about the militarization of the Arctic at the Special Operations/Low Intensity Conflict conference (2015) and in subsequent communications over the next two years, identified a serious need for equipment that would operate reliably in those extreme conditions.

With the experience of providing power generation equipment to the Arctic for well over a decade, Mission Critical Energy Inc. independently verified some of the requirements to meet United States Special Operations Force's needs (power loads for communications, mobile aspects, etc.). We then combined three new technologies to overcome the Arctic region's most serious operational survival issues: High Winds, Extreme Temperatures (cold), and Rime Ice. Mission Critical Energy's Superwind 350 Micro-Wind Turbine Generator was made available with both an Ice-Phobic Coating, as well as battery charging technologies that allow batteries and other equipment to stay "warm" within operational temperature ranges that typically would not work in Arctic conditions.

Superwind's advanced technology allows users to eliminate the weight, cost, maintenance and required manpower of traditional power generation sources in some of the world's most windy areas. This ability to rapidly deliver an autonomous, renewable energy based power supply into the Arctic may allow SOF teams and others to develop and power both manned and unmanned intelligence, reconnaissance and surveillance systems.

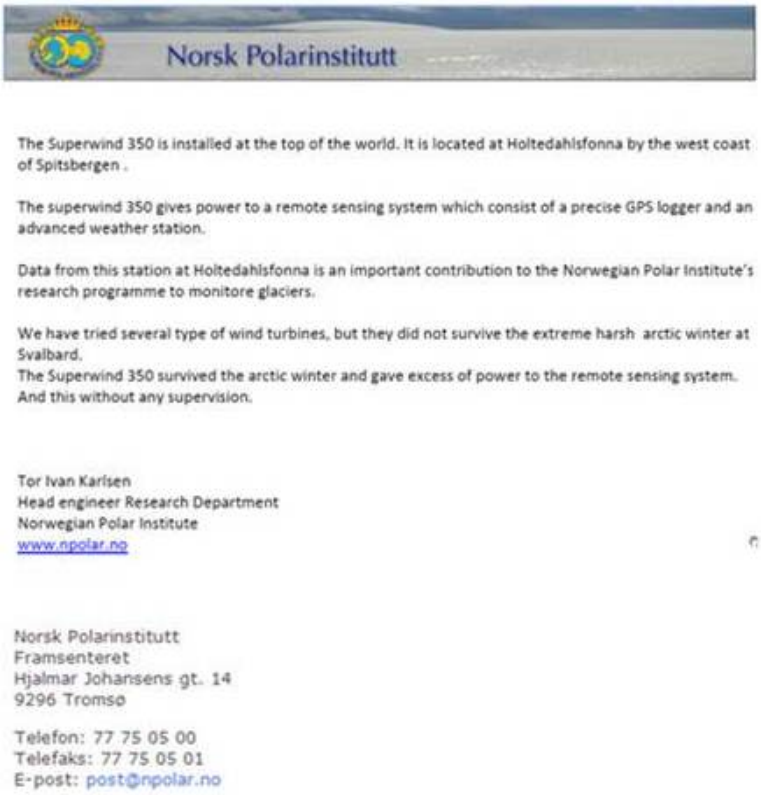
Our Real world history of working in Arctic and Antarctic conditions:

Mission Critical Energy Inc. has had a special focus on integrating ***Superwind*** turbines in the open ocean and in extremely cold areas since 2006 and was one of the founding exhibitors of the Arctic Technology Conference (an offshoot of the Offshore Technology Conference). For over a decade our customers have included many groups, organizations and companies conducting operations in or near the Arctic and Antarctic. These clients include:

- Woods Hole Oceanographic Institute
- Alfred Wegener Institute
- Norwegian Polar Institute *(in Norwegian: Norsk Polarinstitutt)*
- Shell
- Raytheon

- Rio Tinto
- Agnico Eagle
- TARA ARCTIC part of the international DAMOCLES (Developing Arctic Modelling and Observing Capabilities for Long-term Environmental Studies) program.

Our clients know they are working in the harshest of conditions, appreciate our technology and are quick to give appropriate references [see the Norsk Polarinstitutt letter below].



Norsk Polarinstitutt

The Superwind 350 is installed at the top of the world. It is located at Holtedahlsfonna by the west coast of Spitsbergen .

The superwind 350 gives power to a remote sensing system which consist of a precise GPS logger and an advanced weather station.

Data from this station at Holtedahlsfonna is an important contribution to the Norwegian Polar Institute's research programme to monitore glaciers.

We have tried several type of wind turbines, but they did not survive the extreme harsh arctic winter at Svalbard.
The Superwind 350 survived the arctic winter and gave excess of power to the remote sensing system.
And this without any supervision.

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Because of strict Non-Disclosure Agreements, we cannot mention a number of projects we have contributed to (military and industry alike), however we can share some documents and references upon request.

Although we are not currently a direct contributor to projects involving the US National Science Foundation, it is fair to say that ***Superwind*** technology is being used on land, at sea and in Arctic conditions in the U.S., Greenland and Canadian territories by our clients such as Woods Hole Oceanographic Institute and others. Our technology has been used successfully in a number of these programs for over a decade, often deployed to work autonomously for years at a time, while we have worked quietly "behind the scenes" to integrate the small wind systems and vital equipment necessary to make them a success. We welcome the opportunity for the National Science Foundation to become better acquainted with our company, our leading-edge technology and our proven record of success.

It should also be mentioned that we have never taken part in the many "university" style grant programs and "one-off" research programs continually offered to our company. The previously mentioned research groups (who are also repeat customers) discovered us through the gas, oil, and mining industries, as well as the military – end-users who needed reliability and not just another R&D experiment. Our mission is to not only produce electricity from wind resources autonomously in remote and harsh conditions, but also to assist our clients integrate this technology in a realistic way.

In addition to this Superwind Technology & Capabilities Overview, we will provide some confidential photos (via PDF) as well as an article from the DOD Energy Magazine (provided with permission by the publisher). Please look for these separate attachments.

We welcome you to contact us directly with any questions that might help you or your team better understand the products they are researching or to receive our list of customer references.

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