

LIBERTY

THE LIBERTY 2.5_{MW} WIND TURBINE...

...A NEW STANDARD FOR RELIABLE PERFORMANCE AND REDUCED OPERATING COSTS.




Conventional wind turbine architecture has remained relatively unchanged since its modern beginnings in the early 1980's. Its scaling-up in size over recent years, however, has placed extreme forces on today's large megawatt-plus machines, calling for an advanced architecture appropriate for larger-scale operating requirements...namely lower rotor speed and the ability to manage exponentially higher torque in the power-train.

With a goal to create an advanced wind turbine that would simply and innovatively improve upon standard industry benchmarks and address today's wind technology deficiencies, the Liberty design was born. Through her Quantum Drive™ power-train, an evolutionary, advanced method of torque splitting, Liberty eases point loads, reduces major component failures and extends operating life.

As one might expect, a book of new patents flowed from Liberty's remarkable design. From her compact, highly durable and efficient power-train, to simpler, more effective variable speed control and voltage ride-through capability that exceeds the most stringent of planned grid standards. Liberty also achieves higher power-train efficiency through the use of four permanent magnet generators, delivering continuous power generation, even through a generator outage.

LIBERTY



Liberty's standard features offer an abundance of crew safety and installation economy benefits as well as machine health monitoring for preventive maintenance. She's Germanischer Lloyd certified to 20 and 30 year fatigue lives, compact enough for installation with a crane sized for standard 1.5 MW units, and carries her own on-board hoist for ease of maintenance.

Liberty...reduced long-term operating costs and longer machine life... it's operating peace of mind. From her mechanical soundness to electrical simplicity, she's a seamless mixture of efficiency and value-driven quality.

*“ Liberty...she's simply an innovative,
evolutionary advancement of long-proven
wind turbine design. ”*

- Amir S. Mikhail, Ph.D. - Clipper Windpower

LIBERTY



WE KNOW SHE'S BEAUTIFUL...NOW, LET'S TALK INTELLIGENCE

QUANTUM DRIVE™...THE SOLUTION TO POWER-TRAIN TORQUE LOADS...

Liberty's patented quantum distributed generation power-train, "Quantum Drive," a compact two-stage helical distributed design, offers a breakthrough in trouble-free power-train operation.

Gone are the stresses found in standard three-stage planetary gearboxes typically used in today's multi-megawatt wind turbines. Through its load-distributing, multiple-path design, a total of four high-speed output shafts split torque loads from the rotor mainshaft to the generators by a factor that is four times greater than standard gearboxes.

Liberty also employs two pre-loaded, low-speed tapered-roller main bearings to absorb thrust loads, preventing damage, minimizing downtime and extending turbine life. Unlike standard drivetrains, there is no problematic axial motion or mainshaft mis-alignment in Liberty as both are also stabilized through her two robust tapered roller main bearings.

To further reduce long-term operating costs, Liberty's high-speed gear sets are in "cartridge" form and can be easily replaced with her on-board hoist without removal of the gearbox. Multiple inspection ports simplify routine monitoring by way of easy visual observation in addition to an advanced gearbox health monitoring system.

IG GENCO

LIBERTY'S PERMANENT MAGNET GENERATOR ADVANTAGE...

When it comes to generators, permanent magnet was a simple choice. Unlike the industry's most commonly-used doubly-fed generators, permanent magnet is simpler, nearly maintenance-free, and operates at higher efficiency over a wider range of power output. Since there is no need for current to be fed into the generator rotor, stray currents are not created, thus pitting and bearing failures are pretty much a thing of the past.

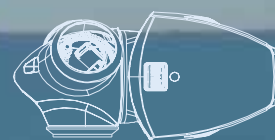
With no brushes, there are none to replace. There's also no need for coupling or a slip clutch between the gearbox and generator since the unit's short-circuit current is low; a benefit that results in lower short circuit torque overall, and absorption of fault torques without harm to the gearbox.

The generator's form-wound Class H insulated stator winding operates at less than a Class F rise in temperature and is rated for medium voltage, another benefit compared to the standard random-wound generator designed only for lower voltage. Liberty's power-train system can operate with only two or three generators, continuing to deliver at a reduced power output until service can be performed. Compact and lightweight, the generators can be serviced via Liberty's on-board jib hoist...no need to bring in a large, costly crane. Finally, the permanent magnet generator system, in combination with the Liberty converter, is grid friendly, staying near unity all the way down to five to ten percent of load, minimizing the need for VAR correction.

Available in two configurations: A IP54 totally enclosed water-to-air-cooled model offering contamination-free enclosure for harsh environments, including damp, corrosive salt situations; and, the IP54 air-cooled system, with filters that protect the generator from contamination.



VARIABL



E S P E E D

SIMPLIFIED VARIABLE SPEED OFFERS GREATER RELIABILITY

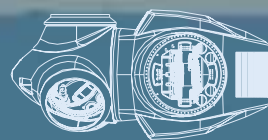
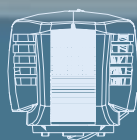
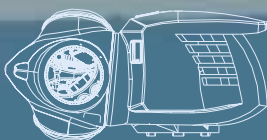
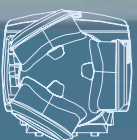
Clipper's patented variable speed system is simpler, more reliable, and meets IEEE 519 high quality power requirements now common in all major electricity power markets.

Today, most variable speed systems are based on a doubly-fed generator with the generator rotor wired directly to dual IGBT's, which, at lower wind speeds, flow current into the generator rotor, and, at higher wind speeds, draw current out to maintain the turbine's desired power output frequency. As the current is transferred, it is conducted through high power slip rings and brushes which require frequent maintenance due to damaging stray currents induced in the generator rotor shaft. Also, these stray currents often find way to an electrical ground, arcing across generator bearings, causing pitting which can lead to costly failures of the generator, turbine downtime, and expensive crane mobilization.



Through Clipper's variable speed system, greater efficiency and reliability is made possible by recent advances in larger capacity IGBT's and the use of proprietary permanent magnet generator technology. Here, power is delivered exclusively from the generator's stator where it is rectified to DC current. Advanced and more reliable IGBT's convert the

DC power to AC current, simply and efficiently maintaining the unit's desired power factor. By way of this simplified process, the need for troublesome slip rings and brushes is eliminated.

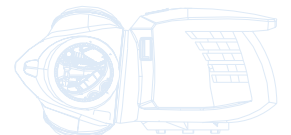
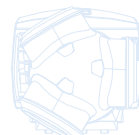
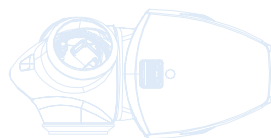


POWER



WIND TURBINE CONTROL

As you might expect, Liberty's control system provides high reliability with simplicity. Through the use of high-speed embedded processors, algorithm processing is repeated every 50 milliseconds. Because unity power factor is produced down to a low percentage of rated power, the need for VAR correction at the substation is reduced. Through the system's line power factor control, Liberty rides through system faults and line outages for up to three seconds. Liberty's control system has fewer parts, about half in fact, than today's standard turbine, resulting in higher reliability overall and greater time between failures.



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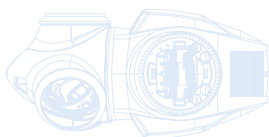
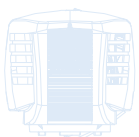


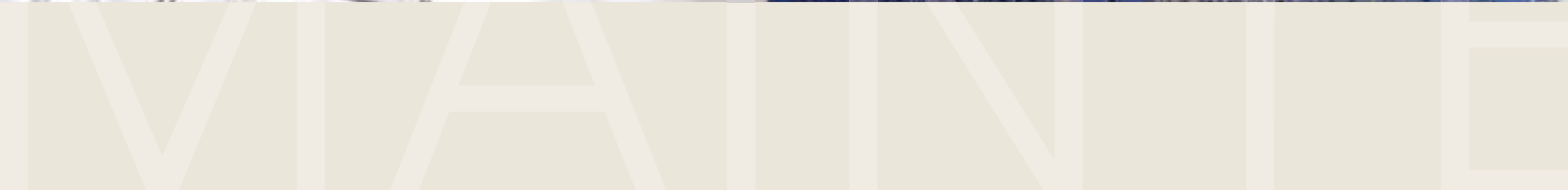
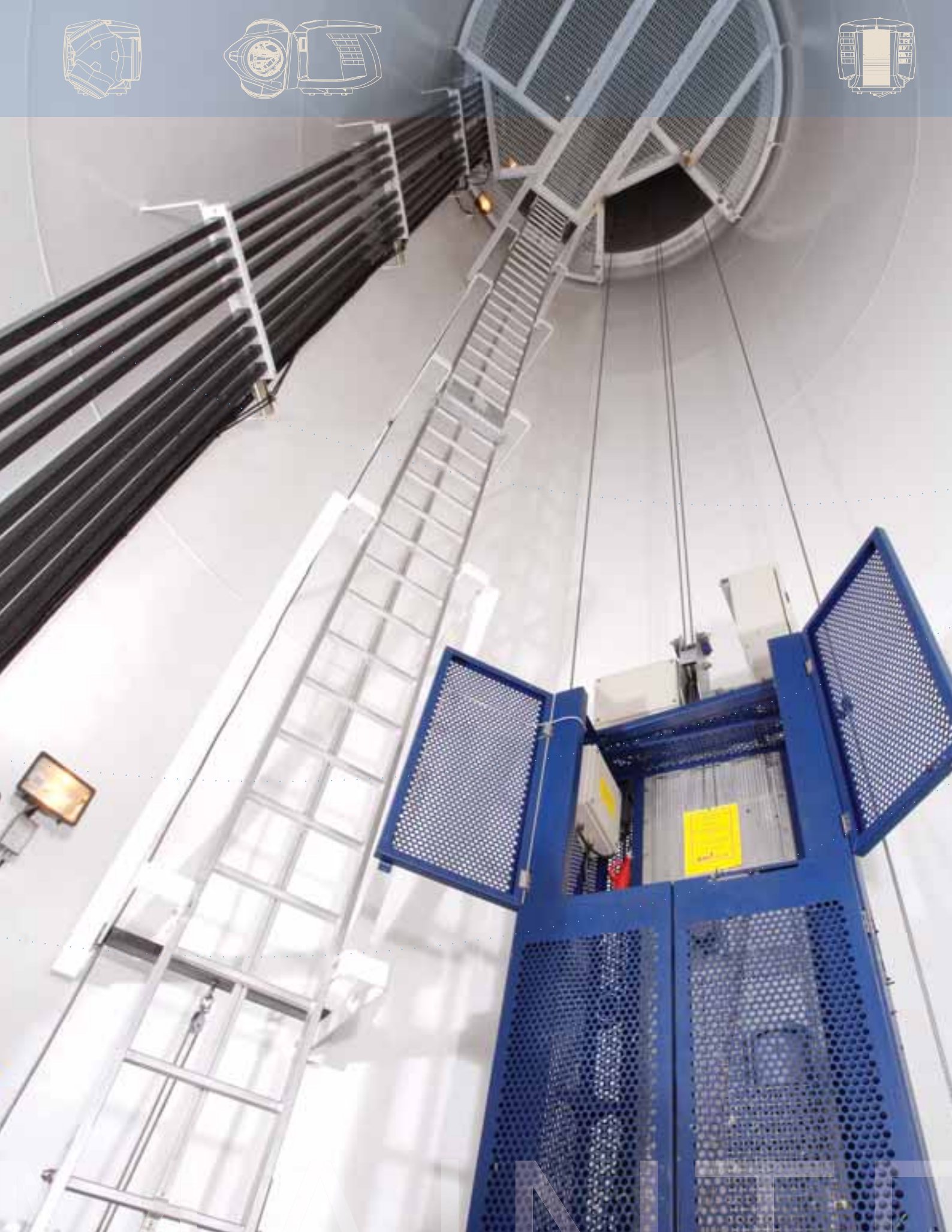
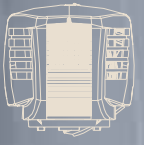
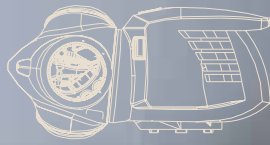
EXTENDED LOW VOLTAGE RIDE THROUGH CAPABILITY

Increasingly, stringent ride-through requirements imposed by regulatory agencies and transmission operators is a factor with which today's turbine owners must comply. Liberty's extended low-voltage ride-through capability works through the generator's stator, completely isolating the generator from the grid, resulting in simpler low-voltage, greatly extended ride through capability, immune from grid disturbance.

LIGHTNING PROTECTION...AT ITS BEST

Minimizing costs associated with unscheduled maintenance is fundamental to Liberty's design. When storm clouds roll in, Liberty's lightning receptors at the tip of each blade connect through brushes on the blade bearing and main shaft to carry lightning strike current down the tower to ground. For service crew and machine safety, a nacelle steel-mesh Faraday cage is an added protective measure. Control signal wires are further protected within a second Faraday cage. As has been repeatedly demonstrated, Liberty is able to ride through severe lightning strikes with minimal to no damage or loss of availability.





SERVICE AREAS BASED ON SAFETY AND ERGONOMICS...

TWO-PERSON SERVICE LIFT

While many may consider the climb to the top of a wind turbine a “rite-of-passage,” after two or more trips each day, service teams may disagree. Liberty’s two-person service lift facilitates timely and efficient service calls, translating to higher turbine operating availability. At the same time, this feature opens career opportunities to a broader range of technician service candidates, and experienced service personnel who are now able to lengthen their careers without the limitation of stringent climbing requirements.

OPEN, SPACIOUS POWER CABIN

For those who work each day, there’s something to be said for full, stand-up workspace, the convenience of a workbench, and near obstacle-free walkways. Environmental, health and safety features have also been designed into Liberty, including an in-tower oil containment deck located below her power-train along with standard personnel evacuation equipment in every nacelle.



LIGHTING AND VENTILATION

A 6’x12’ roll-down door located at the stern of Liberty’s nacelle provides a wide and open access if ever a need for component change out. The on-board, 2-ton jib hoist can easily reach the key components in the nacelle and safely bring most of them down-tower without the use of expensive conventional ground cranes. At the same time, the door can be used to provide both ventilation and ambient light.

INTERIOR HUB ACCESS

Hub access was one of our service teams’ most requested features. Access to and from Liberty’s hub is through a trio of man-sized ports located inside her nacelle housing; there is no need to exit the topside of the nacelle to drop into the hub for service functions. Particularly in rain and icing conditions, this feature offers a much higher level of worker safety and maintenance efficiency and leads way to higher availability. If a need arises to change out a pitch motor, in fact, the task can be performed simply via the hub’s port access by use of a small, portable 2-ton jib hoist supplied by Clipper for each project site, which attaches to convenient lifting eyes inside the hub.

ADVANCE

CONDITION BASED MONITORING

Condition monitoring has matured as a robust and established way to understand the machine and detect wear and warning signs in advance of costly repair. Maintenance changes from being reactive to predictive with measurable savings in availability and cost of unscheduled maintenance and repair. Liberty's optional condition based monitoring regime includes a number of ongoing, advanced systems: a gearbox oil particulate and health monitor; both on-line and off-line measurements for gearbox and generators, which includes a triple redundant vibration monitoring system.

LIBERTY'S ON-BOARD JIB HOIST

A key cost-saving feature Liberty affords you is an on-board, two-metric ton service hoist. Available to assist with standard maintenance activities, if the need were to arise, Liberty's hoist can also be used to efficiently change-out generators, high speed gears, yaw motors and pitch motors. Coupled with her modular distributed power-train and multiple permanent magnet generators, Liberty's on-board service hoist significantly reduces, if not eliminates costs associated with the use of large, expensive cranes. Ultimately, it's about Liberty delivering more power generation for you.

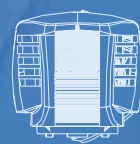
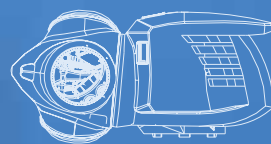


AVA

Liberty's installation process utilizes the same size crane, as well as the same amount of time to install as a standard 1.5 MW unit... reducing installation cost and increasing value on a per megawatt basis.



LABILITY



QUALITY MANUFACTURING AND ASSEMBLY

Assembly is performed at Clipper Turbine Works, a Cedar Rapids, Iowa facility. Located in the middle of the U.S. near major road, rail and river barge services, the facility has over 200,000 square feet of available space, affording a base-line capacity of 350 units per year. Spare parts for support services are also facilitated from this location. Significant investments have been made to ensure state-of-the-art operations.

Clipper's purpose designed components manufacturing is outsourced to well established companies with specialized industrial expertise. Underpinning our core competencies of design, assembly and supply chain management is a culture of quality and ISO 9001:2000 compliant Quality Management System "QMS," designed to manage the full life cycle of our product from design through ongoing operation and maintenance. Clipper's trained quality assurance staff is on site at Clipper's Iowa assembly facility as well as at the plants of its key component suppliers to assure that production is performed to the highest standards.

Extensive testing, inspection and checks are performed on components and systems to verify integrity prior to delivery to the project site. Component inventory through serial and lot control ensures knowledge of components utilized within the final assembly.



OPERATION & MAINTENANCE

During Liberty's warranty period, Clipper provides service support, covering both scheduled and unscheduled maintenance. Clipper's Fleet Service team members are among the wind industry's most skilled, with decades of experience providing a highly qualified professional base. Our team is motivated and incentive-driven toward the highest level of safety, customer service and satisfaction. Our goal is to provide you the highest service value available.

YOUR WARRANTY...OUR COMMITMENT

Your Liberty wind turbines arrive at your project site warranted for two to five years, based on your unique operations needs. Similar to other industry standard warranty packages, the Clipper warranty includes coverage of material and workmanship for all components of the turbine.

VALUE / DEPENDABILITY / QUALITY

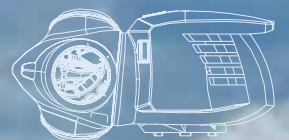
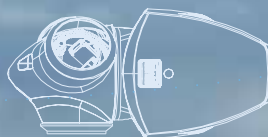
Integrity, dependability and quality are paramount at Clipper. Our aim is to assure you receive the quality and value you expect.





LIBERTY I...FIRST COMMERCIAL TURBINE OPERATION

NEXT GEN



THE FIRST OF THE NEXT GENERATION WIND TURBINE DESIGN



Liberty I, the first commercial Liberty wind turbine, has been challenged and tested in Wyoming's harsh site conditions since March 2005. The site is remote, with little maintenance infrastructure. It has subjected Liberty to extreme temperatures, extended high turbulence wind squalls, and an abundance of lightning, ice and snow. These severe conditions have both challenged Liberty and enabled the testing team and maintenance crews to acquire valuable lessons learned which have been applied to Liberty's production models.

Since Liberty's operation began in March of 2005, tests have confirmed her design. She continues to demonstrate high performance.

NOTABLE ACHIEVEMENTS

- Validating her low-maintenance design, all maintenance, including a generator change-out and other miscellaneous services, have been carried out through use of Liberty's on-board hoist, negating the need for an expensive large-scale crane to be deployed to the site. As a first commercial turbine, with all the testing and adjustments associated with initial operation, this is fairly unusual. The key to this achievement is robust design and the ability to service almost all components subject to routine wear using the 2 metric-ton, on-board service hoist. This capability significantly reduces the crane costs for repair and largely eliminates the down-time associated with crane availability.
- Liberty continues to validate the effectiveness her advanced lightning protection system. After three lightning strikes in 15 months, she continued to operate without damage or fault disturbance. A more recent, fourth lightning strike produced minor damage to a blade tip which was repaired by a small crew through use of a man-basket – there was no need for an expensive on-site crane.

GENERATION



TECHNICAL SPECIFICATIONS - LIBERTY 2.5 MW WIND TURBINE

Power Output 2500 kW
 Operation Variable Speed: 9.6 - 15.5 rpm

Model	C89	C93	C96	C100
Wind Class	Ia*	IIa	IIb	IIIb
Rotor Diameter	89m	93m	96m	100m
Swept Area	6221m ²	6793m ²	7238m ²	7854m ²
Blades	43.2m	45.2m	46.7m	48.7m

* Class Ia - All parameters same as IEC Class Ia except 50-year return gust value is 64.5 m/s instead of 70 m/s

Cut-in Wind Velocity 4 m/s - 10 min. Average
 Cut-out Wind Velocity 25 m/s - 10 min. Average

Pitch System 3X DC Electric-Mechanical Gearmotor, Servo Drives and Batteries

Generator Type Synchronous Permanent Magnet
 Rated Power Each 660 kW at 1133 rpm
 Number of Units 4
 Voltage 1320 VDC at Rated Power

Controller Type Embedded Motorola Power PC
 Voltage 3 Phase 480 VAC

Power Converter Type 4X, Voltage Sourced, IGBT Based
 6 Pulse, Inverters
 Voltage 690 VAC, 50Hz or 60Hz \pm 3Hz

Grid Compatibility Frequency-Continuous 50Hz or 60Hz \pm 3Hz

Line Voltage 690 VAC \pm 10% Continuous

Line Fault Ride-Thru -90% of Nominal Line for 3 sec.

Line Phase Imbalance Rated Power \pm 5%, Cut-in \pm 10%

Yaw System 4 Electro-Mechanical Motors with Planetary Drives
 Yaw Bearing Internal Gear, Ball Bearing
 Yaw Brake System Disc, 4 Active Hydraulic Brake Calipers

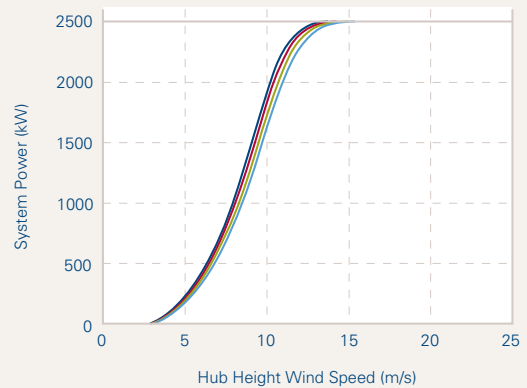
Parking Brake System Dual Disc with Active Hydraulic Brake Calipers
 Parking Brake Location Intermediate Stage of Gearbox

Tower Partial Conical - Tubular Steel, 4 Steel Plate Sections
 Hub Height 80m Standard / Other Options Available

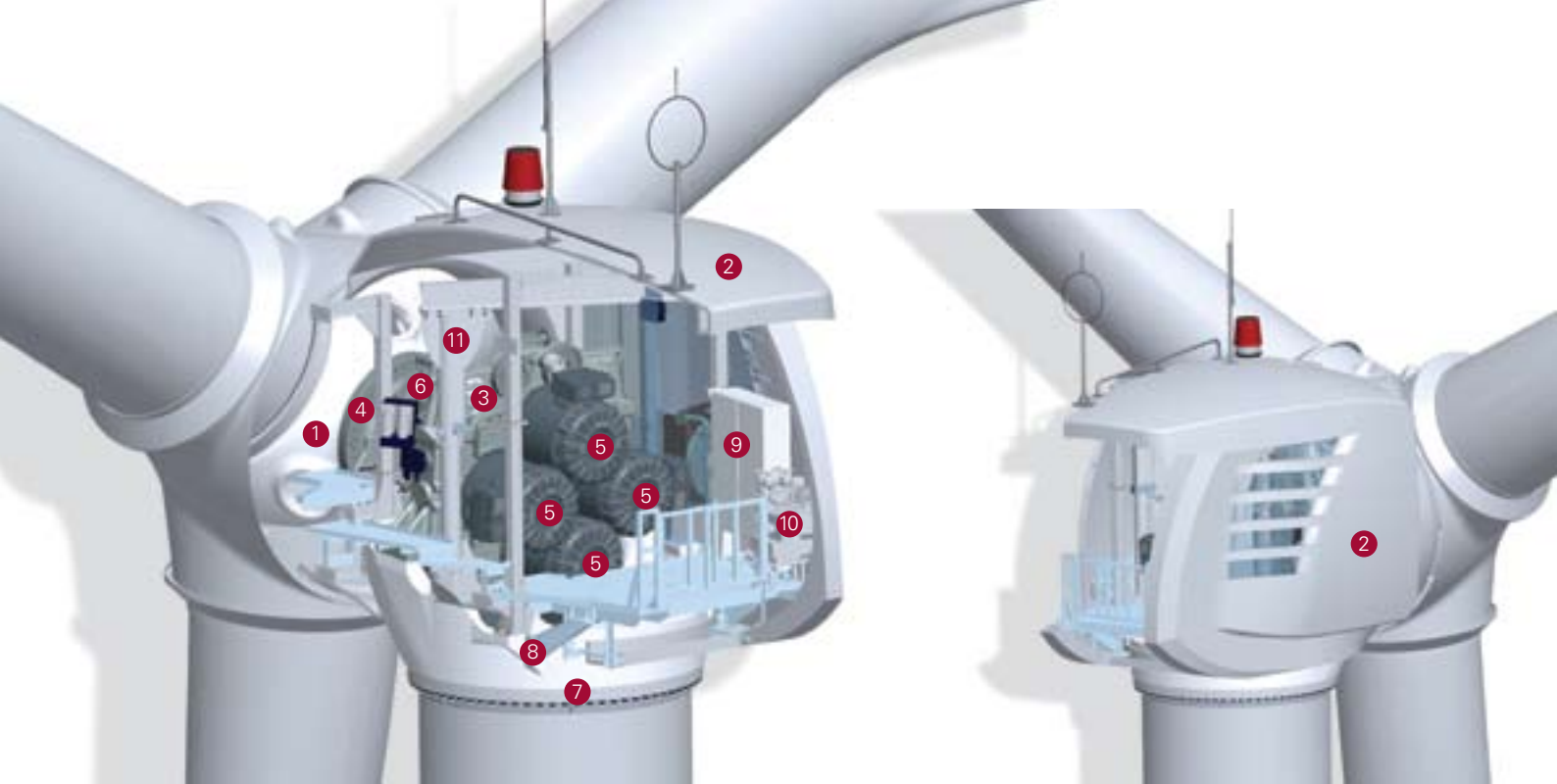
Service Hoist On-Board, 2 Metric-ton Jib Hoist

Maintenance Post Commissioning Once at 700 Hours, Every 6 Months Thereafter

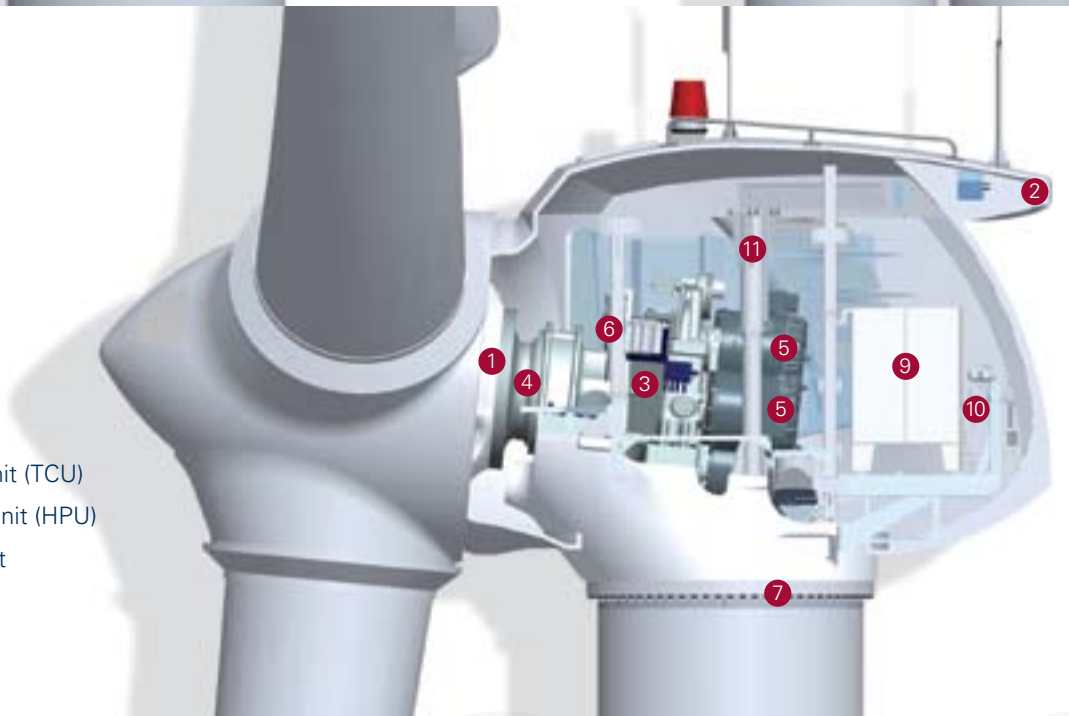
Power Curve



- C100, class IIIb
- C96, class IIb
- C93, class IIa
- C89, class Ia*

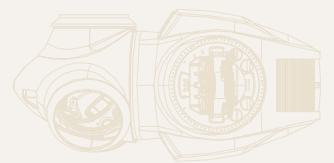
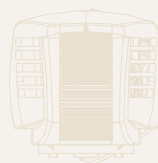
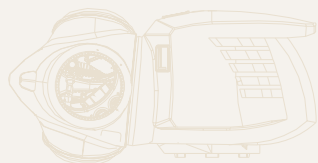



- ① Hub
- ② Nacelle
- ③ Gearbox
- ④ Main Shaft
- ⑤ Generators
- ⑥ Parking Brakes
- ⑦ Yaw System
- ⑧ Machine Base
- ⑨ Turbine Control Unit (TCU)
- ⑩ Hydraulic Power Unit (HPU)
- ⑪ On-Board Jib Hoist



CERTIFICATIONS

- Germanischer Lloyd WindEnergie GmbH: Operation in extreme cold climate conditions (C93 and C96)
Temperatures down to -30° C, survival to -40° C.
- Germanischer Lloyd WindEnergie GmbH: Statement of compliance for design assessment of the wind turbine:
WT-00-009A-2006 (C93) / WT-00-008A-2006 (C96) / WT-00-012A-2006 (C89)
- USDOE's NREL Accredited Lab 12/04-3/05 : Drivetrain dynamometer test





Clipper Windpower is a rapidly growing company engaged in wind energy technology, turbine manufacturing, and wind project development. With offices in California, Colorado, Maryland, Mexico and the U.K., and a ISO9001:2000 QMS Certified, 200,000 square foot manufacturing and assembly facility located in Cedar Rapids, Iowa, the company designs advanced wind turbines, manufactures its 2.5-MW Liberty wind turbine and actively develops wind power generating projects in the Americas and Europe. Clipper is a public company listed on the London Stock Exchange's Alternative Investment Market (AIM). Clipper's ticker symbol is CWP.

The ordinary shares of Clipper Windpower Plc are traded on the Alternative Investment Market of the London Stock Exchange and are not registered under the U.S. Securities Act of 1933, as amended. Such shares may not be offered or sold to residents of the United States or to persons acting on their behalf, or to other persons who are "United States Persons" within the meaning of Regulation S as promulgated under the Securities Act of 1933, unless such shares have been registered under the Securities Act or there is an available exemption from registration.

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