



Ciesse Energia mod.100312 – A
100Wheel wind turbine

- Technical specification -

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1. General characteristics

Ciesse Energia 100312-A (100Wheel) is a three-bladed last generation PM generator wind turbine, 100kW rated power with top quality components and high technological standards. The system is developed by Ciesse Energia, in collaboration with Soga Spa and other Italian partners, so the PM generator, yaw system, double converter, cabling, pitch control components and all the structures are supplied by Italian primary manufacturers. The amplitude of the rotor - available in 21mt - the height of the pole – 30 or 40 meters - ensure the best performance and make the turbine suitable for installation also in low windy sites. The system is also equipped with active pitch control with linear actuator that, by varying the angle of inclination of the blades, controls the output, enables to enjoy high winds without stressing the braking system. The technical characteristics of the turbine also make it one of the quietest on the market. With excellent performance in terms of annual production, 100Wheel is an investment

very interesting and convenient. The turbine starts producing power below the wind speed of 4 m/s, reaches its nominal power of 100 kW at a wind speed around 11 m/s, this value is kept constant with winds up to 20 m/s through the pitch control system.

The synchronous generator connects to LV by a three-phase inverter. 100Wheel - installed on a polygonal monopole– thanks to the embossed placement of the generator is characterized by a shorter tower, thus guaranteeing a latest design, very compact, on compliance with all environmental laws and a very small space occupation on the ground.

The towers have an internal ladder for direct access to the nacelle, to ensure maintenance activities whatever the weather.

The design and the low speed rotation minimize noise and ensure less wear on equipment.. Thanks to these features, the system requires lower maintenance on the wind turbine lifespan, bringing down costs drastically.





TECHNICAL DATAS

Main data

Manufacturer	Ciesse Energia S.r.l.
Model	100312-A 100Wheel
Type	On-grid
Configuration	Horizontal axis; upwind
Design lifespan	20 years
Rated power	100 kW
Rated windspeed	11 m/s
Cut-in windspeed	4 m/s
Cut-out windspeed	20 m/s
Survival windspeed	40 m/s
Hub height	30 m, 40 m
Power controls	Variable pitch control controlled by a microprocessor (Active Pitch Control); Dump load (optional); Yawing; Hydraulic Brake

Rotor

Number of blades	3
Diameter	21 m
Swept area	346 m ²
Rotor rated speed	68 rpm

Blades

Length	10 m
Material	Fiberglass reinforced polymer
Blade thickness (max)	45 cm
Blade breadth (max)	107 cm

Generator

Manufacturer	Soga S.p.A.
Model	EV710S
Type	Permanent magnet / synchronous / 3 phase / direct drive / Insulation class H / Over temperature class F
Voltage	400 V (ac)
Frequency	50 Hz (60Hz option)
Maximum power	110 kW (ac)
Rated current	210 A (ac)
Rated speed	68 rpm

Brake system

Manufacturer	Stromag France or equivalent
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Type	Hidraulic
<u>Weights</u>	
Nacelle	≈4500 kg
Rotor + hub	≈1500 kg
<u>Converter</u>	
Manufacturer	Elpower S.r.l.
Model	CLEANVERTER 100
Maximum power output	100kW (ac)
Rated voltage	400V +/- 10% (ac)
Power factor cos φ	0,99
Performance	97%
Compliance	EN 61000-3-12; ENEL DK 5940
<u>Control systems and sensors</u>	
Type	PLC
Manufacturer	Mitsubishi Electric
Model	Q Series (QS)
Communication	RS-232 / RS-485/USB/Ethernet TCP-IP
Sensors	<ul style="list-style-type: none">• generator temp;• <i>dump load temp</i>• other temps;• wind speed - (Thies Clima);• wind direction (wind vane) – (Thies Clima);• generator speed – (Omron);• nacelle movement – (Omron);• pitch movement;• twisting;• vibrations;• inclination;• <i>many others.....</i>
<u>Towers</u>	
Type 1	Steel made polygonal (16 sides) conical tower S355JR
Heights	29,25 m, 39,25 m
Optionals	safe climbing system external/internal ladder , tower-top work platform;



Yaw & Pitch system

Manufacturers

Brevini S.p.A., Servomech S.p.A. or equivalent (motors) / La Leonessa S.p.A. or equivalent (bearings and rings) / Mitsubishi, ABB or equivalent (electronics)

Type (YAW)

Active, with electronic yaw system

Type (PITCH)

Active

Standards

Protection rate

IP65

Conformity

IEC 61400

First security level

active pitch control

Temperatures

from - 20°C to + 45°C (optional less of -20°C)



POWER CURVE

Wind speed (m/s)	Output power (kW)
2,0	0
3,0	0
4,0	6,5
5,0	10,0
6,0	19,5
7,0	32,5
8,0	49,6
9,0	68,4
10,0	89,8
11,0	100,0
12,0	100,0
13,0	100,0
14,0	100,0
15,0	100,0
16,0	100,0
17,0	100,0
18,0	94,9
19,0	92,3
20,0	88,9

The power curve above refers to wind speed measured at the hub, air density of 1,225 kg/m³, air temperature of 15°C and atmospheric pressure of 1013 mbar, wind turbine in perfect condition and air flow horizontal without turbulence.



ESTIMATED PRODUCTION

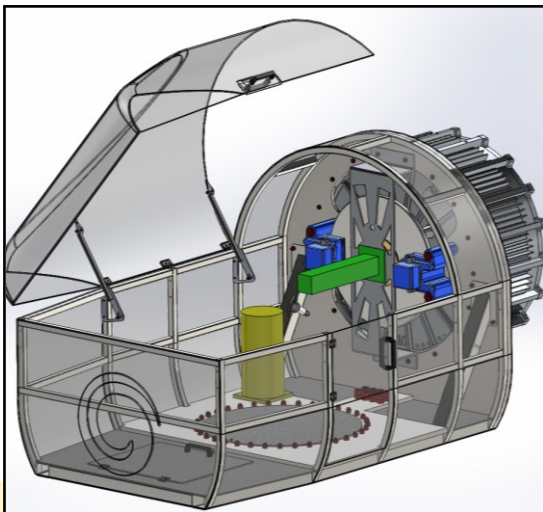
Average annual wind speed (m/s)	Energy production (kWh/year)
3	34.700
4	91.600
5	172.000
6	261.000
7	345.000
8	415.800
9	469.000
10	504.000
11	522.000

The estimated gross production above is obtained with Wind Energy Project Model v.3.2 RETScreen® International – CANADA.



2. Nacelle

The nacelle is made from a steel frame on which are mounted on the generator and the electrical and mechanical equipment. The containment cover is made of glass fiber reinforced. The ventilation of the areas where heat is generated is ensured by adequate openings. In addition to the door fiberglass top fitted with special handle airtight, there is an access tower, an access hatch and a side access staircase (optional)



3. Anemometers

The anemometers installed outside are produced by German Thies Clima, the market leader worldwide in the field of measuring instruments applied to meteorology and building automation. Anemometers used are specific to the horizontal axis turbines and are equipped with analog output signal. The housing is anodized aluminum and plastic.





4. Tower

The wind turbine is installed on a conical tower with a polygonal section (16 sides) made from steel sheet S 355 JR standards UNI EN 10025, within which is housed the passage for the cables; the welding process guarantees compliance with the standards ISO 4063 and DIN 18800-7, the structure is composed of several sections to be joined by overlapping joints according to methodical slip-on joint; the trunk base has an opening. The anchorage to the foundation of the tower is provided with a flange base with reinforcements and cage bolts previously embedded in cement. The tower is supplied hot dip galvanized in accordance with standards UNI EN 1416/99. The heights of the tower can be implemented to the rotor axis are 30 or 40 meters, consisting of three to five trunks with tapered mouth.

All towers are available with internal staircase.

5. Yawing

The wind turbine yawing mechanism is constituted by a system of gear motor and the vane that, on the machine, provides the information on the direction of the wind. Ciesse Energia has chosen the best technology with the use of the Brevini gear motors,

specifically designed to control the rotation with pinion and ring gear.

These reducers can be used in any application where precise positioning is required.



The advantages of these units are:

- compact dimensions
- high performance
- easy assembly
- reliability
- modular implementing
- quality assurance

The execution of planetary gear optimizes the performance of torque and its extent of radial load on the sprockets, in order to allow the perfect meshing between the pinion and the crown gear. Brevini gearboxes have received the prestigious "Type Approval certificate" by the Norwegian Det Norske Veritas.



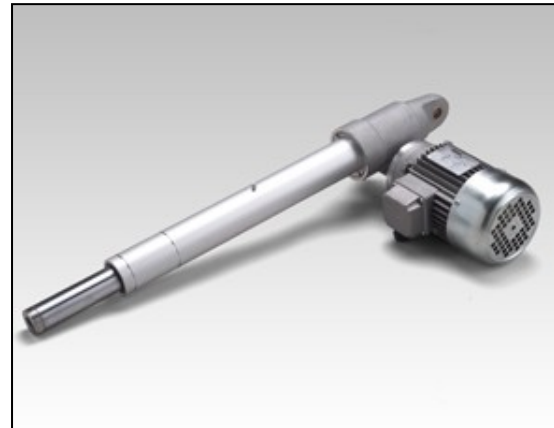
6. Blades variable pitch system

The turbine mod.100312 - A 100Wheel is designed to produce electricity at the lowest possible cost. Like all wind turbines this machine is built to deliver the maximum power for a given value of wind speed. In the case of winds of magnitude greater than the design value it is necessary to dissipate the energy in excess, so as to remain within the rated power and therefore the wind turbine is equipped with devices for controlling the power. For this purpose, the 100Wheel is equipped with an active system for adjusting the blade pitch. This is an automatic mechanism for controlling the power that allows the blades to rotate around its own axis by means of electric controls. In this way the turbine is able to produce electricity at peak level of efficiency because the blades are able to tilt in an optimal manner according to the intensity of the wind. In extreme situations, excessive wind or power failure, the pitch control also allows the security of the entire system.

The active pitch control mechanism works through an electromechanical linear actuator SpA Italian Servomech S.p.A.

This is a motorized mechanical cylinder able to convert the rotary motion of a motor into a linear movement.

The linear actuator replaces successfully pneumatic or hydraulic cylinders for several reasons:



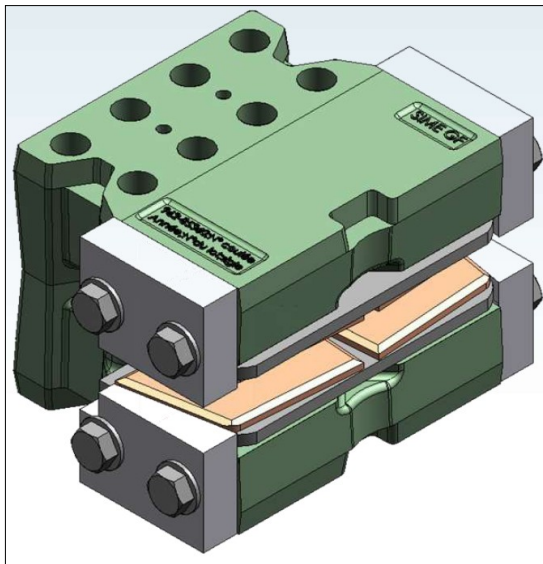
- working precision push or pull
- positioning accuracy in stopping
- maintaining the position under load
- energy consumption only in motion
- installation possible in disadvantaged environment, requiring only electrical control cables
- increased security in the presence of suspended loads (possibility of intrinsic mechanical safety devices)
- a spring mechanism allows the safety of the system in the event of mains failure.



7. Hydraulic brake

The turbine is equipped with an additional protection system to protect the generator by an excessive speed of rotation. For rotor speed higher than the nominal system is used with a hydraulic brake.

This system is also used in case of malfunction of



a critical component, so that the turbine stops automatically. The mechanical brake is also used for maintenance operations.

The brake calipers are built by the French Stromag.

8. Blades

The blades are made of composite material epoxy resin reinforced with glass fibers. The three blades make up a rotor diameter of 21 meters. The result is an area swept very wide, of about 346 square meters, able to ensure the best energy production even in sites with slow wind. Each blade has a grain to its internal stiffening and is connected to the rotating body by means of an insert flange. To ensure security, the wind turbine slows feathering the blades.

The blades are equipped with lightning protection system through a system of sensors.

9. Generation and electric power conversion system

The turbine 100Wheel uses a static converter specific for the network connection of wind power systems that use the synchronous generator with permanent magnets, produced by the Italian Elpower.

In order to manage the generator in the most efficient, the system is designed with a double inverter which allows for the correction of the generator in all regimes of operation and minimize the harmonic distortion of current. The converter, of the digital type with DSP



(Digital Signal Processor), consists essentially of:
Breaker and contactor

- EMI Filter - Filter-C L - C filter
- Three-phase dry transformer
- AFE phase IGBT inverter
- Three-phase IGBT inverter generator side



- Contactor on the generator side

The contactors are controlled by means of a safety circuit.

It is also envisaged that a braking resistor is used to manage transients in a highly dynamic process as a wind turbine, and integrates with the mechanical control of the speed of rotation, in the event of mains failure or excessive speed of the wind. The cooling fans are managed by means of the temperature probe in order to minimize consumption and their functionality is monitored continuously. The design of the converter is superior in terms of reliability:

- Total elimination (power and control) of electrolytic capacitors, in particular the filter capacitor placed between the two inverters, is made with film capacitors with life expectancy, under operating conditions, to 500,000 hours
- Tropical version of the electronic boards and components used in the same extended industrial temperature
- Fans with expected life of 50,000 hours.



10. Generator

For the turbine mod. 100312 - A 100Wheel the generator is specified produced by Soga SpA, a well-known Italian company specializing in the design and manufacture of electric motors. This is a new series of synchronous generators multipole permanent magnet with horizontal axis, specifically designed for the production of wind energy.



These generators eliminate the need for low speed reducers (parts subject to wear), guaranteeing a virtually maintenance-free

operation. The main advantages of this type of generator are:

- high efficiency, even in medium wind conditions
- low weight and small footprint
- type of construction designed to reduce the overall costs of the plant
- bearings designed for long life with axial loads

The general technical characteristics of the generator are:

- windings with insulation and special treatments for frequency inverter operation
- Magnets Nd_Fe_B high-performance
- Thermal protection of windings
- Special Paint
- Output voltage typically between 300V and 400V AC (optional different values)
- Low cogging torque



11. PLC

Ciesse Energia has chosen one of the newest safety PLC of Mitsubishi: the model QS, specific for the protection of complex systems at low cost.



The QS PLC offers a modern solution for a security check able to combine the advantages of I / O stations security in a decentralized network CC-Link Safety with the versatility of a modular PLC. The resulting capacity protects the entire production line, reducing the resources required by the wiring, making it more rapid and safe detection of errors and thus provides simple program changes and maintenance. The modules offer as QS Safety PLC naturally broad protection against failures of the system and unauthorized access. It is approved SIL 3, Category 4.

Among the main features should be noted:

- Integrated Security: combination of standard PLCs and safety without the need for a separate controller

- Flexibility: I / O local safety directly mounted on the backplane or remote CC-Link, for maximum cost efficiency
- modular Solution: no limit in the number of I / O safety to achieve the requirements of the application
- "Open Network" Coexistence of I / O and safety standards, local or CC-Link, reducing the complexity and cost of the system

The Q series has established itself as the preferred automation market in the world, with more than 6 million systems in use. His unique ability to combine different control disciplines with first class performance and reliability, making it the natural choice for solving a problem, a key modern applications simultaneously: security control.

12. Lightning protection

The lightning protection system is produced according to IEC 61400-24. All electrical subsystems, such as the control system and the pitch of the blades, are positioned inside the steel structure of the turbine, thus ensuring an optimal lightning protection.



13. Remote control system

The local control system is used remotely through the standard VNC on all compatible computers, including smartphones, through communication GPRS / UMTS / HSDPA, on TCP / IP (Web).

The remote control system is completed by:

- infrared rays illuminated camera to allow monitoring of the rotor also during the evening and nighttime hours.
- mail system that warns the maintenance of any anomalies by sending warning messages and error, thus allowing a timely intervention and restoring the correct mode of operation.

There is also an option that allows the UPS registration and maintenance of the data

collected even in the event of a auxiliary power failure.

14. Noise level

For the calculation of noise level generated by a wind turbine, reference is made to the methods of detection and calculation defined by the standard IEC 61400-11.

Below is a summary table for 100Wheel containing all the data for the parameters of interest always with reference to the integer values of the wind speed of between 6 and 10 m/s inclusive.

Wind speed [m/s]	6	7	8	9	10
Output power [KW]	19,5	32,5	49,6	68,4	89,8
Environmental sound level $L_{Ae,c,k}$ [dB]	51,12	52,72	54,32	55,93	57,53
Uncertainty U_c [dB]	1,48	1,48	1,48	1,48	1,48
Effective produced sound level $L_{WA,k}$ [dB]	92,55	94,16	95,76	97,36	98,97
Tone ΔL_k [dB]	-16,23	-11,4	-8,37	-7,31	-9,54



15. User cabin

The user cabin for facility based on turbine mod. 100312 - A 100Wheel is required to hold the electrical and electronic components dedicated to conversion and control. The cabin shall be in accordance with the standards dedicated. With regard to space to devote inside, below is a list of the dimensions and the minimum needs predictable:

a) conversion and control framework: SIZE = L 2000 +500 (space on the side sn) P 1000 +500 (space on one side sn), H 2200.

It must be considered also the need to 1 mt of space to leave the front of the equipment to allow the opening of the doors

b) part of the field: DIMENSIONS (for reference) = L 770 P 250 H 1750

c) the cabin must be equipped with a ventilation system for a minimum of 2000 mc / h, controlled by thermostat.

For the purposes of conformance with the Smart Grid directives, or in case of electrical brake option, the roof of the cab should provide a protected space for the positioning of the resistors, as well as an adequate ability of resistance to the weight and the temperatures of the same.

16. Foundation

The foundations will be designed and dimensioned on the basis of the specific characteristics of the soil on the site of installation, which can be determined if necessary geological survey and according to the national and local regulatory requirements. In the case where the allowable pressure of the soil is found to be very low, pilings may be required. The foundations standards provide a platform of reinforced concrete inground of about 8X8mt with a thickness of approximately 2.50 mt. At the center of the platform is placed a column of reinforced concrete that comes up to the surface and contains a cage bolts galvanized steel.

17. Transport and installation resources

By way of illustration, we list the resources needed for the installation of a turbine mod. 100312 - A 100Wheel 40m hub height:

- n. 2 truck with tipper of mt.13 of length
- n. 1 mobile cranes with capacities up to 100 tons and a minimum height of 50 meters
- n. 1 aerial platform height min. 50 mt

At the site must be provided enough space for the presence of said means of transport and storage of the component



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21m ROTOR DIAMETER

ALL DATA HEREIN PRESENTED IS PRELIMINARY FOR BID/QUOTE.
STRUCTURAL DESIGN SHALL BE PERFORMED ACCORDING TO IEC 61400
"WIND TURBINE GENERATOR SYSTEMS-SAFETY REQUIREMENTS"

TOWER CHARACTERISTICS

TOWER BASE:

EQU M=483.764 daNm T=14.415 N N=18.884 daN
STR M=483.764 daNm T=14.415 N N=21.248 daN
GEO M=419.262 daNm T=12.493 N N=16.918 daN

TOWER SECTION 1:

L=9.00 m
M=483.763.512 Ncm
N=212.476 N
fa=338 N/MM²
Fmax=314 N/MM²
Fmax/fa=0.93

TOWER SECTION 2:

L=9.3 m
M=328.846.184 Ncm
N=151.654 N
fa=338 N/MM²
Fmax=309 N/MM²
Fmax/fa=0.91

TOWER SECTION 3:

L=9.7 m
M=215.625.432 Ncm
N=110.410 N
fa=338 N/MM²
Fmax=288 N/MM²
Fmax/fa=0.85

TOWER SECTION 4:

L=11.25 m
M=108.509.635 Ncm
N=77.548 N
fa=338 N/MM²
Fmax=285 N/MM²
Fmax/fa=0.84

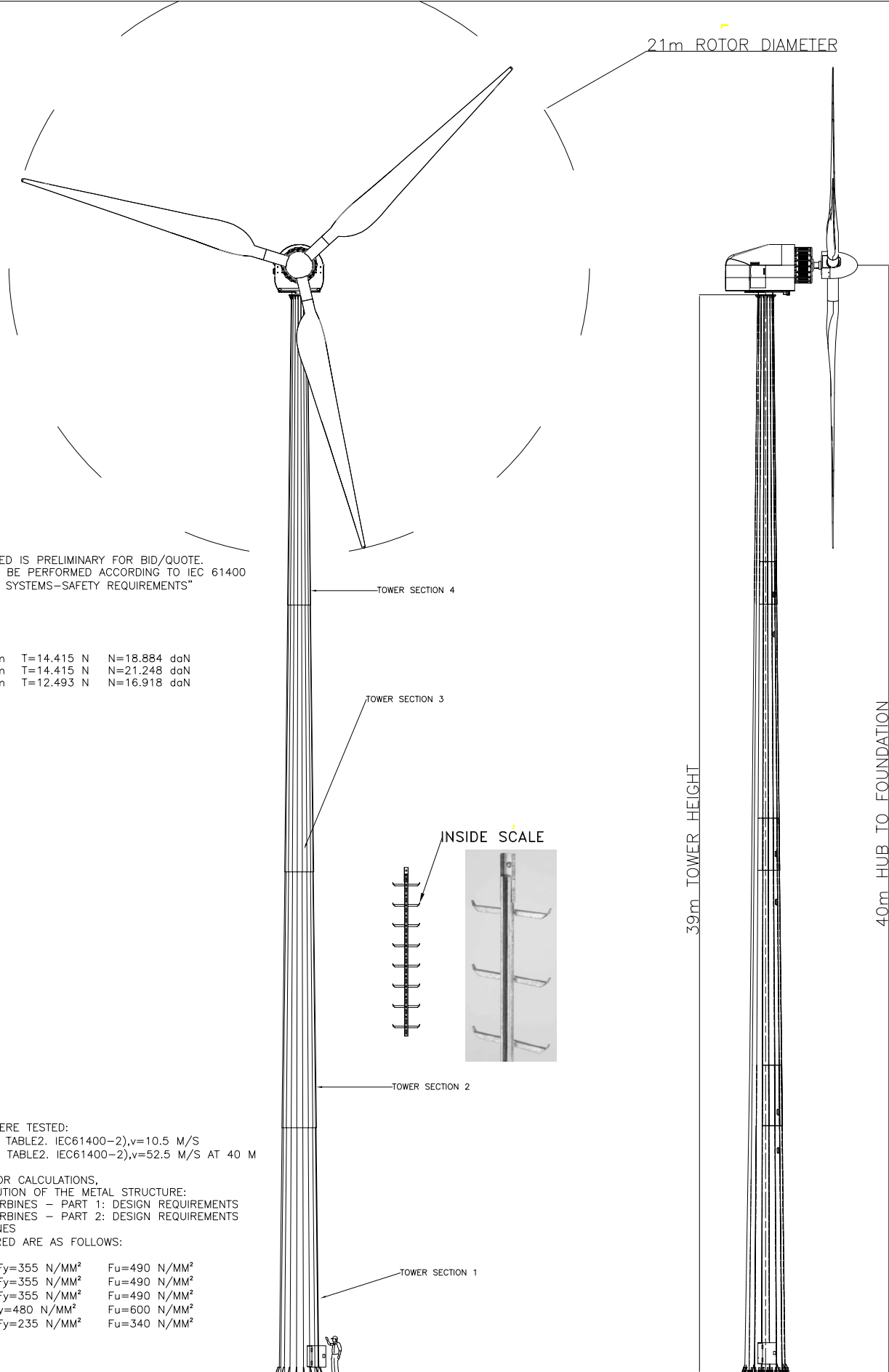
NOTES

- TWO LOAD CONDITIONS WERE TESTED:
 - LOAD CONDITION A (SEE TABLE2. IEC61400-2),v=10.5 M/S
 - LOAD CONDITION H (SEE TABLE2. IEC61400-2),v=52.5 M/S AT 40 M

- THE STANDARDS USED FOR CALCULATIONS, CHECKS AND THE EXECUTION OF THE METAL STRUCTURE:
 - IEC 61400-1 WIND TURBINES - PART 1: DESIGN REQUIREMENTS
 - IEC 61400-2 WIND TURBINES - PART 2: DESIGN REQUIREMENTS FOR SMALL WIND TURBINES

- THE MATERIALS CONSIDERED ARE AS FOLLOWS:

SHAFT	EN10025	Fy=355 N/MM ²	Fu=490 N/MM ²
FLANGES	EN10025	Fy=355 N/MM ²	Fu=490 N/MM ²
ANC. BOLTS	EN10025	Fy=355 N/MM ²	Fu=490 N/MM ²
BOLTS	UNI6.8	Fy=480 N/MM ²	Fu=600 N/MM ²
ACCESSORIES	EN10025	Fy=235 N/MM ²	Fu=340 N/MM ²



39m TOWER HEIGHT

40m HUB TO FOUNDATION

INSIDE SCALE



100312-A 100WHEEL
STRUCTURAL LOADS AND GEOMETRY
TOWER HEIGHT 39,25m
ROTOR DIAMETER 21m
HUB HEIGHT 40m
TIP HEIGHT 56m
INSIDE SCALE

PROJECT	100312-A 100WHEEL
CUSTOMER	
SITE NAME	



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