4. Technical data

4.1 Technical design

Technical design	
Survival temperature	-40 °C to +50 °C
Operating temperature range of the normal climate version	-20 °C to +40 °C[1)]
Operating temperature range of the cold climate version	-30 °C to +40 °C[1)]
Stop	Standard: -20 °C, restart at -18 °C CCV: -30 °C, restart at -28 °C
Max. height above MSL	2000 m[1)]
Certificate	In accordance with IEC 61400-22 and DIBt 2012
Type	3-blade rotor with horizontal axis, up-wind turbine
Output control	Active single blade adjustment
Nominal power	Up to 5700 kW[1)]
Nominal power starting at wind speeds of (at air density of 1.225 kg/m^3)	Approx. 13.0 m/s
Operating speed range of the rotor	6.2 min^{-1} to 12.2 min^{-1}
Nominal speed	Approx. 10.7 min^{-1}
Cut-in wind speed	3 m/s
Cut-out wind speed	26 m/s[2)]
Cut-back-in wind speed	25.5 m/s[2)]
Calculated service life	≥ 20 years

[1)] Nominal output is achieved depending on the power factor and the installation altitude up to defined temperature ranges. The N149/5.X can be operated project-specifically with up to 5900 kW.

[2)] Depending on the project, the cut-out wind speed can be decreased to safeguard the structural stability.

4.2 Towers

Towers	TS105-01	TS108-05	TS125-04	TS135-01	TS155-02
Hub height*	104,7 m	108,0 m	125,4 m	135,0 m	154,9 m
Tower type	Tubular steel tower				
Wind class	DIBt S/ IEC S	IEC S	DIBt S IEC S	DIBt S IEC S	IEC S
Number of tower sections	4	5	6	6	6
Surface finish	Color system coating				

Towers	TC120N	TCS164
Hub height*	120,0 m	164,0 m
Tower type	Concrete tower	Hybrid tower
Wind class	IEC S	DIBt S IEC S
Number of tower sections	Concrete tower	3 steel sections 1 concrete part
Surface finish	Fair-faced concrete	**

* Includes foundation height above ground level

** Steel section: Color system coating; Concrete part: Fair-faced concrete

4.3 Rotor and rotor blades

Rotor	
Rotor diameter	149.1 m
Swept area	17460 m2
Nominal power/area	326.5 W/m2
Rotor shaft inclination angle	5 °
Blade cone angle	4.0 °

Rotor blade	
Material	Fiber glass and carbon fiber reinforced plastic
Total length	72.4 m

Rotor hub	
Material of the rotor hub body	Casting
Material spinner	Glass-fiber reinforced plastic

4.4 Nacelle

Nacelle	
Support structure	Welded steel structure
Cladding	Glass-fiber reinforced plastic
Machine frame	Casting
Generator frame	Welded steel construction

4.4.1 Rotor shaft

Rotor shaft/rotor bearing	
Type	Forged hollow shaft
Material	42CrMo4 or 34CrNiMo6
Bearing type	Spherical roller bearing
Lubrication	Regularly using lubricating grease

4.4.2 Brake and gearbox

Mechanical brake	
Type	Actively actuated disk brake
Location	On the high-speed shaft
Number of brake calipers	1
Brake pad material	Organic pad material

Gearbox	
Type	Multi-stage planetary gear + spur gear stage
Gear ratio	50 Hz: i = 117.3 60 Hz: i = 140.7
Lubrication	Forced-feed lubrication
Oil quantity including cooling circuit	Max. 650 l
Oil type	VG 320
Max. oil temperature	Approx. 77 °C
Oil change	Change, if required

4.4.3 E-chain hoist and crossbeam

E-chain hoist and lifting beam	
Electrical chain hoist max load	Min. 850 kg
Crossbeam max load	Sliding trolley to accommodate a manual chain hoist 1000 kg

4.5 Electrical system

Electrical system	
Nominal power P_{nG}	Up to 5900 kW
Nominal voltage	3 x AC 750 V ± 10 % (specific to grid code)
Nominal current during full reactive current feed-in I_{nG} at S_{nG}	4889 A
Nominal apparent power S_{nG} at P_{nG}	6351 kVA
Power factor at P_{nG}	1.00 as default setting 0.929 underexcited (inductive) up to 0.929 overexcited (capacitive) possible
Frequency	50 and 60 Hz

*) All data are maximum values. The values may deviate depending on the rated voltage, rated apparent power and WT active power.

4.5.1 Transformer

Transformer*	**50 Hz**	**60 Hz**
Total weight	Approx. 9 t	
Insulation medium	Ester	
Rated voltage OV, U_r	750 V	
Maximum rated voltage OS, dependent on MV grid, U_r	20 kV / 30 kV / 34 kV	
Taps, overvoltage side	20 kV and 30 kV: + 4 x 2.5 % 34 kV: + 4 x 0.5 kV	
Grid voltage OS	20; 20.5; 21; 21.5; 22 kV 30; 30.75; 31.5; 32.25; 33 kV 34; 34.5; 35; 35.5; 36 kV	
Rated frequency, f_r	50 Hz	60 Hz
Vector group	Dy5	
Installation altitude (above MSL)	Up to 2000 m	
Rated apparent power, S_r	6350 kVA	

Transformer*	**50 Hz**	**60 Hz**
Impedance voltage, U_z	8 to 9 % ± 10 % tolerance	
Minimum peak efficiency index, η, (EU) 2019/1783, 548/2014	99.571%	–
Inrush current	≤ 5.5 x I_N (peak value)	
Power loss[1)] No-load losses Short circuit losses	 2900 W 70000 W	 4000 W 71000 W

*) The values are, if not specified otherwise, maximum values. The values may deviate depending on the rated voltage, rated apparent power and WT active power.

1) Guide values

4.5.2 Medium-voltage switchgear

Medium-voltage switchgear	
Rated voltage (depending on MV network)	24; 36; 38 or 40.5 kV
Rated current	50 Hz: 630 A 60 Hz: 600 A
Rated short-circuit duration	1 s
Rated short circuit current	24 kV: 16 kA (20 kA optional) 36 / 40.5 kV: 20 kA (25 kA optional)
Minimum/maximum ambient temperature during operation	NCV: -25 °C to +40 °C
	CCV: -30 °C to +40 °C
Connection type	External cone type C according to EN 50181 For USA: External cone type E according to IEEE 386
Circuit breaker	
Number of switching cycles with rated current	E2
Number of switching cycles with short-circuit breaking current	E2
Number of mechanical switching cycles	M1
Switching of capacitive currents	Min. C1 - low
Switch disconnector	
Number of switching cycles with rated current	E3
Number of switching cycles with short-circuit breaking current	E3
Number of mechanical switching cycles	M1

Medium-voltage switchgear	
Disconnector	
Number of mechanical switching cycles	M0
Ground switch	
Switching number with rated short-circuit inrush current	E2
Number of mechanical switching cycles	≥ 1000

4.5.3 Generator

Generator	
Type	6-pole doubly-fed induction machine
Degree of protection	IP 54 (slip ring box IP 23)
Nominal voltage	750 V
Frequency	50 and 60 Hz
Speed range	50 Hz: 650 to 1500 min^{-1} 60 Hz: 780 to 1800 min^{-1}
Poles	6
Weight	Approx. 10.6 t

4.6 Cooling system

Cooling system	
Gearbox	
Type	Oil circuit with oil/water heat exchanger and thermal bypass
Filters	Coarse filter 50 µm / fine filter 10 µm / ultrafine filter <5 µm
Generator	
Type	Water circuit with water/air heat exchanger and thermal bypass
Coolant	Water/glycol-based coolant
Converter	
Type	Water circuit with water/air heat exchanger and thermal bypass
Coolant	Water/glycol-based coolant
Transformer	

Cooling system	
Coolant	Water/glycol-based coolant
Cooling circuit	Ester circuit with ester/water heat exchanger

4.7 Pitch system

Pitch system	
Pitch bearing	Double-row four-point contact bearing
Gearing/raceway lubrication	Regular lubrication with grease
Drive	Electric motors incl. spring-loaded brake and multi-stage planetary gear
Emergency power supply	Batteries

4.8 Yaw system

Yaw system	
Yaw bearing	Double-row four-point contact bearing
Gearing/raceway lubrication	Regular lubrication with grease
Drive	Electric motors incl. spring-loaded brake and four-stage planetary gear
Number of drives	5-6
Yaw speed	Approx. 0.4 °/s

4.9 Corrosion protection

Corrosion protection*	Inside	Outside
Nacelle	C3	C4
Hub	C3	C4
Tower Steel sections Concrete components	C3 Color system coating Fair-faced concrete	C4 Color system coating Fair-faced concrete

* Categories of corrosion protection according to ISO 12944-2

4.10 Automation systems

Automation system	
Field bus system	Profinet
Safe fieldbus system	Profisafe via Profinet

Automation system	
Turbine control	Profinet system control
Safety control	Integrated safety control