



## Technical Documentation

# TECHNICAL DATA

## S97-2.1 MW

**INFORMATION ONLY**

Project: Standard  
Document Number: WD00332 [Original document]  
Document Class: 2 [3, 4 = Confidential]  
Issue: 00-03 (Draft) [2010-04-28]

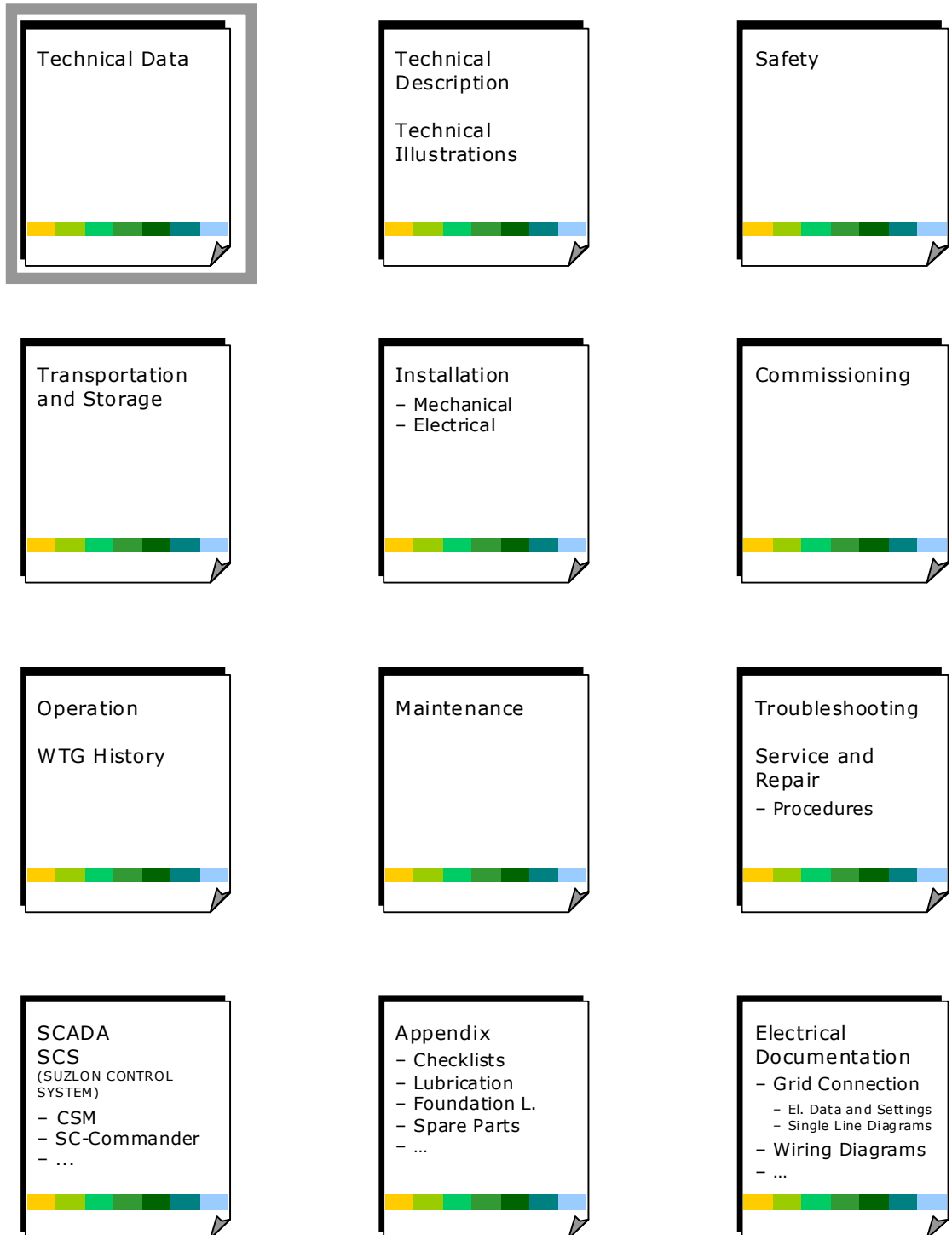
## SUZLON Energy GmbH

Doberaner Str. 115  
18057 Rostock | Germany

**P** +49 381 203578-0  
**F** +49 381 203578-10  
**E** [germany-documentation@suzlon.com](mailto:germany-documentation@suzlon.com)  
**I** [www.suzlon.de](http://www.suzlon.de)

## Overview Technical Documentation

The grey marked image indicates the description which follows on the next pages.



The information contained in this documentation is the property of SUZLON Energy GmbH. This documentation and extracts thereof may only be duplicated or forwarded to third parties following explicit written approval by SUZLON Energy GmbH. We reserve the right to make changes and improvements to this documentation as well as the hardware and software features at any time and without prior notification.

All product names used in this documentation are trademarks or otherwise protected by law, even if not specifically indicated.

© 2007-2010 by SUZLON Energy GmbH | All rights reserved.

## Table of contents – Technical Data

<b>1</b>	<b>Notes on manual</b> .....	<b>5</b>
1.1	Scope.....	5
1.3	Copyright.....	6
<b>2</b>	<b>Main data</b> .....	<b>7</b>
2.1	Own consumption .....	8
2.2	Operational parameters .....	9
2.3	Control .....	9
<b>3</b>	<b>Tubular tower</b> .....	<b>10</b>
<b>4</b>	<b>Nacelle</b> .....	<b>11</b>
4.1	Main frame .....	11
4.2	Main bearing .....	11
4.3	Main bearing housing.....	11
4.4	Main shaft.....	11
4.5	Gear box .....	12
4.5.1	Electric oil pump .....	12
4.6	Mechanical brake .....	12
4.7	Hydraulic aggregate .....	13
4.8	Coupling .....	13
4.9	Yaw system.....	13
4.9.1	Bearing .....	13
4.9.2	Yaw drives .....	14
4.10	Generator .....	14
<b>5</b>	<b>Rotor</b> .....	<b>16</b>
5.1	Hub .....	16
5.2	Rotor blades.....	16
5.3	Pitch system .....	17
5.3.1	Bearing .....	17
5.3.2	Pitch drives .....	17
5.3.3	Batteries.....	18
<b>6</b>	<b>Transformers</b> .....	<b>19</b>
6.1	Power outside Tower (POT) (option 1).....	19
6.2	Power in Tower (PIT) (option 2) .....	19
6.2.1	Medium voltage switchgear .....	20
<b>7</b>	<b>External conditions</b> .....	<b>22</b>
7.1	Humidity conditions.....	22
7.2	Corrosion protection .....	23
7.3	Altitude .....	23

**8        Annotations ..... 24**

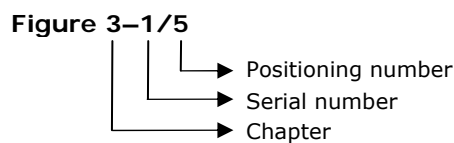
# 1 Notes on manual

This manual is part of the Technical Documentation of a SUZLON wind turbine generator (WTG). It describes the Technical Data of a WTG and/or wind farm.

In this manual consistent terminology is used resulting from SUZLON terminology work in order to avoid multiple designations. Furthermore, the document contains abbreviations. When used for the first time the term is written in full notation. The abbreviation stands in brackets behind the full notation term, e.g.: wind turbine generator (WTG).

Pages, tables and figures are cross-referenced and numbered consecutively. The document contains further cross references and bookmarks intended to guide the reader to more detailed information.

Figures may come with positioning numbers explaining determined components. The positioning number appears again behind the explained component in the text as follows:



Photos in this manual illustrate examples. Equipment and procedures may differ regarding the specific projects. Therefore, the content of the photos is not to be considered as generally applicable. Contact the responsible logistic manager for project-specific information.

Dimensions and weights are given according to the "International System of Units" (SI). Project-specific these data may be completed with Anglo-American units.

If any suggestions or improvements are required please forward your comments to [germany-documentation@suzlon.com](mailto:germany-documentation@suzlon.com).

As the SUZLON WTGs are continually improved and further developed, we reserve the right of modifications. Make sure that this document is available in the latest version according to the appropriate configuration of the WTG.

## 1.1 Scope

This manual is valid for the S97-2.1 MW WTG. Please note the following variant specification giving information on the documents content.

Feature	Variant/version
Blade version	<input checked="" type="checkbox"/> V1 <input type="checkbox"/> V2 <input type="checkbox"/> V3
Frequency	<input checked="" type="checkbox"/> 50 Hz <input checked="" type="checkbox"/> 60 Hz
Temperature version	<input checked="" type="checkbox"/> Standard Temperature Version (STV) <input checked="" type="checkbox"/> Low Temperature Version (LTV) <input type="checkbox"/> High Temperature Version (HTV)
Tower version	<input checked="" type="checkbox"/> Tubular tower (80 m/90 m/100 m)

Feature	Variant/version
Control system	<input checked="" type="checkbox"/> SUZLON CONTROL SYSTEM (SCS)

### 1.3 Copyright

The manufacturer has the copyright for this document.

Reproduction, copying, propagation or any other use by or information of a third party of this documentation – whether in parts or as a whole – for competition purposes requires prior written consent by the manufacturer.

All rights reserved.

**Address of the manufacturer:**

SUZLON Energy Limited

One Earth,  
Opp. Magarpatta City,  
Hadapsar

Pune 411 0028  
India

[www.suzlon.com](http://www.suzlon.com) | [info@suzlon.com](mailto:info@suzlon.com)

## 2 Main data

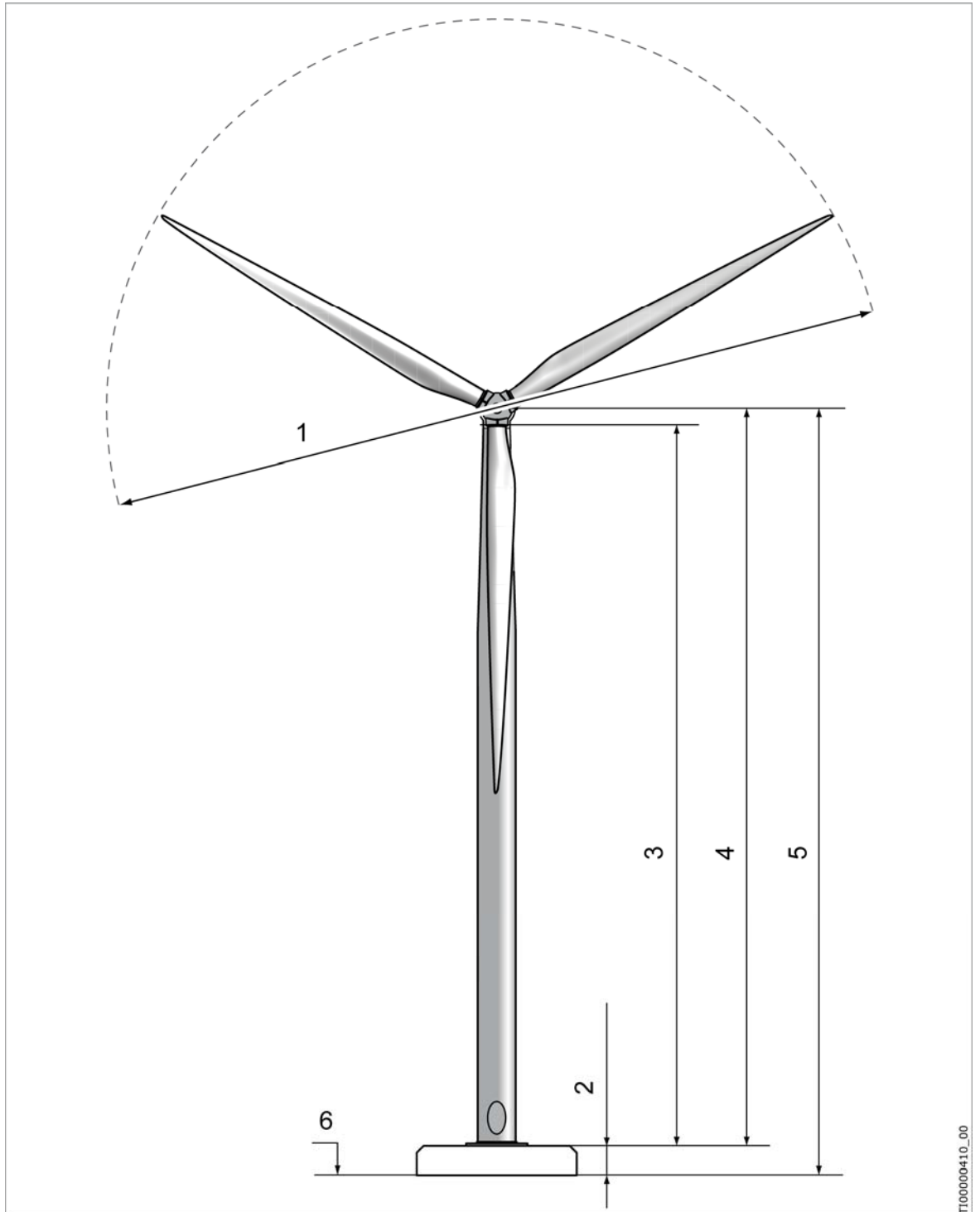


Figure 2-1: Overview of WTG dimensions

Description	All variants		
Wind class	IIIa		
Estimated service life	20 years		
Rated power	2.1 MW		
Swept area	7,386 m <sup>2</sup>		
Rotor speed	12.0 to 15.5 rpm (up to 18 rpm dynamically)		
Rotor diameter (Figure 2-1/1)	97.0 m		
Tower	80 m	90 m	100 m
Rotor height (Figure 2-1/4)	79 m		97.5
Tower height (Figure 2-1/3)	77.5 m	87.5	96.2
Foundation level (Figure 2-1/2)	project-specific		
Hub height (Figure 2-1/5)	project-specific (rotor height plus foundation level)		
Ground (Figure 2-1/6)	base of foundation		

## 2.1 Own consumption

Description	STV	LTV
Average values of WTG	From 7 to 9 kW	
Additional average values	no additional values	42 kW for heater
Peak values	10 kW (30-second average)	
	50 kW (3-second average)	



## 2.2 Operational parameters

Description	All variants
Rated wind speed	11 m/s (without turbulence intensity according to GL guideline)
Cut in wind speed	4 m/s (30-second average)
Cut out wind speed	20 m/s (10-minute average)
	25 m/s (3-second average)
Restart wind speed	18 m/s (10-minute average)

## 2.3 Control

Description	All variants
Type	Programmable Logic Controller with SUZLON CONTROL SYSTEM software
Access	Multi-level, user authenticated
Communication system	Internal: CAN-bus
	External: Ethernet; optional: MODBUS, OPC

### 3 Tubular tower

Description	80 m	90 m	100 m
Material	Welded steel plate according to EN10025		
Corrosion protection	Double anti corrosion paint inside		
	Triple anti-corrosion paint outside		
Top end diameter	2.97 m		2.97 m
Bottom end diameter	4.04 m		4.30 m
Internals/access	Ladder, platforms, anchorage points, cabling, climbing assistance (optional), service lift (optional)		
Light	Emergency light inside tower		

## 4 Nacelle

### 4.1 Main frame

Description	STV	LTV
Type	Cast frame	
Material	EN-GJS-400-18U-LT	EN-GJS-350-22U-LT
Corrosion protection	Anti-corrosion paint	

### 4.2 Main bearing

Description	STV	LTV
Type	Spherical roller bearing	
Quantity	1	
Fan heater		1 additional fan heater with a power of 9 kW

### 4.3 Main bearing housing

Description	STV	LTV
Type	Cast housing, flanged feet	
Material	EN-GJS-400-18U-LT	EN-GJS-350-22U-LT
Quantity	1	

### 4.4 Main shaft

Description	All variants
Type	Forged shaft and flange
Material	42CrMo4/42CrMoS4
Corrosion protection	Anti-corrosion paint

## 4.5 Gear box

Distinction by frequency		
Description	50 Hz	60 Hz
Type	1 planetary stage, 2 helical stages	
Material of gear box housing	Cast	
Gear ratio	1 : 98.8 (±0.5%)	1 : 118.6 (±0.5%)
Mechanical power	2.250 MW	2.250 MW
Shaft seals	Maintenance-free labyrinth seal	

Distinction by temperature		
Description	STV	LTV
Material of gear box mounts	EN-GJS-400-18U-LT	EN-GJS-350-22U-LT
Type of cooling	Forced oil cooling lubrication system	
Fan heater	2 additional fan heaters with a power of 9 kW	

### 4.5.1 Electric oil pump

Description	50 Hz	60 Hz
Voltage (phase to phase)	3 × 690 V	3 × 600 V

## 4.6 Mechanical brake

Description	All variants
Type	Hydraulic disc brake, activated by hydraulic pressure (active brake)
Brake disc	Steel, mounted on high speed shaft
Number of brake calipers	1

## 4.7 Hydraulic aggregate

Distinction by frequency		
Description	50 Hz	60 Hz
Voltage (phase to phase)	3 × 690 V	3 × 600 V
Power consumption	1.5 kW	
Maximum operation pressure	hydraulic brake: 11.5 MPa (115 bar)	
	rotor lock system: 70 MPa (700 bar)	
Oil capacity	0.0045 m <sup>3</sup> (4.5 litres)	

Distinction by temperature		
Description	STV	LTV
Fan heater		1 additional fan heater with a power of 9 kW

## 4.8 Coupling

Description	All variants
Type	Flexible coupling

## 4.9 Yaw system

### 4.9.1 Bearing

Description	All variants
Type	Friction bearing with gear
	Automatic lubrication system

#### 4.9.2 Yaw drives

Description	50 Hz	60 Hz
Type	Electric motors with brake, gear box and pinion	
Quantity	4	
Yaw speed	21.8 °/min	26.5 °/min
Voltage (phase to phase)	3 × 690 V	3 × 600 V
Power consumption	15.00 kW (3.75 kW per motor)	17.04 kW (4.26 kW per motor)
Winding connection of yaw drives	Star (Y)	

#### 4.10 Generator

Description	50 Hz	60 Hz
Type	Asynchronous MRL-063E04	Asynchronous MRL-063D04
Rated power	2.100 MW	2.100 MW
Voltage stator (phase to phase)	690 V	600 V
Frequency	50 Hz	60 Hz
Number of poles	4	4
Synchronous speed	1500 rpm	1800 rpm
Speed at rated power rotor short-circuited	1511 rpm	1812 rpm
Operation speed range	1200 to 1528 rpm (up to 1800 rpm dynamically)	1440 to 1830 rpm (up to 2160 rpm dynamically)
Rated generator speed	1528 rpm	1830 rpm
Efficiency	96.7%	96.7%
Max. rotor slip	20%	20%
Power factor (uncompensated)	0.92	0.92
Rated current	1895 A	2190 A
Winding connection of stator	Delta ( $\Delta$ )	Delta ( $\Delta$ )
Winding connection of rotor	Star (Y)	Star (Y)

Description	50 Hz	60 Hz
Protection class (generator)	IP 54	IP 54
Cooling	IC6A1A6 (as per IEC 60034-6), air cooled; forced air-air cooled	
Protection class (slip ring)	IP 23	IP 23
Thermal classification	Class H	Class H

## 5 Rotor

Description	50 Hz	60 Hz
Number of blades	3	
Rotor cone angle	5°	
Rotor speed (at rated power)	15.45 rpm	15.50 rpm
Tip speed (at rated power)	78.8 m/s	79.1 m/s
Main shaft tilt angle	5°	
Power regulation	DFIG inverter system	
Rotor orientation	Upwind	

### 5.1 Hub

Description	STV	LTV
Type	Cast spherical hub	
Material	EN-GJS-400-18U-LT	EN-GJS-350-22U-LT
Corrosion protection	Anti-corrosion paint	

### 5.2 Rotor blades

Description	All variants
Type	LM47/SBxx
Blade length	47.5 m
Material	Glass-fibre reinforced plastic (GRP)/Polyester
Type of aerodynamic brake	Pitch/full blade
Blade profiles	



### 5.3 Pitch system

Description	All variants
Type	Electric drive with electric brake, gear box, frequency converter and batteries
Pitch angle range	-5 to 95°
Pitch speed	0 to 8 °/s
Emergency pitch speed	8 °/s

#### 5.3.1 Bearing

Description	All variants
Number of bearings	3 (1 per blade)
Material	42CrMo4 QT

#### 5.3.2 Pitch drives

Description	STV	LTV
Type	Electric motor, gear box and electric brake	
Number of drives	3 (1 per blade)	
Mechanical power per drive	7.5 kW	
Material	Differences in certain materials, sealings and lubricants between STV and LTV version. LTV version improved with regards to low temperature application.	

### 5.3.3 Batteries

Description	STV	LTV
Backup system	1 battery set per blade (1 battery set contains 22 batteries)	
Battery service life	2 to 4 years	
Rated voltage per battery	12 V	
Rated capacity (20 hour rate)	7.2 Ah	
Heater		1 additional heater per battery set with a power of 0.2 kW and with rubber mats

## 6 Transformers

### 6.1 Power outside Tower (POT) (option 1)



The scope of supply of the transformer is agreed by contract. If the transformer is supplied by the customer the below values are to be referenced as recommendations.

Description	50 Hz	60 Hz
Type	Oil filled transformer	
Winding connection	Delta/Star ( $\Delta/Y$ )	
Vector group	Dyn5/Dyn11 (grid-dependent)	
Rated apparent power	2500 kVA	
Rated winding ratio	(XX) kV/0.69 kV	(XX) kV/0.6 kV
	(voltage level at line side depends on supply voltage level)	
Tapping	At HV $\pm 5\%$ in 2.5% steps	
Reactance	6%	
Short circuit power losses	22.5 kW	
No-load losses	~2500 W	
Full load losses	~26500 W	

### 6.2 Power in Tower (PIT) (option 2)

Description	50 Hz	60 Hz
Type	Midel filled transformer	
Winding connection	Delta/Star ( $\Delta/Y$ )	
Vector group	Dyn5/Dyn11 (grid-dependent)	
Rated apparent power	2500 kVA	

Description	50 Hz	60 Hz
Rated winding ratio	(XX) kV/0.69 kV	(XX) kV/0.6 kV
	(voltage level at line side is depends on supply voltage level)	
Tapping	At HV ±5% in 2.5% steps	
Reactance	6%	
No-load losses	2400 W	
Full load losses at 75°	19600 W	
Full load losses at 120°	22000 W	

### 6.2.1 Medium voltage switchgear

Description	50 Hz	60 Hz
Type	SF6-cabinet	
Max. service voltage	12 kV/24 kV/36kV (depends on supply voltage level)	
Rated current busbars	630 A	
	max. 1250 A (project-specific)	
Rated current feeder	630 A/1250 A	
Rated short time current	16 kA/20 kA	
Rated short circuit duration	3 s	
Rated inrush current	40 kA/50 kA	
Rated lightning impulse withstand voltage	75 kV/125 kV/170 kV	
Rated power frequency withstand voltage	28 kV/50 kV/70 kV	
Rated frequency	50 Hz	60 Hz
Protection class (line side)	IP 65	
Protection class (load side)	IP 40	
Rated SF6 pressure abs.	136 kPa	
Service SF6 pressure abs.	120 kPa	

Description	50 Hz	60 Hz
Feeder 1/2/(3)	Load break switch panel (630 A)	
	Earthing switch	
	Capacity voltage indicators	
Feeder 4	Circuit breaker 630 A	
	Earthing switch	
	Protection equipment for transformer	
	Capacity voltage indicators	

## 7 External conditions

Description	STV	LTV
Ambient temperature range – operation	–10 °C to +40 °C	–30 °C to +40 °C
	Beyond the temperature ranges stated above, a WTG may derate or shut itself down if any of its core equipment moves outside its safe operating range. This is dependent on WTG load as well as external conditions.	
Ambient temperature range – general	–20 °C to +50 °C	–40 °C to +50 °C
	The WTG always has to be connected to the grid.	
Ice/snow on blades	Considered in calculation of structural design	
A-factor	8.46 m/s	
Form factor, c	2.0	
Annual average wind speed	7.5 m/s	
Vertical wind shear exponent	0.2	
Extreme wind speed	37.5 m/s (10-minute average)	
Survival wind speed	52.5 m/s (3-second average)	
Automatic stop limit	20 m/s (10-minute average)	
Characteristic turbulence intensity according to IEC 61400-1 (15 m/s)	18.0%	
Air density	1.225 kg/m <sup>3</sup>	

### 7.1 Humidity conditions

Description	All variants
Permissible relative ambient humidity	30 to 99%
Permissible relative humidity during operation (outside cabinet, inside WTG)	30 to 99% (no precipitation)
Permissible relative humidity during operation (inside cabinet)	20 to 80% (no precipitation)

## 7.2 Corrosion protection

Description	All variants
<p>The corrosion protection applies in accordance with ISO 12944-2.</p>	
<p>Industrial environment without salinity</p>	<p>Corrosion protection class C4 (normal)</p> <p><i>If corrosion protection against salinity (coast and near coast) is required, the corrosion protection class has to be determined for the project and to be agreed by contract with SUZLON.</i></p>

## 7.3 Altitude

Description	All variants
<p>Maximum height altitude</p>	<p>1000 m above sea level</p> <p><i>If the altitude exceeds 1000 m above sea level, this has to be agreed by contract with SUZLON considering the possible consequences regarding e.g. power reduction, higher maintenance and spare part costs as well as supplier warranty restriction.</i></p>

# 8 Annotations

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---