Type Certificate

Certificate-No.:	**TC-159/125420879/2018, Rev.01**
Applicant and Manufacturer:	**PASL Wind Solutions (P) Ltd.** 34-35, Phase 1, GIDC Vatva, Ahmedabad-382445, India
Wind Turbine Type(s):	**PWS1800i (de-rated),** 1500.0 kW, P-41, HH 80.0 m, IEC wind class II A *The technical specifications of the wind turbine are given in the attached Annex.*

The conformity evaluation has been carried out according to:

GL 2010: "Germanischer Lloyd, "Guideline for the certification of Wind Turbines"; Edition 2010.

This Certificate attests compliance with:

GL 2010: "Germanischer Lloyd, "Guideline for the certification of Wind Turbines"; Edition 2010,

concerning the design and manufacture. It is based on the following reference documents:

Item	Reference document	Dated	Issued by
Design Evaluation - Conformity Statement	DE-159/125420879/2018, Rev.01	2018-08-03	TÜV Rheinland
Manufacturing Evaluation - Conformity Statement	ME-159/125420879/2018, Rev.01	2018-08-03	TÜV Rheinland
Prototype Testing - Conformity Statement	STC-151209, Rev.0	2015-12-23	DEWI-OCC
Type Characteristics - CEA Conformity Statement	Statement is based on evaluation report no.: 968/GI 1014.02.18, Rev.0.1	2018-05-25	TÜV Rheinland
Final Evaluation Report	125420879/8.9, Rev.01	2018-08-03	TÜV Rheinland

Any changes in the design or the manufacturer's quality system are to be approved by TÜV Rheinland, Certification Body for Wind Turbines. Without approval the Type Certificate loses its validity.

The Type Certificate is valid until 2023-05-17.

Cologne, 2018-08-03

Jai Prakash Narayan

Karl Friedrich

Certification Body Wind Turbines
TÜVRheinland®
Industrial Services

TÜV Rheinland Industrie Service GmbH,
Certification Body for Wind Turbines,
Am Grauen Stein,
51105 Cologne,
Germany

TRUE COPY
FOR, PASL WIND SOLUTIONS PVT. LTD.

DIRECTOR

Type Certificate

Wind turbine type specifications

Certificate No.: **TC-159/125420879/2018, Rev.01**

Applicant and Manufacturer: **PASL Wind Solutions (P) Ltd.**

Wind Turbine Type(s): **PWS1800i (de-rated),** 1500.0 kW, P-41, HH 80.0 m, IEC wind class II A

Machine Parameters

WTG Manufacturer	:	PASL Wind Solutions (P) Ltd.
Wind Turbine Model	:	PWS 1800i (de-rated configuration)
Wind Turbine Configuration (Drive Train)	:	Geared Wind Turbine with 'two - bearing' Support
Wind Turbine Axis of Rotation	:	Horizontal Axis
Power Regulation	:	Active Pitch with variable speed
Rotor Orientation	:	Upwind
Rotor Tilt	:	5.00 deg.
Rotor Cone Angle	:	2.00 deg.
Rated Power	:	1500.0 kW
Rated Wind Speed, V_r	:	12.0 m/s
Rated Rotational Speed	:	15.76 rpm
Rotor Diameter	:	83.64 m
Hub Height	:	80.0 m
Operating Wind Speed Range, (V_{in} – V_{out})	:	3.0 ~ 25.0 m/s
Design Life Time	:	20.0 years
Generator Type	:	Asynchronous Induction Generator
Tower Type	:	Tubular Steel
Primary Brake System	:	Mechanical Brake
Pitch/ Stall System	:	Electrical Pitch System

Wind Conditions

Wind Class	:	II *(according to IEC 61400-1:1999)*
Turbulence Class	:	A *(according to IEC 61400-1:1999)*
Characteristic Turbulence Intensity, I_{15}	:	0.18 *(@ V_{hub} = 15.0 m/s)*
Slope Parameter, a	:	2.0
Annual Average Wind Speed, V_{ave}	:	8.5 m/s
Reference Wind Speed, V_{ref}	:	42.50 m/s
50-year Extreme Wind Speed, V_{e50}	:	59.50 m/s

Wind speed values refer to hub height

TRUE COPY
OR, PASL WIND SOLUTIONS PVT. LTD.

DIRECTOR

Type Certificate

Annex

Wind turbine type specifications

Certificate No.: **TC-159/125420879/2018, Rev.01**

Applicant and Manufacturer: **PASL Wind Solutions (P) Ltd.**

Wind Turbine Type(s): **PWS1800i (de-rated),** 1500.0 kW, P-41, HH 80.0 m, IEC wind class II A

Electrical Network Conditions

Normal Supply Voltage and Range	:	690.0 V ± 10%
Normal Supply Frequency and Range	:	50.0 Hz ± 2%
Voltage imbalance	:	Max. 2%
Electrical Network Outages per year	:	350.0

Other Environmental Conditions

Environmental Condition	:	Normal Climate Condition *(according to IEC 61400-1:1999)*
Operating Temperature Range (Outside)	:	-10.0 ~ + 40.0 deg. C
Extreme Temperature Range (Outside)	:	-20.0 ~ + 50.0 deg. C
Air Density	:	1.225 kg/m³
Solar Radiation	:	1000.0 W/m²
Lightning Protection System	:	Protection Level II *(according to IEC 61400-24)*

Major Wind Turbine Components

Rotor Blade:

Blade Name/Model	:	P-41
Blade Length	:	40.55 m
Rated Power	:	1500.0 kW
Blade Material	:	Glass fibre reinforced epoxy resin
Bolt Circle Diameter	:	2100.0 mm
Blade Root Connection Type	:	T-Bolt Concept
Blade Mass	:	6443.0 kg *(with bolted joints, flanges and balancing masses)*
Static Moment from blade root	:	73630.0 kgm

Pitch Gearbox:

Manufacturer/Supplier	:	Bonfiglioli, KEB
Name/Model	:	706T3F, E2.SM.50T-1YB0

Blade Bearing (Slew Ring):

Manufacturer/Supplier	:	Schaeffler technologies GmbH & Co., KG
Name/Model	:	F-577937.VZI; Rev. 2

Hub:

Manufacturing Process	:	Casting
Material	:	EN-GJS-400-18U-LT
Drawing Reference	:	PWS 1800 0013.00; Rev.9

TRUE COPY
)R, PASL WIND SOLUTIONS PVT. LTD.

DIRECTOR

Type Certificate

Annex

Wind turbine type specifications

Certificate No.: **TC-159/125420879/2018, Rev.01**

Applicant and Manufacturer: **PASL Wind Solutions (P) Ltd.**

Wind Turbine Type(s): **PWS1800i (de-rated),** 1500.0 kW, P-41, HH 80.0 m, IEC wind class II A

Main Shaft:

Manufacturing Process	:	Casting
Material	:	EN-GJS-400-18U-LT
Drawing Reference	:	PWS 1800 0002; Rev. 05

Rotor Lock Disc:

Manufacturing Process	:	Casting
Material	:	EN-GJS-400-18U-LT
Drawing Reference	:	PWS 1800 0020.01; Rev. 04 & PWS 1800 0020.02; Rev. 06

Rotor Lock Pin:

Manufacturing Process	:	Forging
Material	:	34CrNiMo6H
Drawing Reference	:	PWS 1800 0001.07; Rev. 03

Main Bearings:

Manufacturer/Supplier	:	Schaeffler KG
Name/Model	:	230/710-B-MB-R300-450-H50V

Main Bearing Housings:

Manufacturing Process	:	Casting
Material	:	EN-GJS-400-18U-LT
Drawing Reference	:	PWS 1800 0012.01; Rev. 0

LSS Shrink Disc - Rotor Side:

Manufacturer/Supplier	:	Siemens
Name/Model	:	FSD 720

Main Gearbox:

Manufacturer/Supplier	:	Winergy AG
Name/Model	:	PEAB 4420 (*1-planetary and 2 - helical stages)*
Gear Ratio	:	95.2

Torque Arm (Main Gearbox) Support:

Manufacturing Process	:	Casting
Material	:	EN-GJS-400-18U-LT
Drawing Reference	:	PWS 1800 0014.01, Rev. 00

Elastomer Bearings:

Manufacturer/Supplier	:	Aegis Rubber Engineering Ltd.
Drawing Reference	:	BS2703

TRUE COPY
FOR, PASL WIND SOLUTIONS PVT. LTD.

DIRECTOR

Type Certificate

Annex

Wind turbine type specifications

Certificate No.: **TC-159/125420879/2018, Rev.01**

Applicant and Manufacturer: **PASL Wind Solutions (P) Ltd.**

Wind Turbine Type(s): **PWS1800i (de-rated),** 1500.0 kW, P-41, HH 80.0 m, IEC wind class II A

Mechanical Brake:

Manufacturer/Supplier	:	Kateel Engineering Industry Pvt. Ltd.
Name/Model	:	KL-HA-75x2WW

HSS Coupling:

Manufacturer/Supplier	:	Flender
Name/Model	:	ARV-4 KRZK 520-4

Main Frame:

Manufacturing Process	:	Casting
Material	:	EN-GJS-400-18U-LT
Drawing Reference	:	PWS 1800 0001; Rev. 8

Generator Frame:

Manufacturing Process	:	Casting
Material	:	EN-GJS-400-18U-LT
Drawing Reference	:	PWS 1800 0001.93; Rev 00

Generator (Alternative 1):

Manufacturer/Supplier	:	Loher (Siemens)
Name/Model	:	JGEA-500SR-04A *(Asynchronous Induction Generator)*
Rated Voltage	:	690.0 V AC
Rated Current	:	1770.0 A
Rated Power	:	1900.0 kW
Rated Speed	:	1500.0 rpm
Rated Frequency	:	50.0 Hz
Duty Type	:	S1 *(continuous. according to IEC 60034-1)*
Insulation Class	:	F
Degree of Protection	:	IP 54

Generator (Alternative 2 - de-rated):

Manufacturer/Supplier	:	ABB
Name/Model	:	AMI 500L4A BAFTI *(Asynchronous Induction Generator)*
Rated Voltage	:	690.0 V AC
Rated Current	:	1460.0 A
Rated Power	:	1500.0 kW
Rated Speed	:	1500.0 rpm
Rated Frequency	:	50.0 Hz
Duty Type	:	S1 *(continuous: according to IEC 60034-1)*
Insulation Class	:	F
Degree of Protection	:	IP 55

TRUE COPY
OR, PASL WIND SOLUTIONS PVT. LTD.

DIRECTOR

Type Certificate

Annex

Wind turbine type specifications

Certificate No.: **TC-159/125420879/2018, Rev.01**

Applicant and Manufacturer: **PASL Wind Solutions (P) Ltd.**

Wind Turbine Type(s): **PWS1800i (de-rated),** 1500.0 kW, P-41, HH 80.0 m, IEC wind class II A

Main Circuit Breaker (Alternative 1):

Manufacturer/Supplier	:	ABB
Name/Model	:	SACE Emax E3S25
Rated Voltage	:	690.0 V
Rated Nominal Current	:	2500.0 A
Breaking Current Capacity	:	65.0 kA

Main Circuit Breaker (Alternative 2):

Manufacturer/Supplier	:	Schneider Electric
Name/Model	:	ACB NW20
Rated Voltage	:	69.0 V
Rated Nominal Current	:	2000.0 A
Breaking Current Capacity	:	65.0 kA

Frequency Converter (Alternative 1):

Manufacturer/Supplier	:	Converteam/ GE
Name/Model	:	ProWind
Nominal Apparent Power	:	1800.0 kVA
Rated Voltage	:	690.0 V ±10 %
Nominal DC Bus Voltage	:	1100.0 V
Power Factor Range	:	0.86 to 1
Maximum Rated Current	:	2050.0 A *(Generator side)*/ 1500.0 A *(Grid side)*
Rated Grid Frequency	:	50.0 ± 2% Hz
Switching Frequency	:	2.5 kHz
Degree of Protection	:	IP21

Frequency Converter (Alternative 2):

Manufacturer/Supplier	:	ABB
Name/Model	:	ACS800N-87LC
Nominal Apparent Power	:	2205.0 kVA
Rated Voltage	:	750.0 V
Rated Voltage	:	690.0 ±10 % V
Nominal DC Bus Voltage	:	975.0 V
Power Factor Range	:	0.63 ind. To 0.63 cap.
Maximum Rated Current	:	2304.0 A *(Generator side)*/ 1880.0 A *(Grid side)*
Rated Grid Frequency	:	50.0 ± 2 % Hz
Switching Frequency	:	2.0 kHz
Degree of Protection	:	IP54

TRUE COPY
FOR, PASL WIND SOLUTIONS PVT. LTD.

DIRECTOR

Type Certificate

Annex

Wind turbine type specifications

Certificate No.: **TC-159/125420879/2018, Rev.01**

Applicant and Manufacturer: **PASL Wind Solutions (P) Ltd.**

Wind Turbine Type(s): **PWS1800i (de-rated),** 1500.0 kW, P-41, HH 80.0 m, IEC wind class II A

Yaw Drive:		
Manufacturer/Supplier	:	Bonfiglioli Trasmital
Name/Model	:	711T4 AND Motor BN100LB4
Gear Ratio	:	1450
Yaw Bearing (Slew Ring):		
Manufacturer/Supplier	:	SCHAEFFLER
Name/Model	:	F-577612.VI
Tower Top Flange:		
Material	:	S355
Reference Drawing	:	18TT-0-00-00-01; Rev. 4
Tower:		
Manufacturer/Supplier	:	Patel Alloy Steel (P) Ltd.
Hub Height	:	80.0 m
Type(s)	:	Tubular Steel
Section(s)	:	1st, 2nd & 3rd sections - Cylindrical and 4th section - Conical
Tower Length	:	77.848 m *(tower bottom to tower top)*
Top Outer Diameter	:	2292.0 mm
Bottom Outer Diameter	:	4200.0 mm
Weight	:	123650.0 kg *(with flanges, bolted connections and painting)*
Bolt Grade, Size and Number(s)	:	8.8 x 120 x M42 *(Bottom Flange)*, 10.9 x 100 x M48 *(1st Flange)*
	:	10.9 x 116 x M36 *(2nd Flange)*, 10.9 x 84 x M30 *(3rd Flange)*
Material	:	Shell Part - S355 JR *(EN 10025-2)*
	:	Flanges, Seamless - S355 JR *(EN 10025-2)* + Z15 *(EN 10164)*
	:	Bottom T-Flange, Seamless - S355 J0 *(EN 10025-2)* + Z15 *(EN 10164)*
	:	Door Frame - S355 JR *(EN 10025-2)* + Z25 *(EN 10164)*
Reference Drawing	:	18TT-0-00-00-02; Rev. 04
Control and Safety System:		
Main Controller Manufacturer	:	Beckhoff CX 1020-0111
Main Controller Model/Hardware	:	ABB PM592-XC
Manuals:		
Manufacturing Process	:	PWS/1800/HAD/001; Rev. 00; Dated: 2013-01-30
Transportation Process	:	PWS/1800/GEN/EM/01; Rev. 02; Dated: 2012-07-31
Installation & Commissioning Manual	:	PWS/1800/GEN/COM/01; Rev. 02; Dated: 2012-10-10
Operation Manual	:	PWS/1800/GEN/OM/01; Rev. 03; Dated: 2013-01-11
Service Manual	:	PWS/1800/GEN/MP/01; Rev. 03; Dated: 2013-01-11
Personnel Safety	:	PWS/1800/GEN/PS/01; Rev. 00; Dated: 2011-06-07

End of Annex

TRUE COPY
OR, PASL WIND SOLUTIONS PVT. LTD.

DIRECTOR