



EVK' 2015

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Sakarya
05 June 2015



- 1. NORDEX PRODUCT PORTFOLIO**
- 2. TURBINE'S OPTIONAL FEATURES**
- 3. NORDEX BLADE PRODUCTION IN TURKEY**





NORDEX PRODUCT PORTFOLIO



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05 June 2015



14 years and
more than **7,600 MW**

*as of Sept.14



Generation Alpha
N80/2500



Generation Beta
N90/2500



Generation Gamma
N80/2500
N90/2500
N100/2500
N117/2400



Generation Delta
N100/3300
N117/3000
N131/3000

Current portfolio

Global fleet availability in 2013: **~98 %**
Turbines under Nordex Service

2000

2007

2010

2013/14

THE NORDEX 2.4/2.5 MW CLASS (**GAMMA** GENERATION)



Current platform

Type	Capacity	Swept area	Certified for
N90/2500	2.5 MW	6,362 m ²	IEC I
		↓	
N100/2500	2.5 MW	(+23%) 7,823 m ²	IEC II
		↓	
N117/2400	2.4 MW	(+37%) 10,715 m ²	IEC III



N117/2400
First installation
running since 12/2011

THE NORDEX 3.0/3.3 MW CLASS (**DELTA** GENERATION)



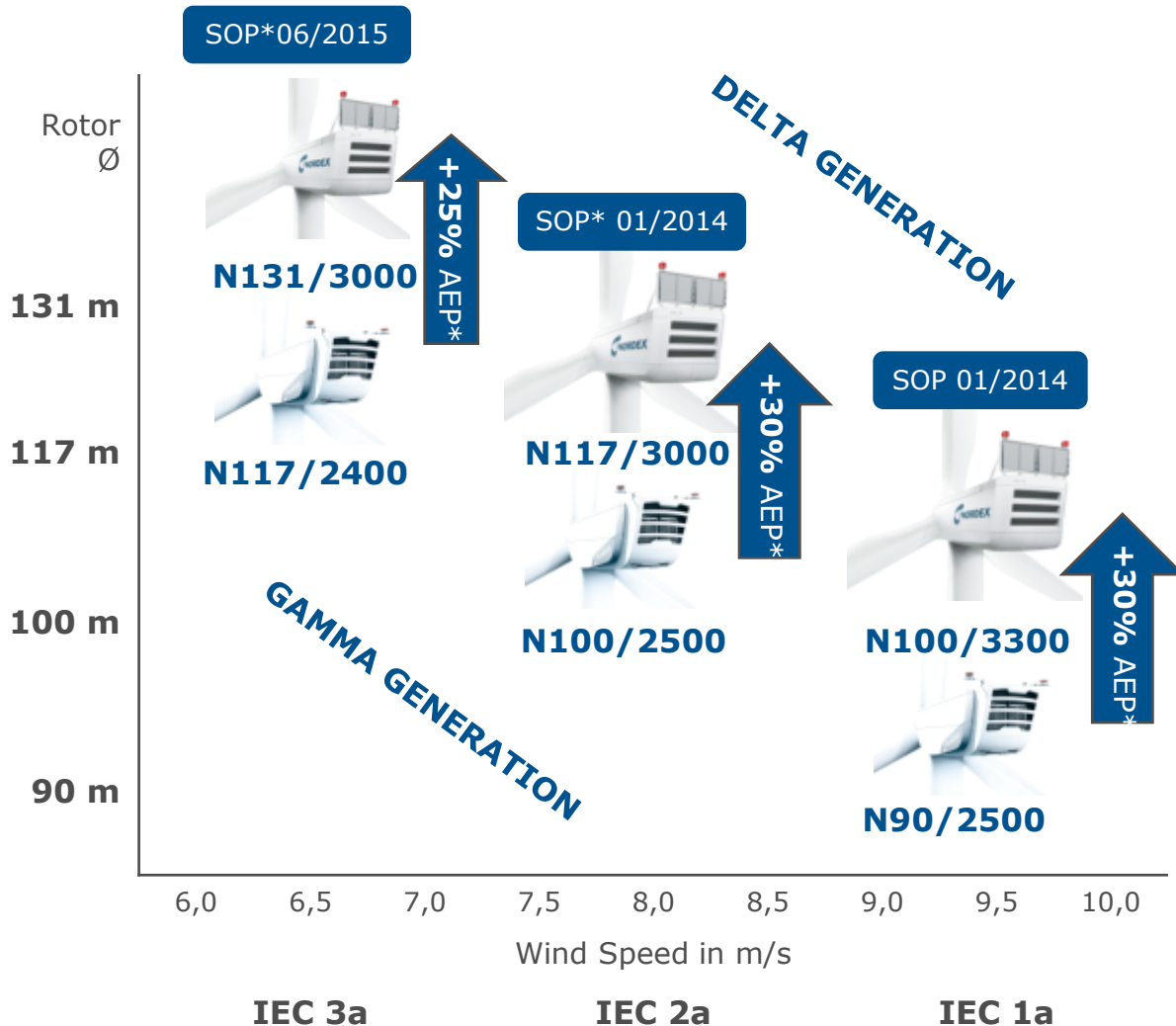
Current platform

Type	Capacity	Swept area	Certified for
N100/3300	3.3 MW	7,823 m ²	IEC I
		↓	
N117/3000	3.0 MW	(+37%) 10,715 m ²	IEC II
		↓	
N131/3000	3.0 MW	(+26%) 13,478 m ²	IEC III



N100/3300
First installation
running since 8/2013

Current product portfolio



Product Development Principles

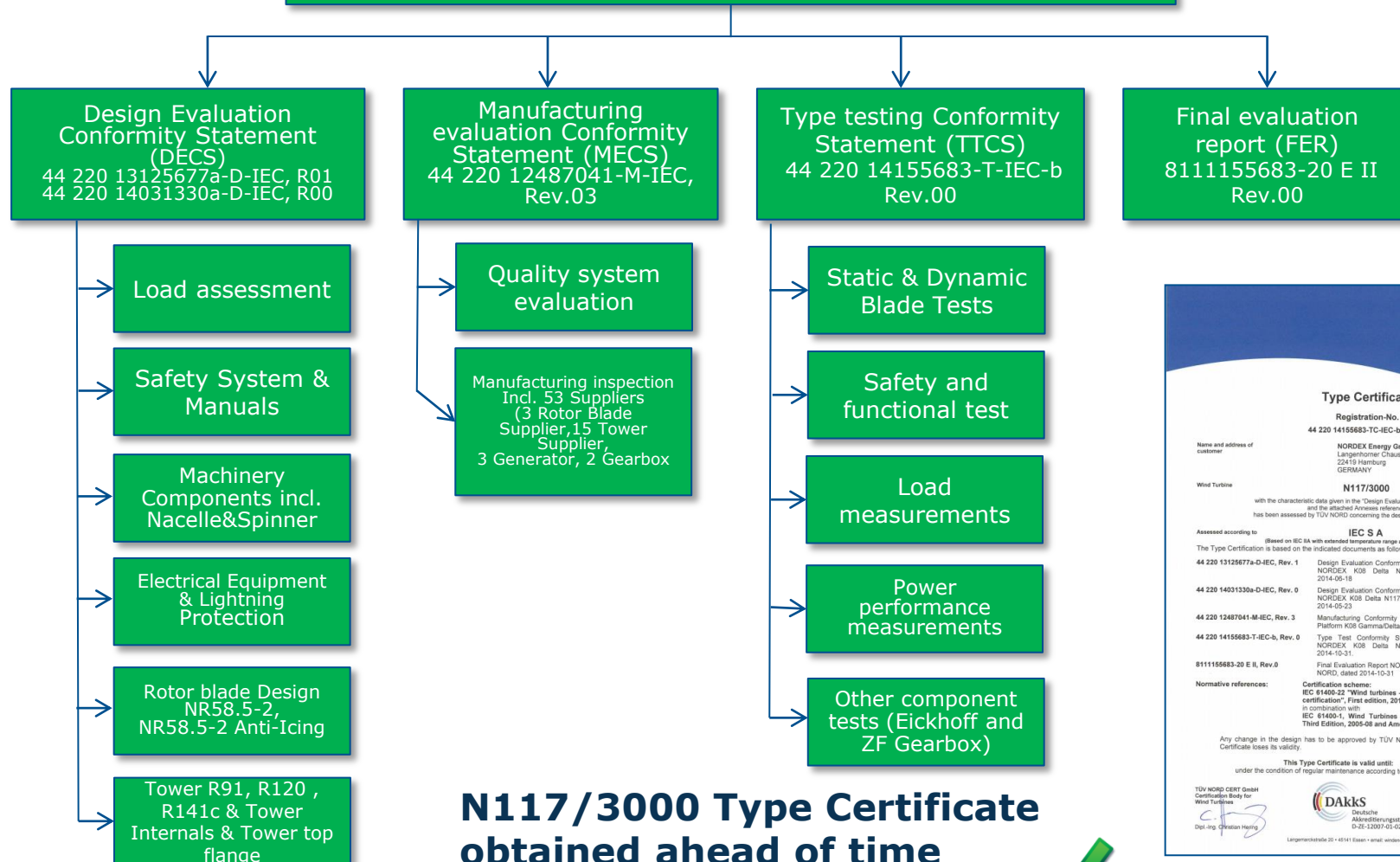
1. New product every 18-24 months
2. One highly competitive turbine per wind class
3. Continuous launch of efficiency improvement packages to keep product competitive
4. Innovations like "anti-icing" as differentiator

*SOP = Start of production

*AEP = Annual energy production

GENERATION DELTA – N117/3000 CERTIFICATION ON TRACK

Type certificate N117/3000 R91, R120, R141c IEC IIa SA 44 220 14155683-TC-IEC-b, Rev.0



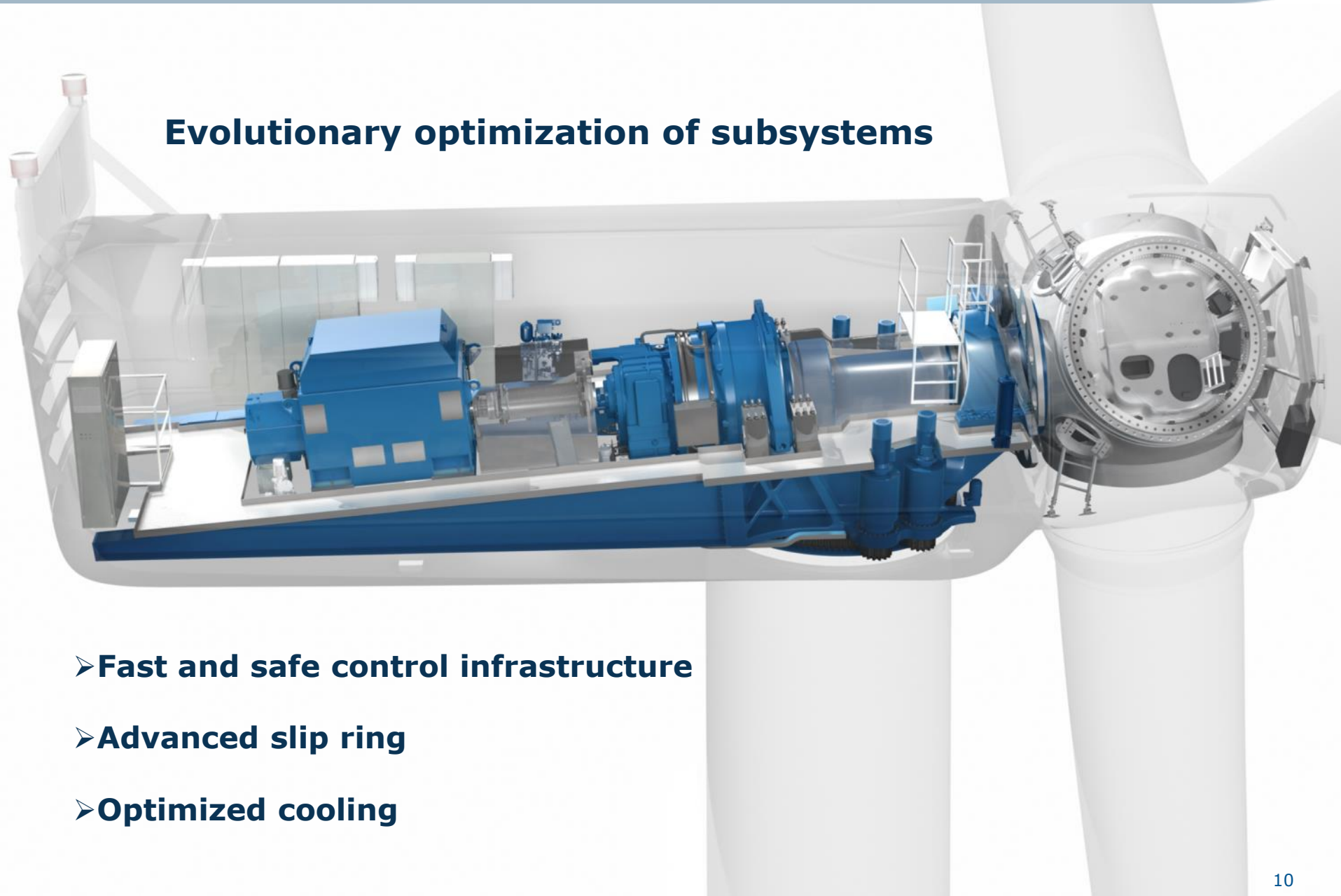
N117/3000 Type Certificate obtained ahead of time





N131/3000

Evolutionary optimization of subsystems



- **Fast and safe control infrastructure**
- **Advanced slip ring**
- **Optimized cooling**

Quiet, more quiet, N131/3000

2 dB(A) lower sound level than average low wind turbine*

- **Less sound effects** on residential areas and surroundings
- **Less curtailment** at sound restricted areas
- **More flexibility** in wind farm layout

N131/3000:
104.5 dB(A)

Average IEC3:
106.5 dB(A)

40 dB(A)

500m

32 dB(A)

+170m

1,000m

23 dB(A)

2,000m

An average IEC3 class turbine* needs to stand **17% further away** from immission point to reach **same sound** pressure level as **N131/3000**

* N131/3000-R99 compared to current IEC3 class turbines with rotor diameter >110m

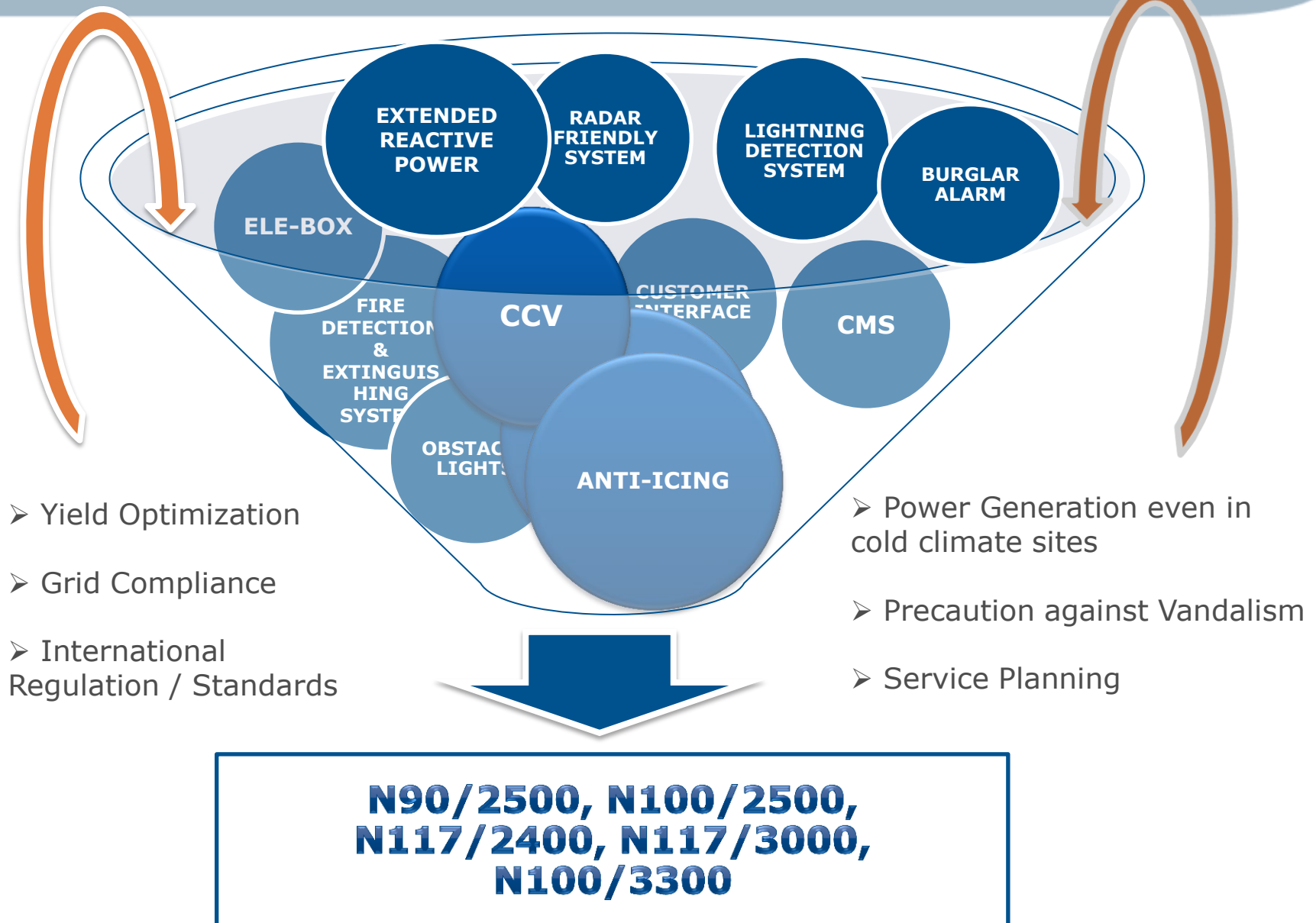


TURBINE'S OPTIONAL FEATURES



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Aviation Lights

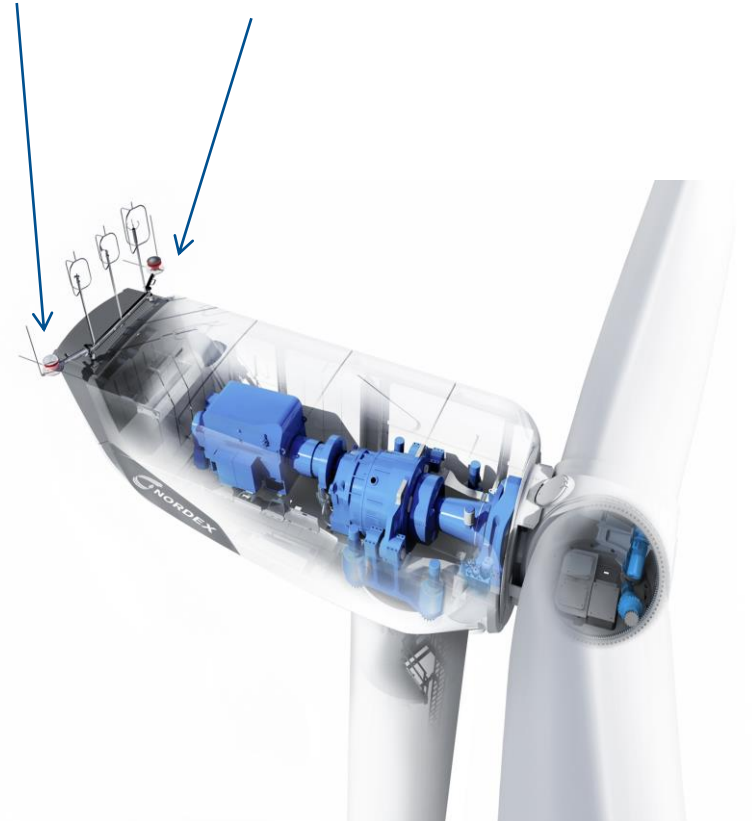
Purpose:

In order to be able to protect low-flying aircraft, wind turbines must in some cases be marked and illuminated using obstacle lights.

Their common features are:

- LED lights only
- Flashing lights
- Constant light
- Dusk sensor
- Red and/or white lights
- Day/night lights single or combined in the housing

Obstacle Lights



Condition Monitoring

A condition monitoring system serves to regularly monitor the condition of the main components of wind turbines.

- Service operations can be planned in advance
- Total breakdowns and consequential damage to components are avoided
- As Nordex is able to order and provide spare parts, components, cranes and vehicles in good time, downtime on site is shortened,
- The date and time for exchanging a component can therefore be arranged during low wind periods
- Inspection cycles can be extended



Cold Climate Version

Ambient temperature **CCV:**

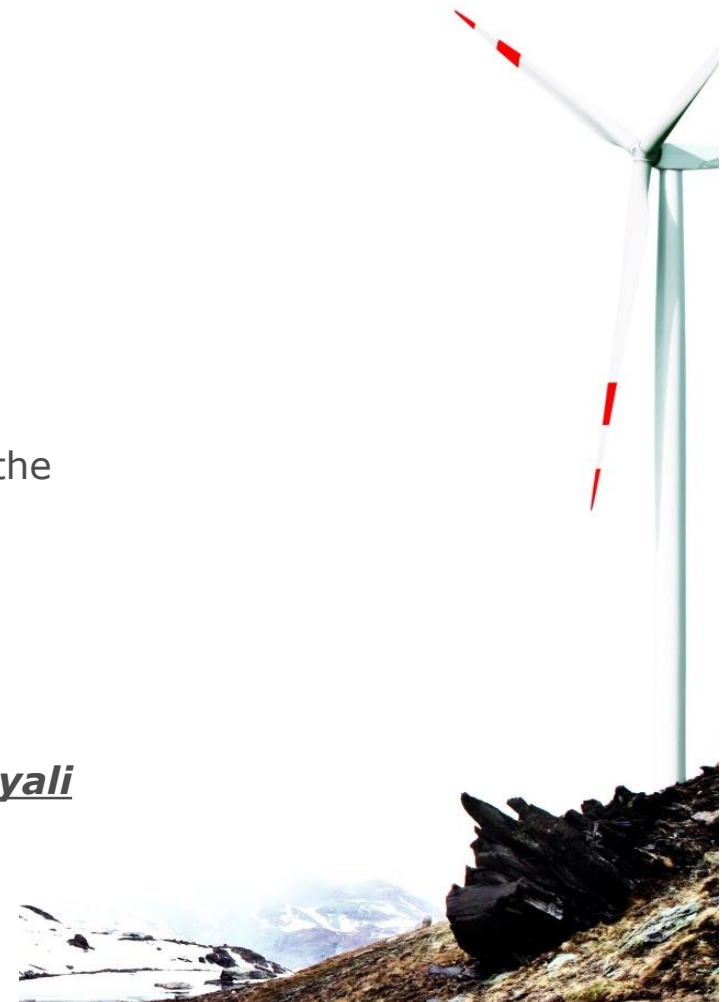
Survival: **-40 °C...+50 °C**

Nominal power*: **-30 °C...+40 °C**

Stop: **-30 °C**, restart **at -28 °C**

- The control system monitors the temperature of all relevant components.
- Should the temperature of the components fall under the permissible operating range, the temperature-sensitive components are kept at the lowest possible start temperature via heating.
- Power Generation even in cold climate site conditions
- First N117/2400 CCV turbines will be installed for **Yahyali** Project in Turkey. (Installed capacity is 52.5 MW)

To meet the design restraints of the wind turbine, if necessary, nominal power and cut-out wind speed can be slightly reduced.

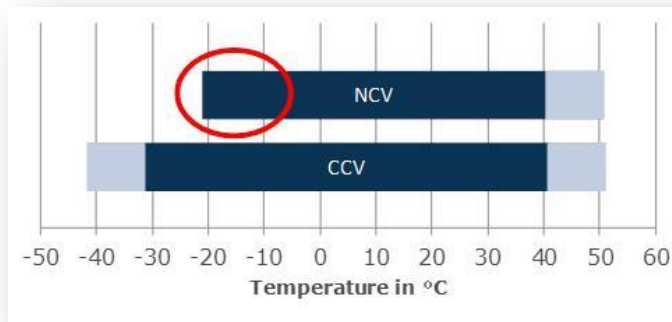


NCV Operation to -20°C (Gamma) - CCV Light Option

*Increased temperature range for K08
Gamma turbines*

*N100/2500 IEC 2a , 3a
N117/2400 IEC 3a*

for operation to -20°C.



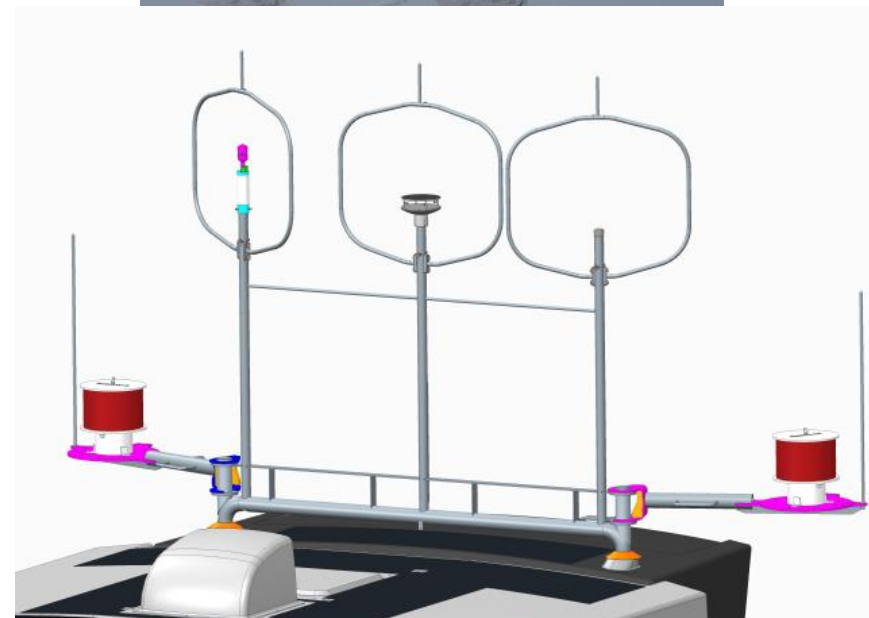
TURBINE STOP DURING ICING CONDITIONS

- Reduce risks related to ice throw
- Comply with local regulations
- Reduce vibrations and fatigue loads
- Avoid increased noise



Purpose:

To ensure that the lightning cage and mounting rods kept free of ice at severe icing sites, Nordex offers an optional CCV Anemometer and mast heating upgrade for normal climate version Turbines (NCV).

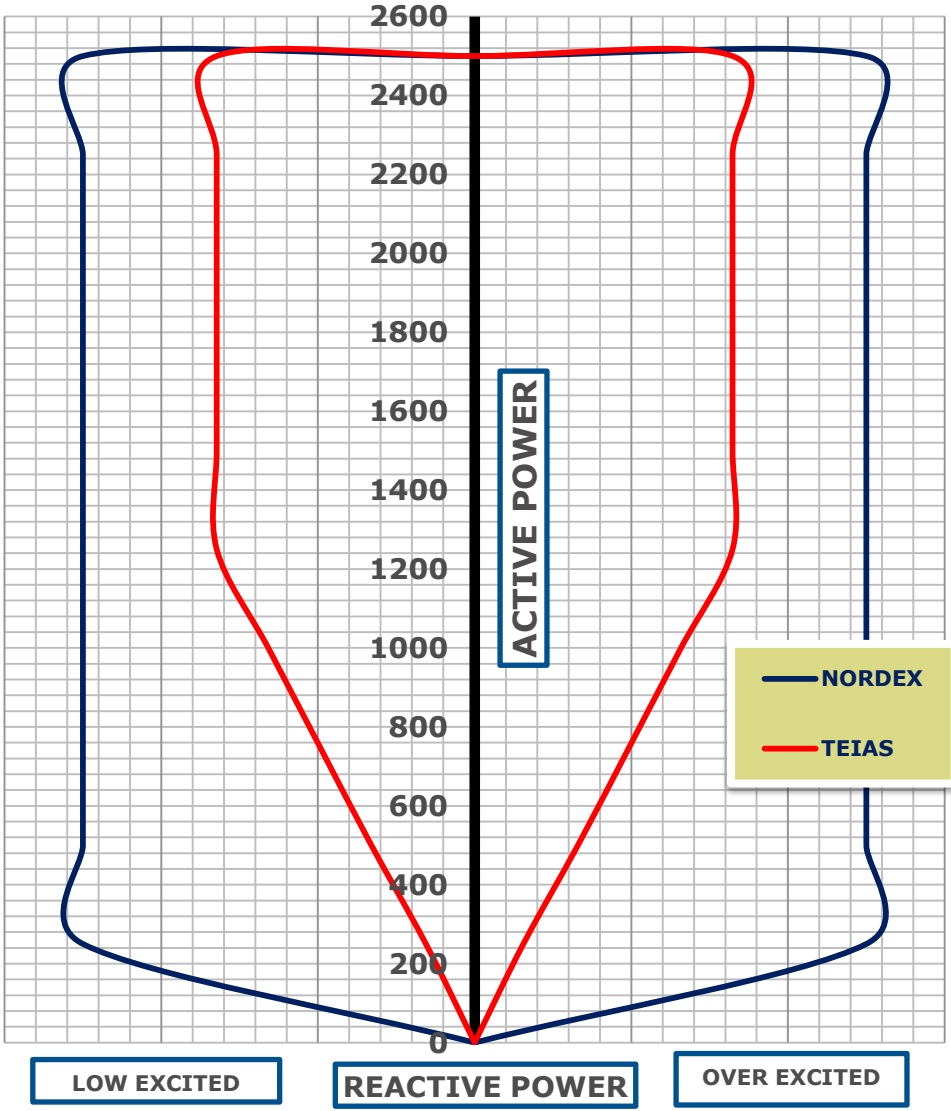


Power Factor Value ($\cos \phi$:0.9)

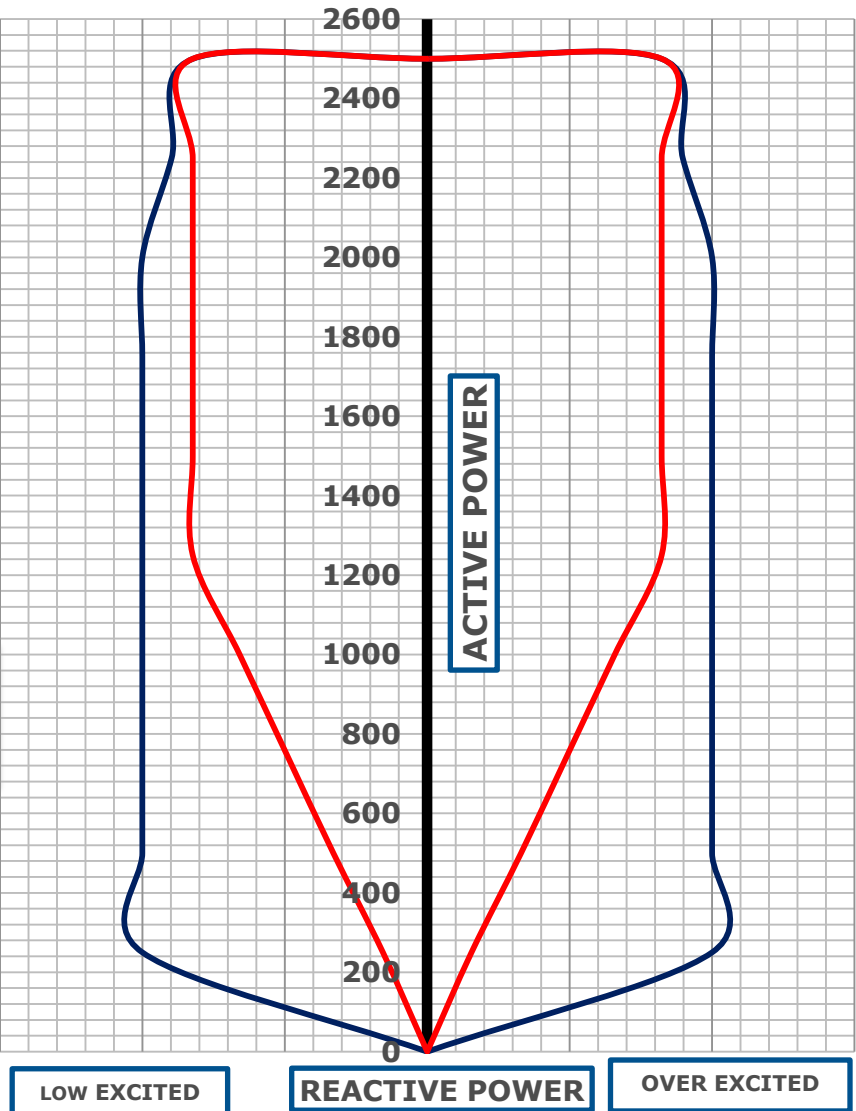
- Reactive power capability option ensures more reactive power in range between 0 (kW) - rated power in comparison to existing standard reactive power capability.
- Existing system is operated 0.95lead to 0.95lag power factor range
- With the use of extended reactive power capability option, power factor value can be achieved as 0.90lead to 0.90lag.
- This option is only for Gamma turbines, in Delta turbines this option is included in the standard turbine.



Extended



Standard



Methode:

- Lightning field is observed as a magnetic signal in the two antennas.
- Magnetic signals picked up by antenna and fed via coax cables to a converter box
- Converter box signals are combined, filtered and converted to optical signals
- Lightning current itself provides power to generate optical signals (no power supply needed)
- Control box for direct indication and NC2 interface

Setup:

- 2 Antenna outside
- Connection box
- Control box

Connection



OPC XML DA CIF MODULE & SQL ONLINE ACCESS

- **OPC XML DA CIF MODULE:**
With the use of Customer Interface module, investors can query the NC2 module online data of their wind farms such as the power data at the wind farm grid connection point and generates the set points and then process this data in their own Software / SCADA systems.
- **SQL ONLINE ACCESS:**
The Nordex Control 2 module SQL Online Access is intended for customers who need direct access to historical data of the wind. The wind turbine (WT), the met mast (MET), the Monitoring System Substation (MSS) and the Combined Wind Farm Management and Electrical System (CWE) can be used as data sources.



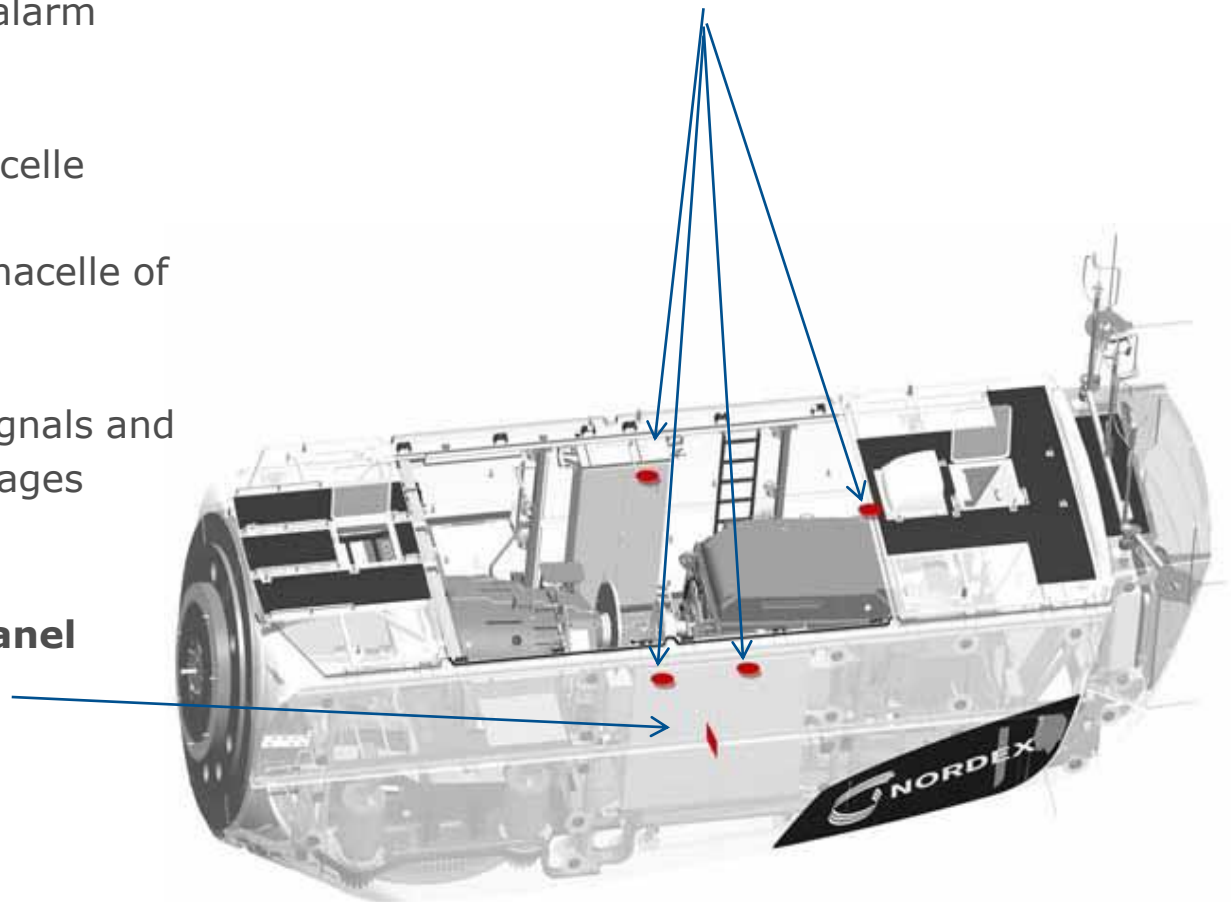
Fire Detection System

The fire detection and alarm system serves to:

- Fire detection in the nacelle
- Reporting a fire in the nacelle of the wind turbine
- Generating electrical signals and forwarding alarm messages

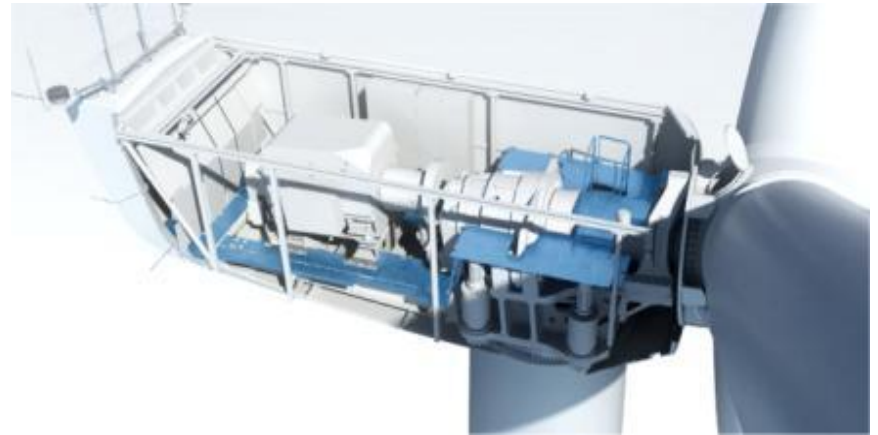
Fire Detection Panel

Fire Detector



Fire Extinguishing System

- Fire Monitoring and Fire Fighting in Wind Turbines
- The fire extinguishing system serves to detect and put out a fire in the nacelle of the wind turbine.
- The fire extinguishing system is an independent unit.



Burglar Alarm System

- Detecting of any unauthorized access to the wind turbine
- Providing preventive protection to the wind turbines against vandalism

Components:

- System consists of sensors, detectors, GSM module, transponders, acoustic and visual signalling device etc.



Nordex Blade Production in Turkey



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NR 58.5m BLADES

For signed projects in 2014, 75 percent of blades to be produced locally.

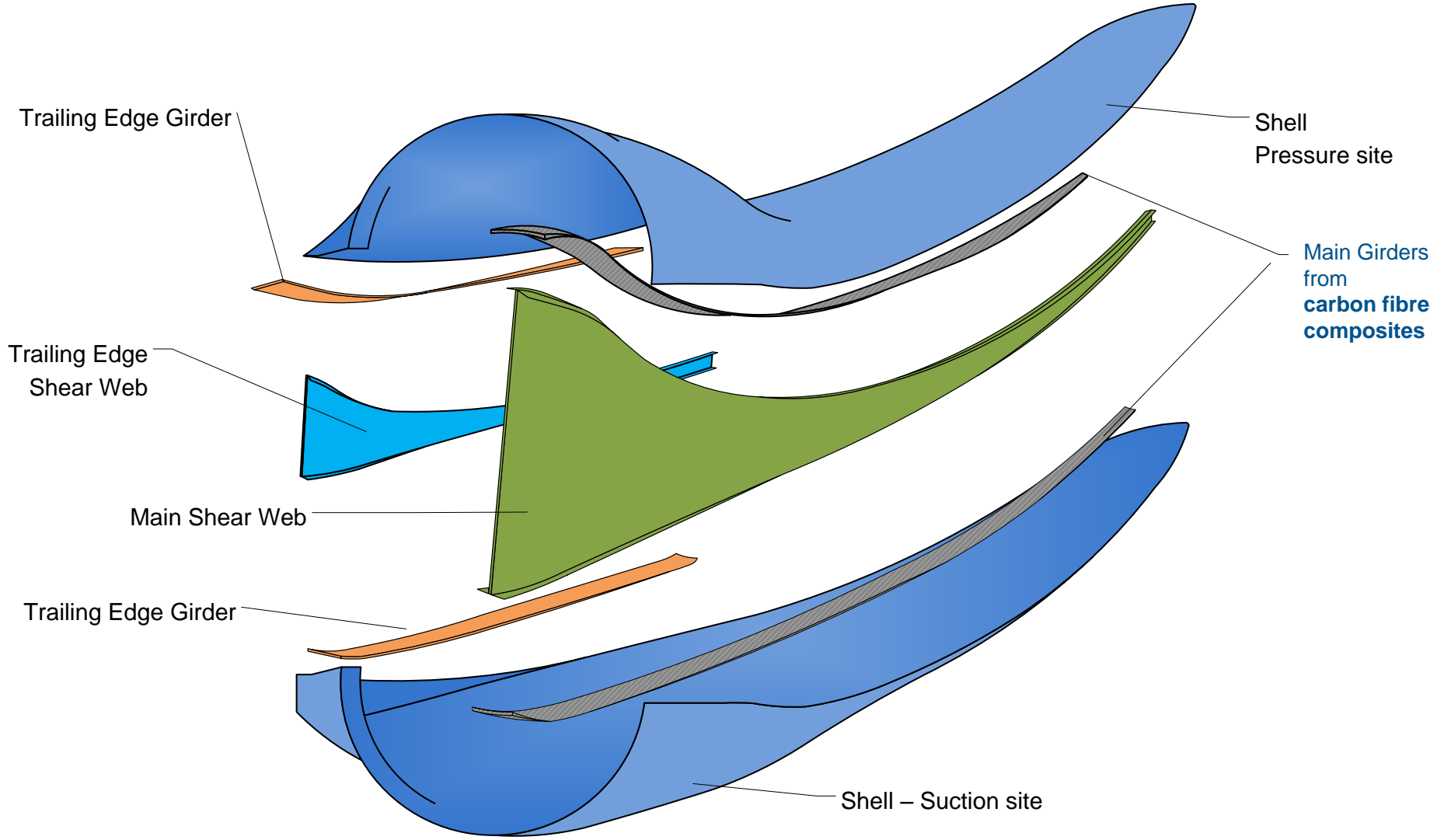
Success factors

- Structural & aerodynamic design are based on the experiences of the fully certified in-house developments NR45 and NR50
- **Use of carbon fiber composites (CRP)** in the girders of the **newly developed rotor blade NR58.5** is key for weight reduction
- **+17% of rotor diameter** while **reducing rotor weight by 1,500 kg**
- Development of **manufacturing concept in cooperation** with carbon specialist **SGL Carbon**

	NR45	NR50	NR58.5
WTG Type	N90	N100	N117
Length	43.8 m	48.8 m	57.3 m
Weight	10,300 kg	11,000 kg	10,500 kg
Max. Chord	3,220 mm	3,700 mm	3,496 mm
Pre-Bend	1,500 mm	2,000 mm	2,000 mm
Projected Surface	93 m ²	116 m ²	121 m ²
# of Bolts	64 (M36)	64 (M36)	64 (M36)
Bolt Circle Diameter	2,300 mm	2,300 mm	2,300 mm
Materials	GRP	GRP	GRP & CRP

NR 58.5m BLADES

Rotor Blade - Structural Design with Key Innovation - Carbon Girders



BLADE PRODUCTION IN TURKEY

TPI TURKEY COMPANY OVERVIEW

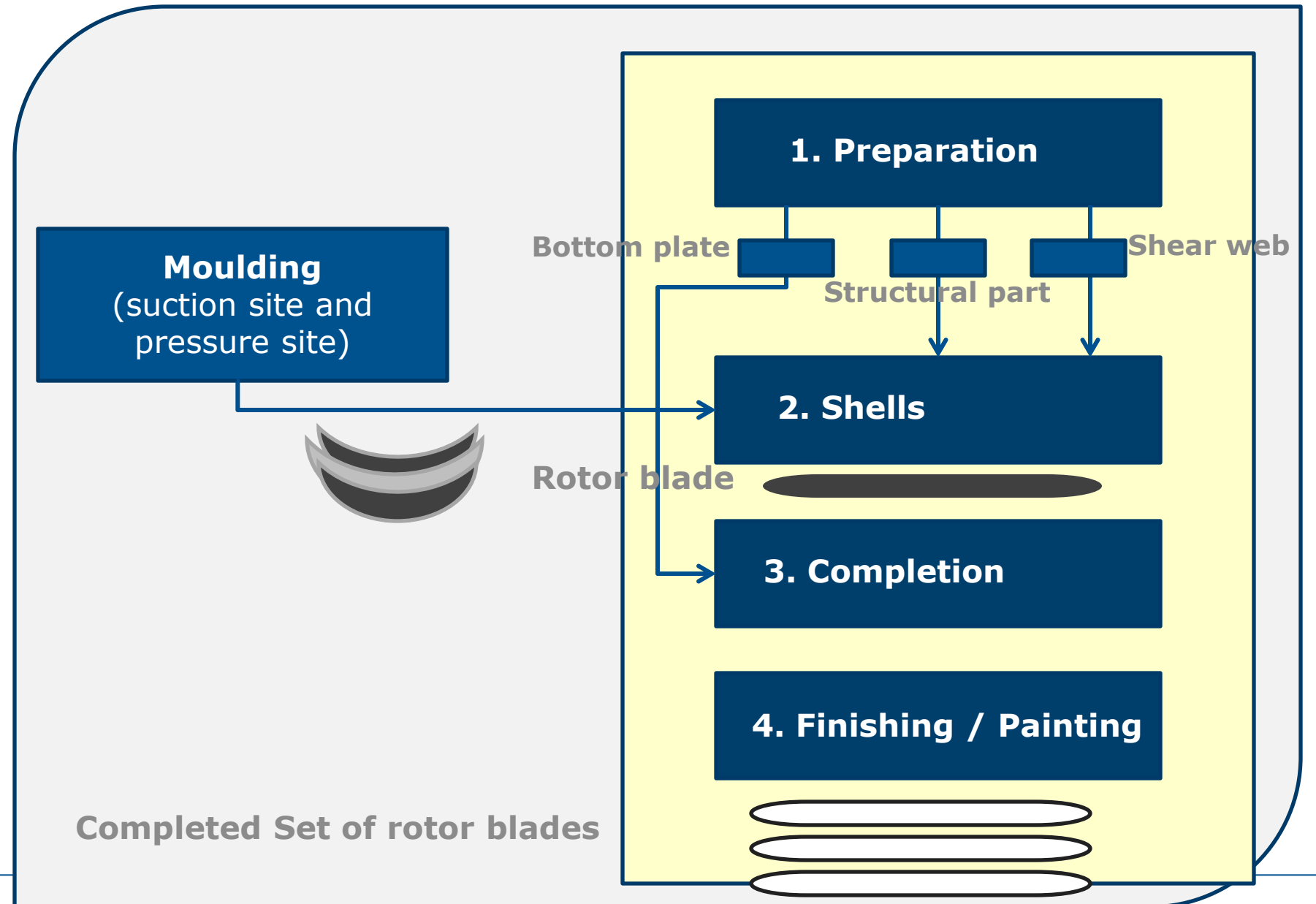


TPI TURKEY PLANT



BLADE PRODUCTION IN TURKEY

PRODUCTION PROCESS IN GENERAL



BLADE PRODUCTION IN TURKEY

GENERAL OVERVIEW IN THE FACILITY HALL IN TURKEY



BLADE PRODUCTION IN TURKEY

NORDEX MOULDS IN PRODUCTION FACILITY IN TURKEY



Bottom plate - phase1



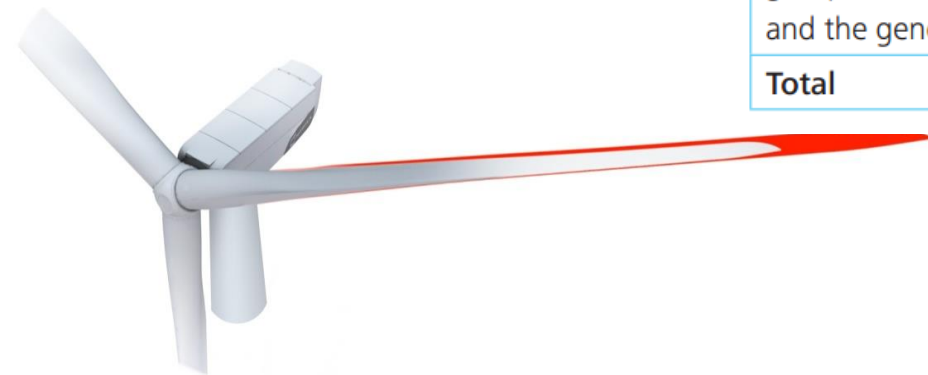
Bottom plate - phase 2

Regulation on local content requirements in wind energy law

According to current Turkish legislation, wind farm investors are entitled to have additional feed-in-tariff bonus for a period of five years, if they choose a turbine manufacturer who domestically manufactured mechanical and/or electromechanical equipment of the WTG.

NR 58.5 Blades will bring extra bonus for the investors for 5 years together with tower equipment !

Maximum price including the local equipment bonus (USD cent / kWh)	
Feed-in-tariff	7.3
Equipment bonus	3.7
1- Blade	0.8
2- Generator and power electronics	1.0
3- Turbine tower	0.6
4- All of the mechanical equipment in rotor and nacelle groups (excluding payments made for the wing group and the generator and power electronics)	1.3
Total	11.0



Questions?



THANKS FOR YOUR ATTENTION!

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