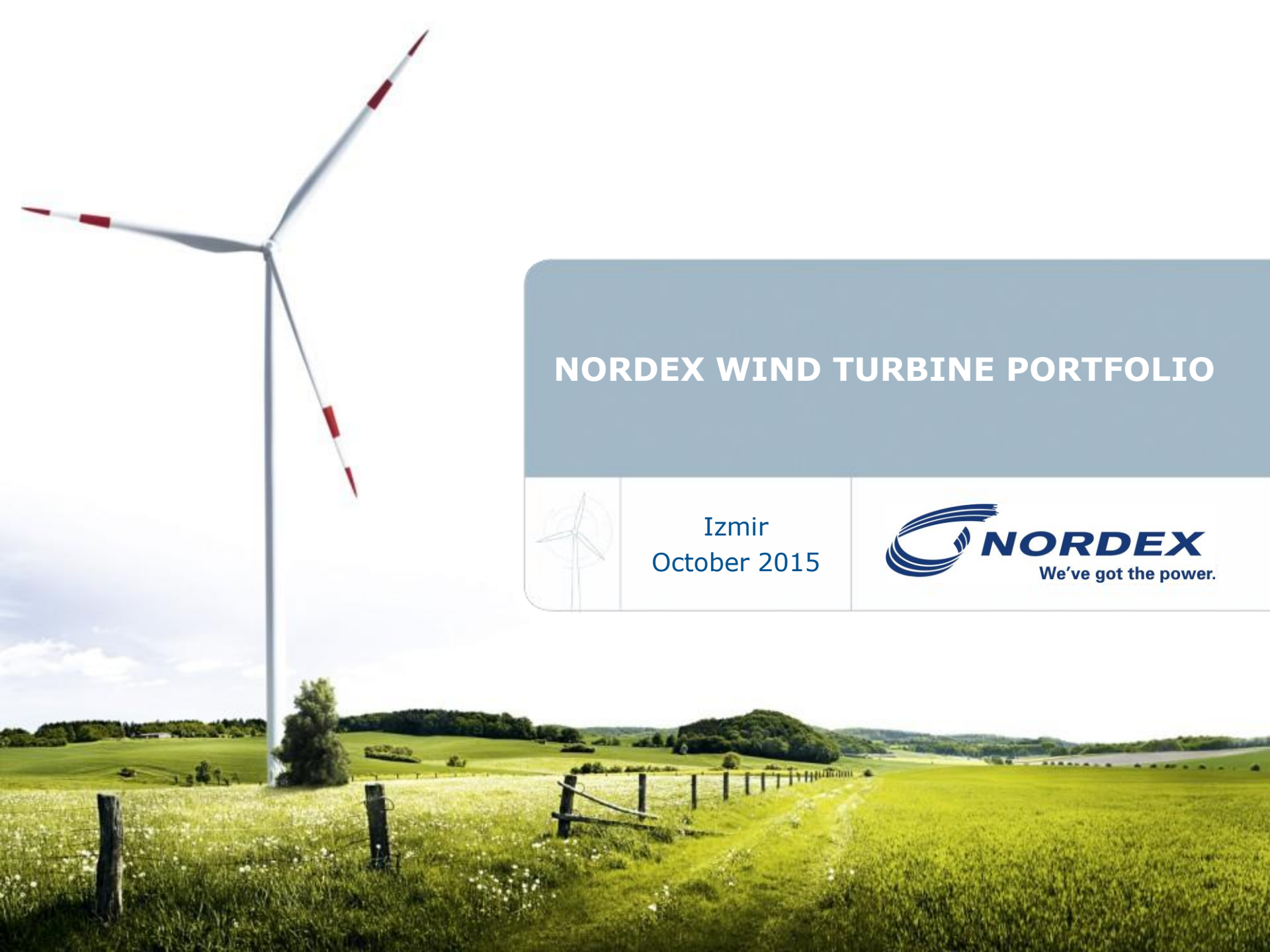


NORDEX WIND TURBINE PORTFOLIO

Izmir
October 2015

NORDEX
We've got the power.

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 m²	IEC I
		⬇	
N100/2500	2.5 MW	(+23%) 7,823 m²	IEC II
		⬇	
N117/2400	2.4 MW	(+37%) 10,715 m²	IEC III

N117/2400
First installation
running since 12/2011

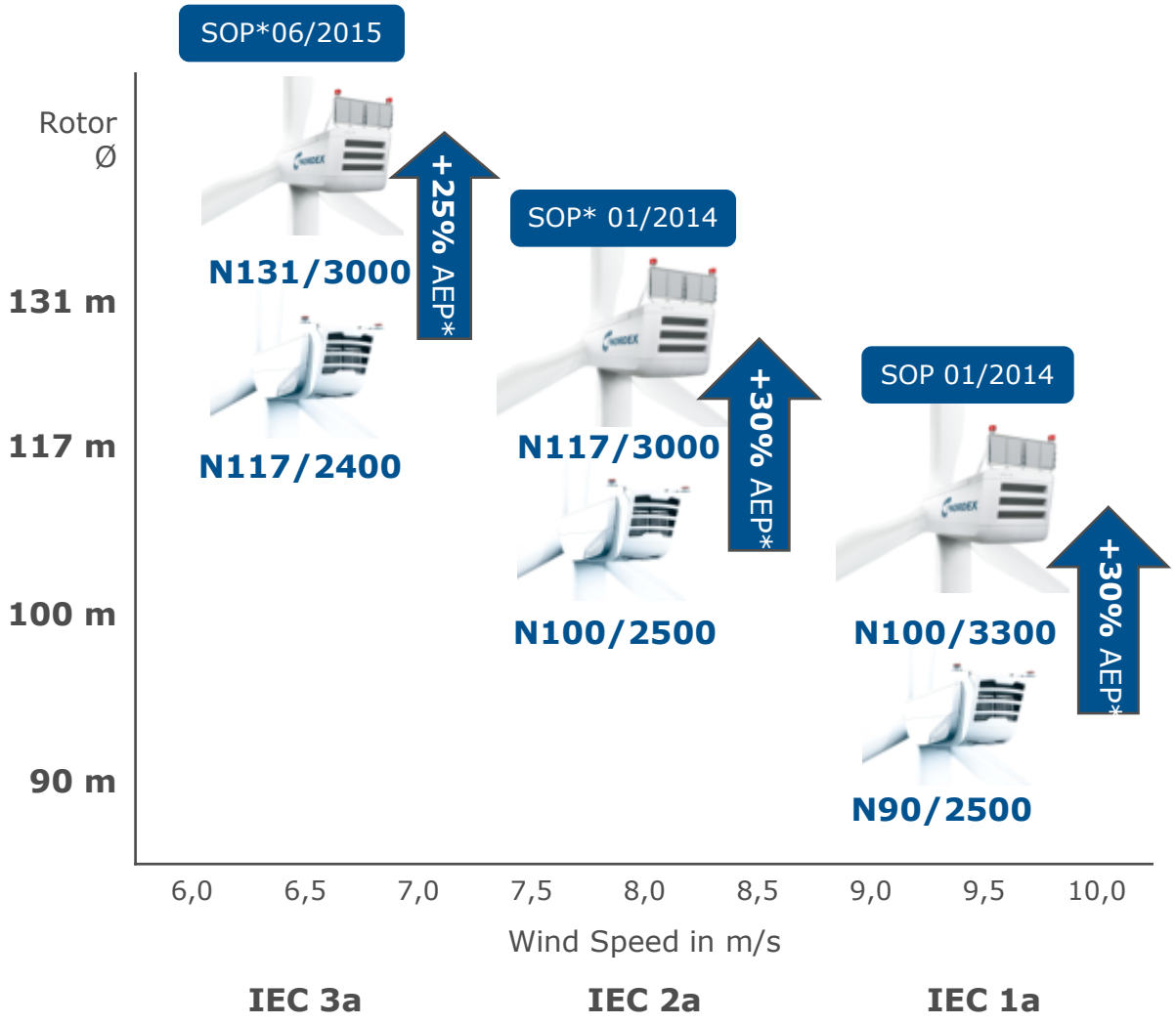
Current platform

Type	Capacity	Swept area	Certified for
N100/3300	3.3 MW	7,823 m²	IEC I
		↓	
N117/3000	3.0 MW	(+37%) 10,715 m²	IEC II
		↓	
N131/3000	3.0 MW	(+26%) 13,478 m²	IEC III

N100/3300
First installation
running since 8/2013

WITH THE NEW IEC I / II / III TURBINES, NORDEX WILL PURSUE THE SUCCESSFUL PATH LAID BY THE N117/2400

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

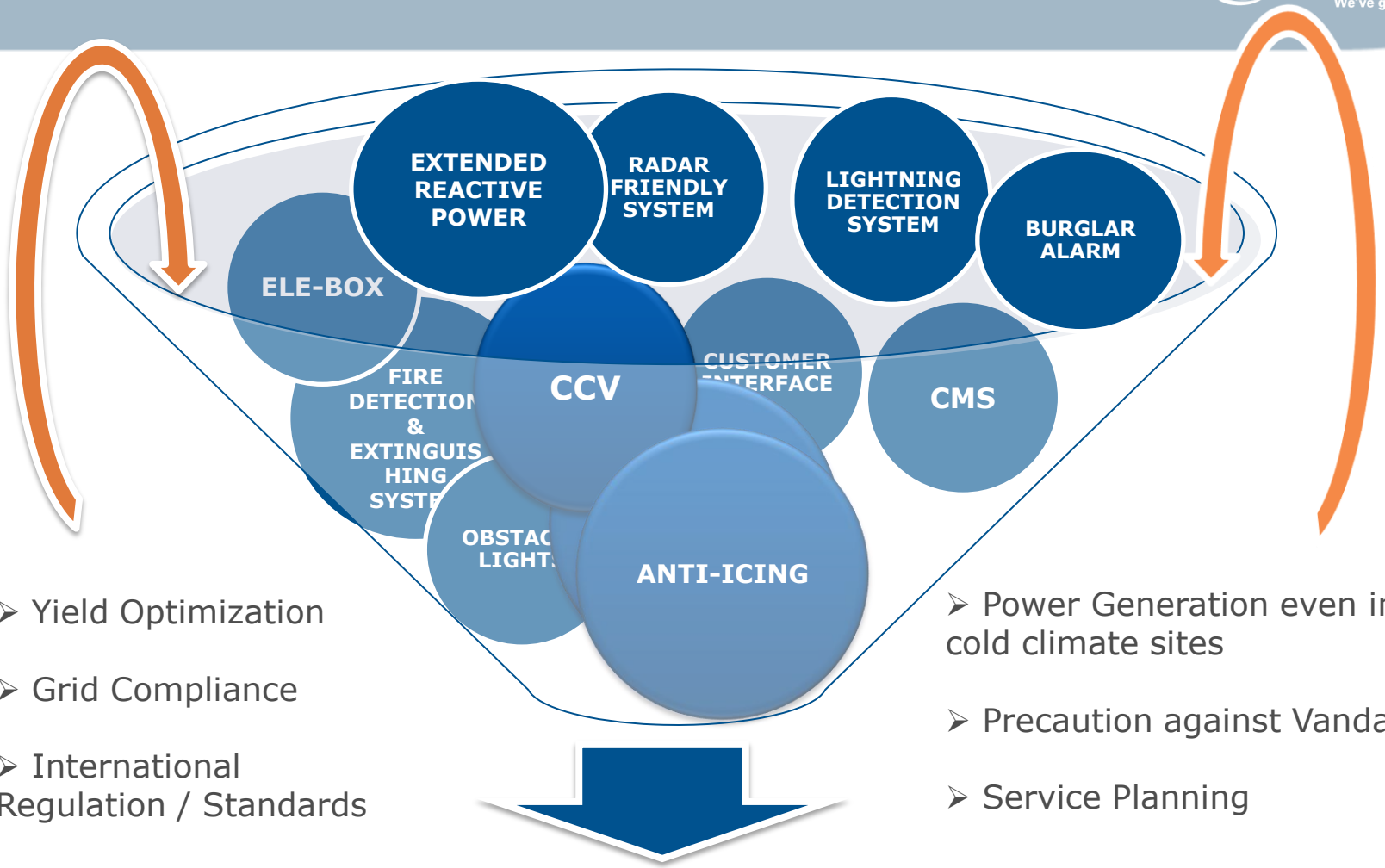
*AEP = Annual energy production

OPTIONAL SOLUTIONS TO WIND ENERGY SECTOR NEEDS

October 2015

NORDEX
We've got the power.

REASONS OF OPTION DEVELOPMENT



- Yield Optimization
- Grid Compliance
- International Regulation / Standards

- Power Generation even in cold climate sites
- Precaution against Vandalism
- Service Planning

N90/2500, N100/2500, N117/2400, N117/3000, N100/3300

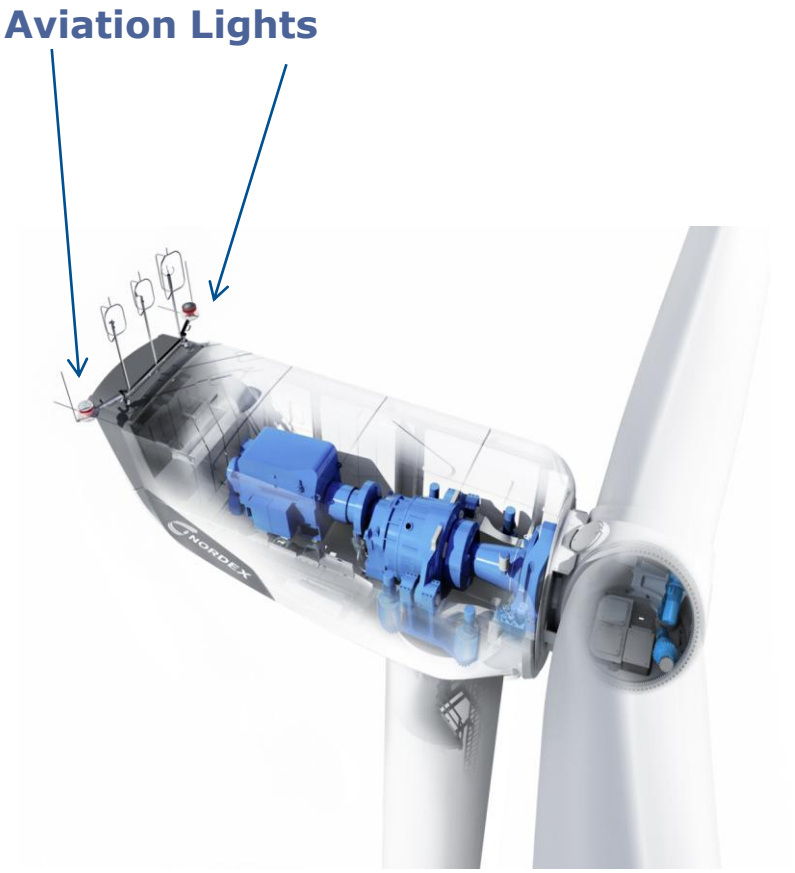
Aviation Lights

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



Aviation Lights

Advantages of Aviation Lights:

- Very high service life of lamps; only LEDs are used
- Service friendly
- Low consumption
- Comprehensive technical modifications of optical impact to the surroundings
(can be synchronized, intensity regulation through visibility measurement)

2000 cd Red/Night

20000 cd
White/Day +
LED + 2000 cd,
Red/Night or
2000 cd White

Tower Marking

20 cd
Constant Light

Condition Monitoring

- 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
- The System sends once per day data for the analysis

Cold Climate Version

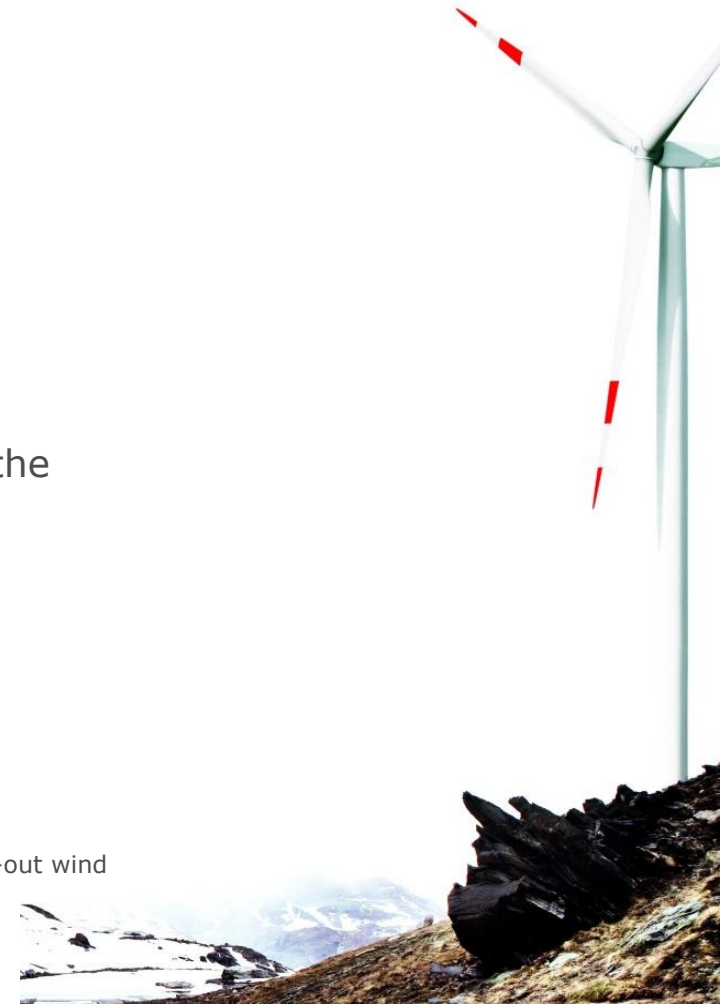
Ambient temperature **CCV:**

Survival**: -40 ºC…+50 ºC**
Nominal power***: -30 °C…+40 ºC**
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



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

CCV Light Option

- The extended operation temperature range:

Operation down to -20°C with re-start at -18^{0}C

Rotor Blade Anti-Icing System

The heating element which is integrated in the rotor blade heats up the surface of the blade until the ice melts.

With the use of anti-icing system, Nordex customers can rely on secure yields from their wind turbines and maximum availability, even in cold climate conditions.

The Anti-Icing System pays for itself after an average of 5 years of operation even at locations with only a few weeks of cold temperatures

Test Results of Blade Heating

- **Over 8 per cent** increase in yields for the whole of the year

- **Over 25 per cent** increase in yields in months with severe icing conditions

ROTOR BLADE ICE DETECTION SYSTEM

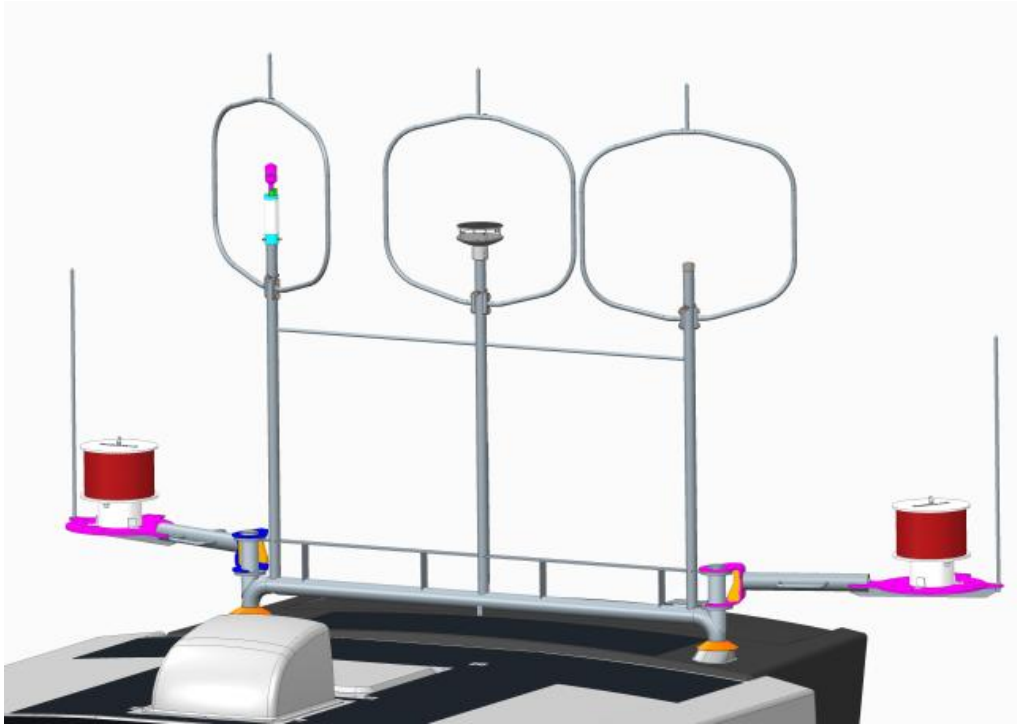
TURBINE STOP DURING ICING CONDITIONS:

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

CCV-ANEMOMETER-KIT FOR NCV TURBINES

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).



EXTENDED REACTIVE POWER (0.90 POWER FACTOR)

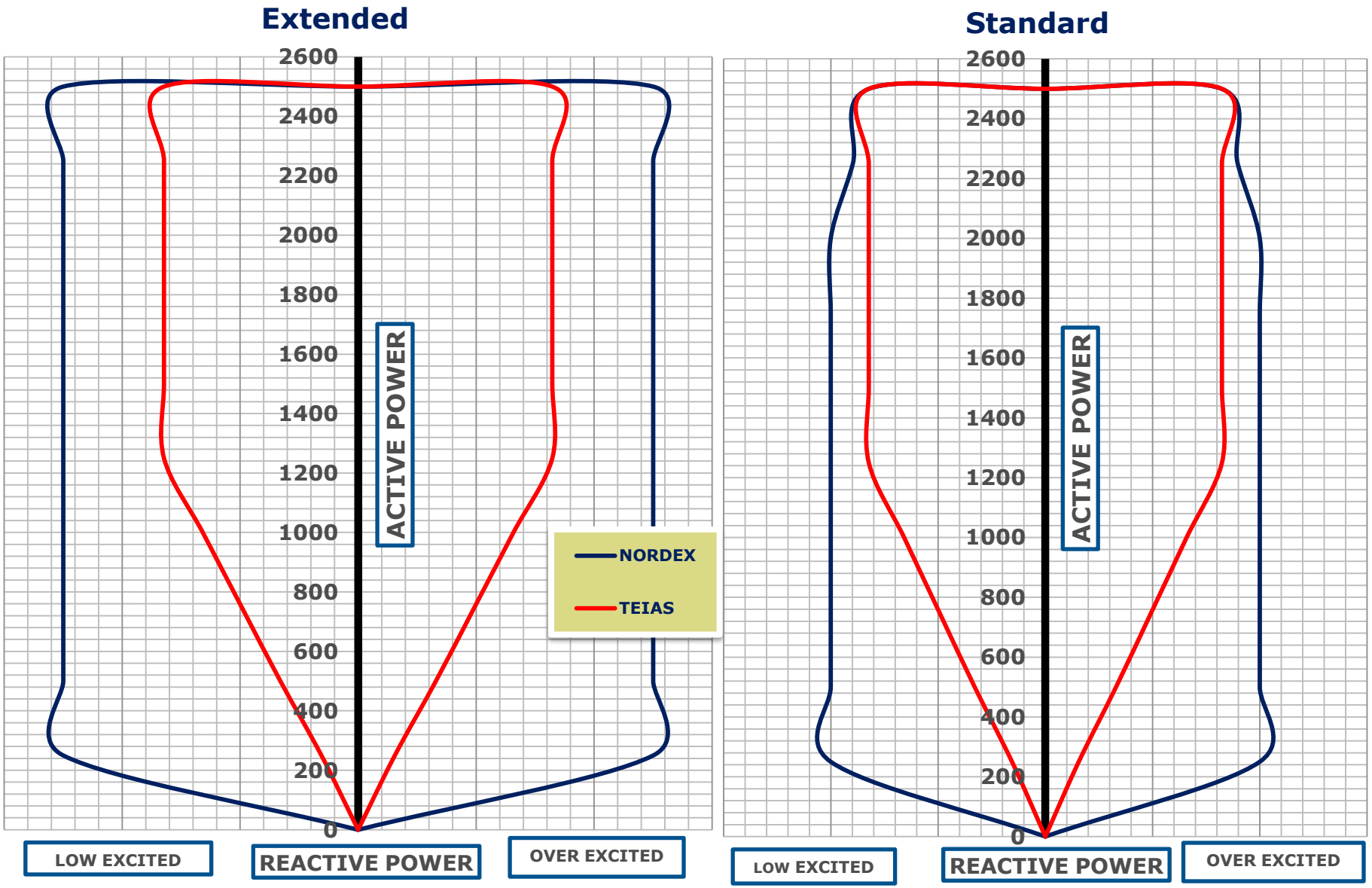
Power Factor Value (cos phi:0.9)

- 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.

EXTENDED REACTIVE POWER (0.90 POWER FACTOR)



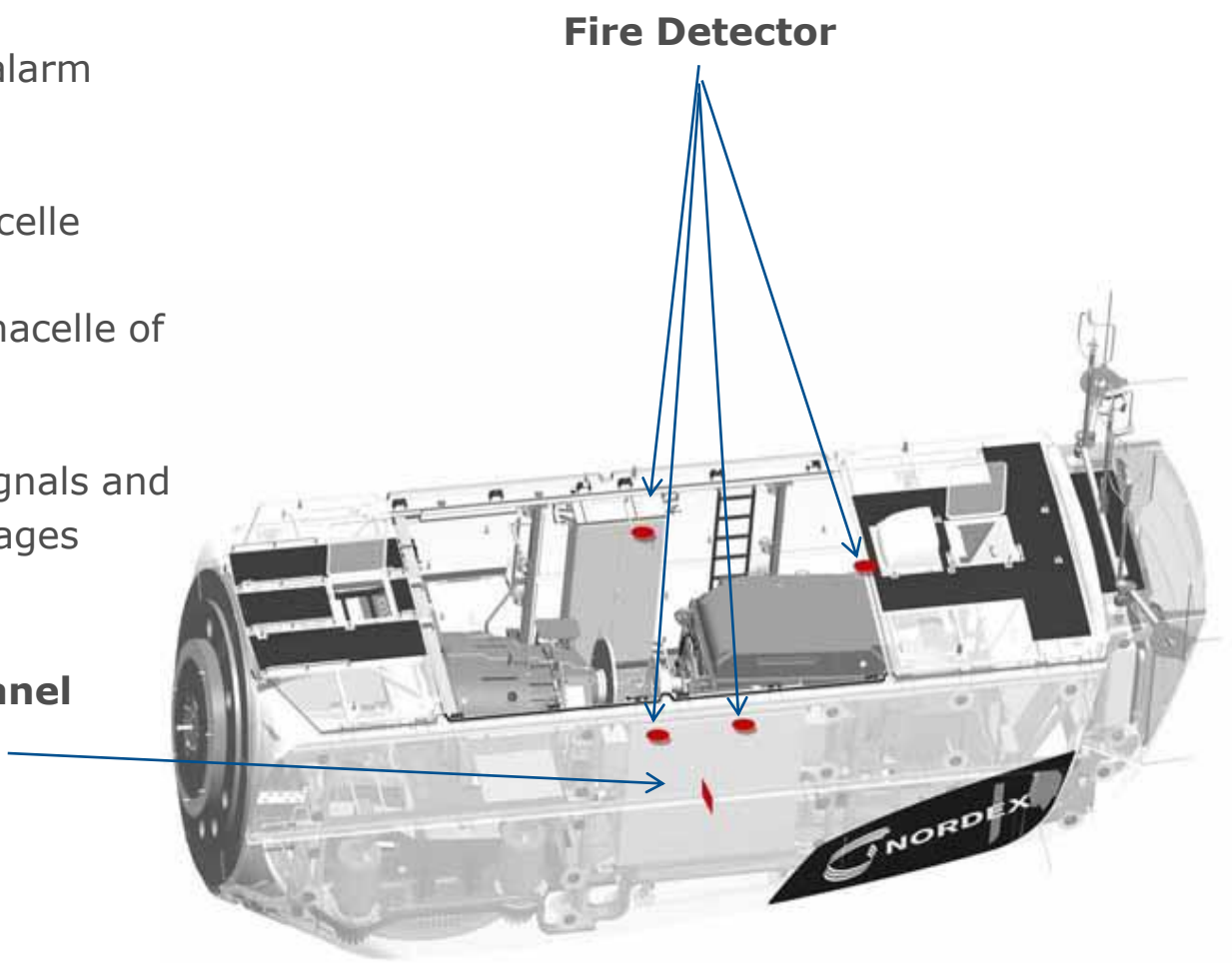
OPC XML DA CIF MODULE

With the use of Customer Interface module, investors can query the NC2 module online data of their wind farms and then process this data in their own Software / SCADA systems.

Fire Detection System

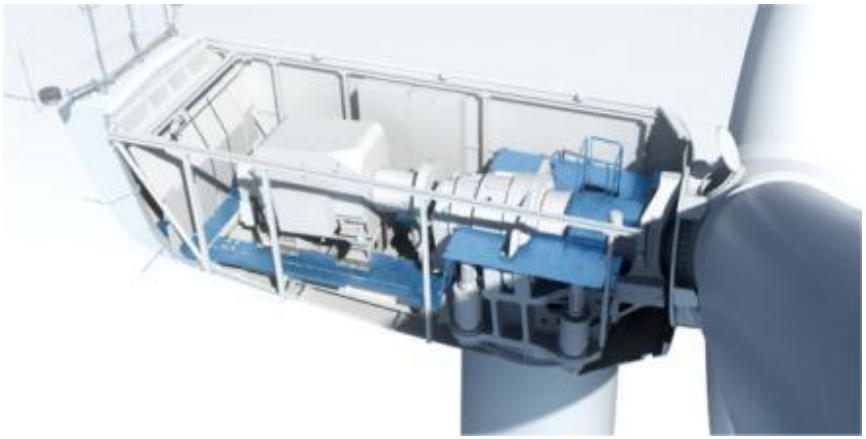
The fire detection and alarm system serves to:

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



Fire 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.



Nordex Blade Production in Turkey

October
2015

NORDEX
We've got the power.

BLADE PRODUCTION IN TURKEY
TPI TURKEY COMPANY OVERVIEW

NORDEX
We've got the power.

tpi

TPI TURKEY PLANT

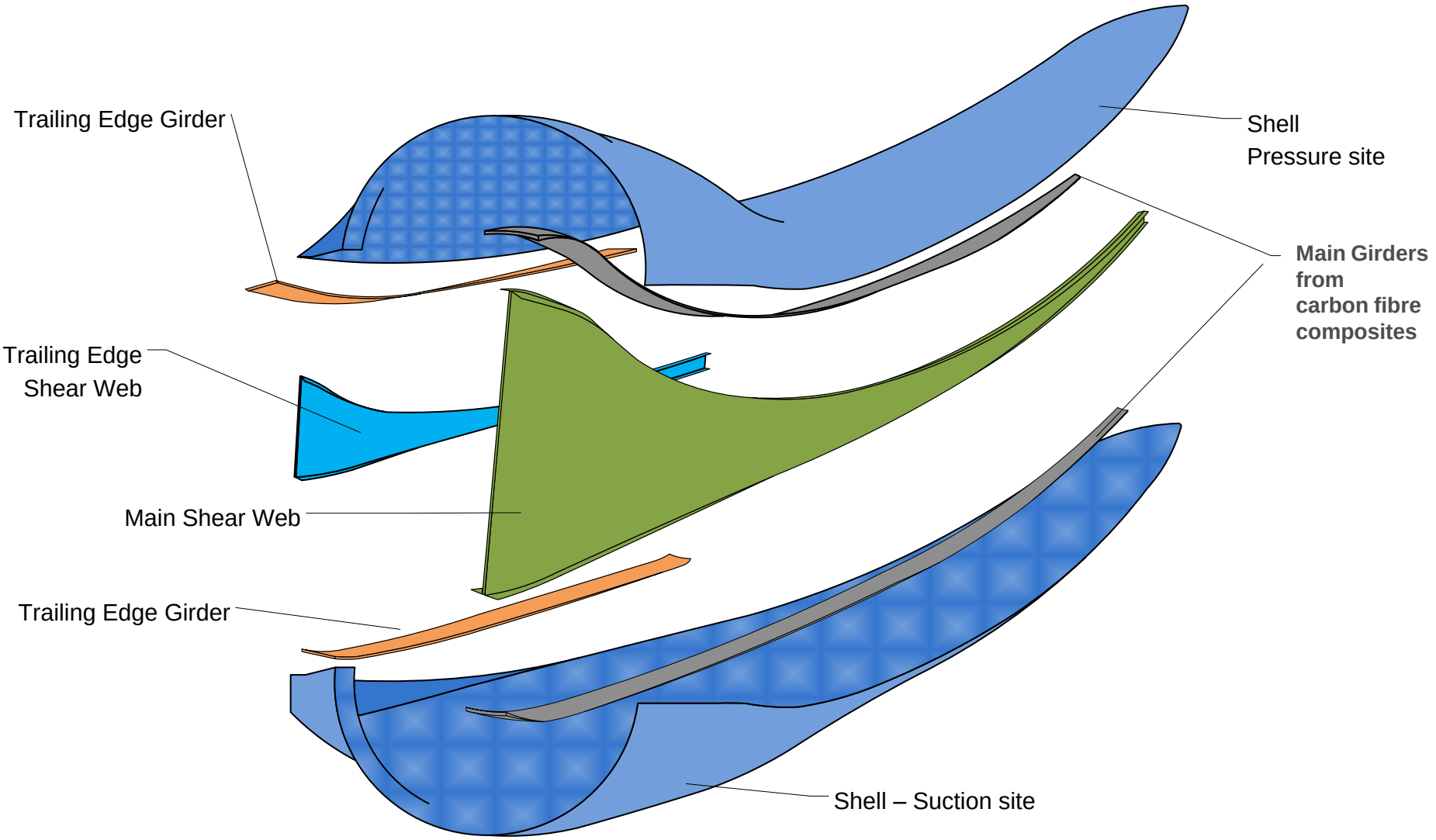
BLADES FOR BOTH TURBINES ARE PRODUCED IN TURKEY

NR 58.5m BLADES

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 m²	116 m²	121 m²
# 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**

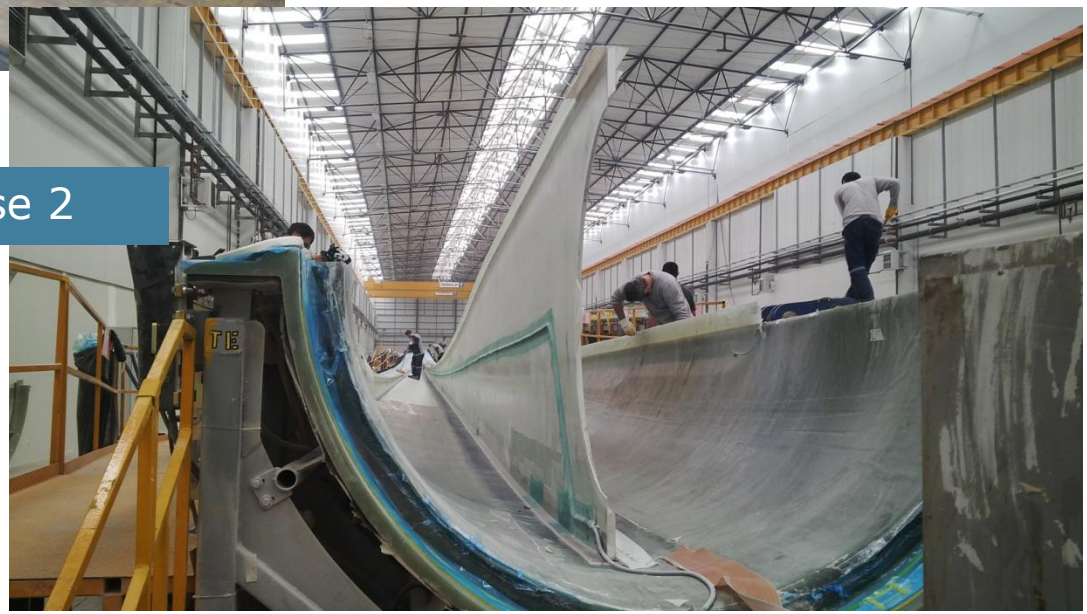

Trailing Edge Girder
Shell
Pressure site
Main Girders
from
carbon fibre
composites
Trailing Edge
Shear Web
Main Shear Web
Trailing Edge Girder
Shell – Suction site

BLADE PRODUCTION IN TURKEY
GENERAL OVERVIEW IN THE FACILITY HALL IN TURKEY

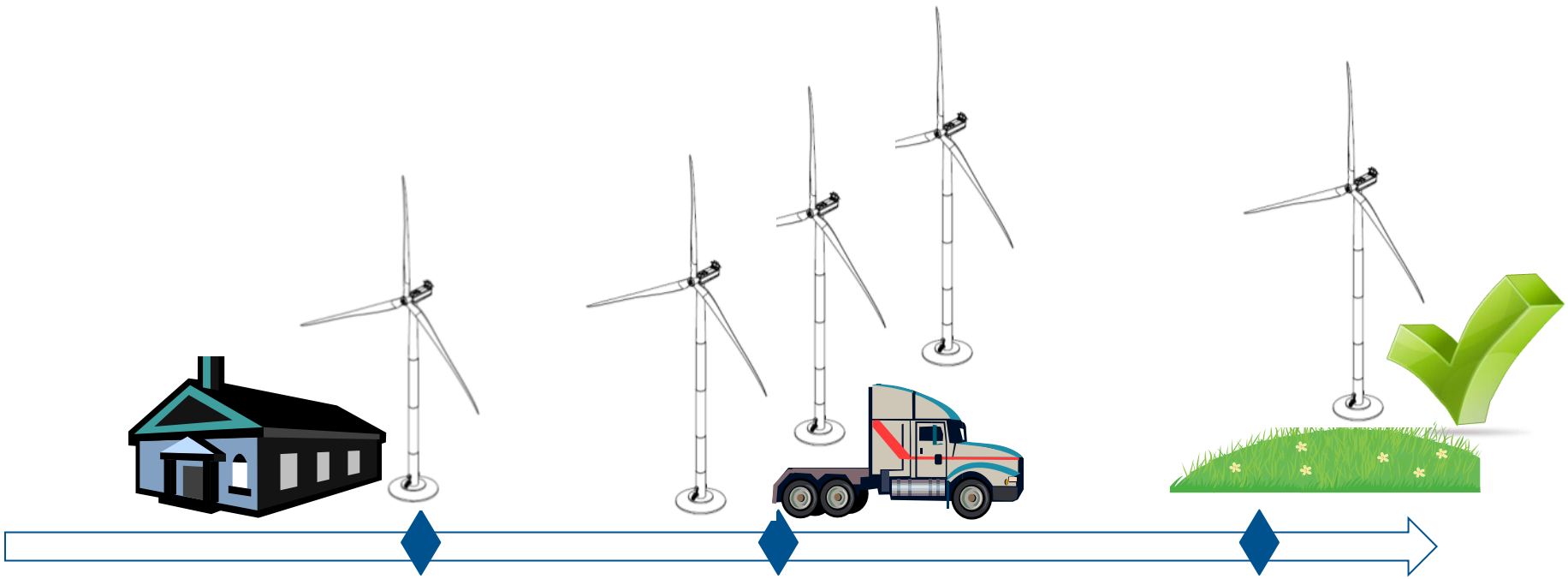
BLADE PRODUCTION IN TURKEY
NORDEX MOULDS IN PRODUCTION FACILITY IN TURKEY

Bottom plate - phase1

Bottom plate - phase 2



KEY MILESTONES



February 2014

First N117 blades produced by TPI in Turkey

March 2014

Start of Serial Deliveries across Europe

Mid of 2014

Erection of first project in Turkey with blades manufactured in Turkey

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 icluding 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**

THANKS FOR YOUR KIND ATTENTION!

Alper Kayhan
akayhan@nordex-online.com

NORDEX
We've got the power.