

TECHWINDGRID '09

Wind power on weak grids

Wind with a vision

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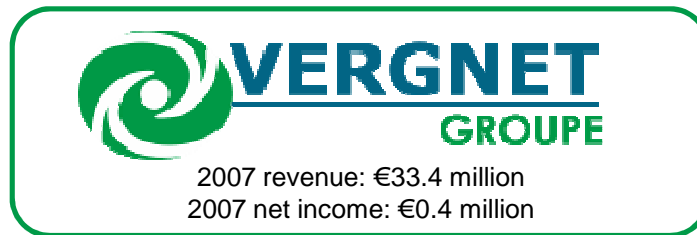
SUMMARY

- Who is Vergnet ?
- Farwind® issues
- Utility support and studies
- Rethought concepts



Who is Vergnet? - Its business

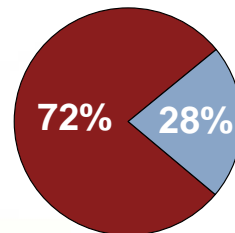
The design, production, marketing and operation of innovative renewable energy solutions



Analysis of revenue
by division

Wind Turbine Division

156 employees
Revenue: €23,9 million
Over 650 wind turbines installed



Water Division

37 employees
Revenue: €9.6 million
Over 80,000 water pumps installed
Supplying 40 million people

2 research centres
30 engineers and technicians

3 wind turbine test centres
Château Lastours (11), Gommerville (28) et Greneville (45)

Who is Vergnet? - Company history

VERGNET, a pioneer in sustainable development



Source : Company

Farwind® - The market

Vergnet offers “the” technology adapted to the FARWIND market

Challenging environments that exclude the use of conventional wind turbines

- Difficult geographic terrain, lack of infrastructure and logistical resources, etc.
- Violent climates

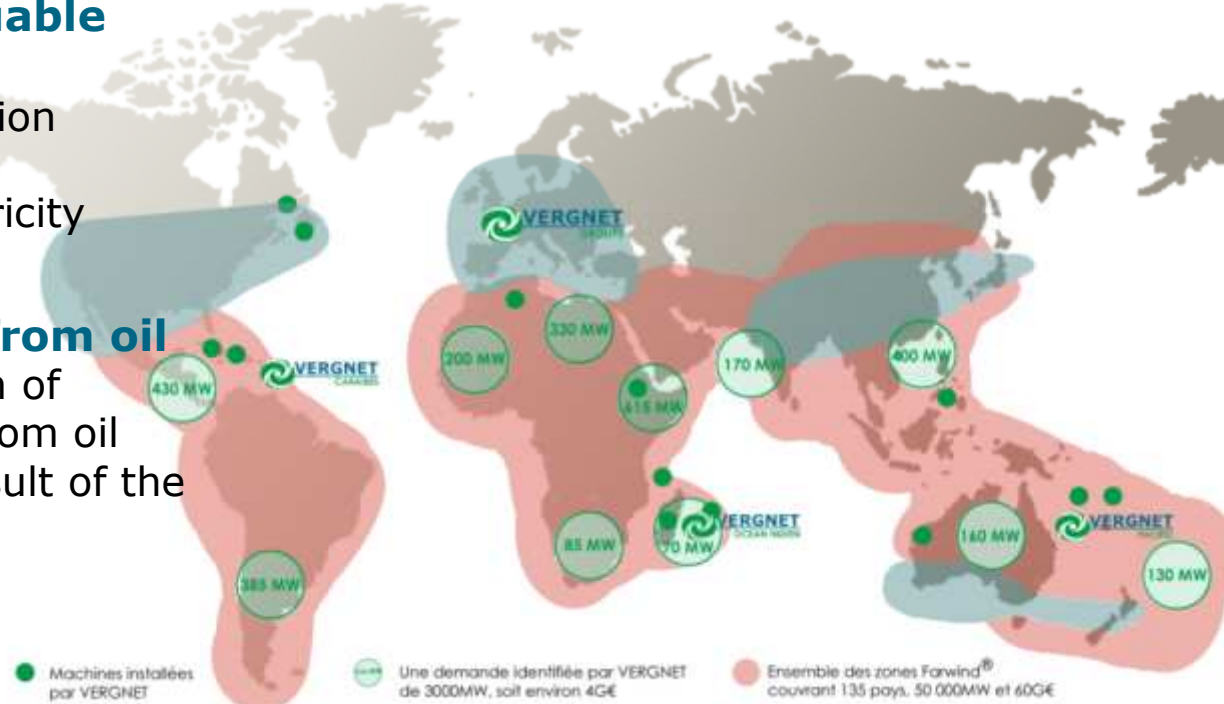


● Potentially highly valuable market

- ▶ 134 countries / 1.5 billion people
- ▶ Strong growth in electricity consumption

● Electricity generated from oil

- ▶ A significant proportion of electricity generated from oil
- ▶ “Electroshock” as a result of the price of crude



VERGNET has identified demand of 3,000 MW, spread across all FARWIND regions

Farwind® - Grid issues

Exchange knowledge Grid ↔ WTG

- ▶ “Nature & life” of the grid : overhead, underground, neutral connection, looped, radial, primary source (hydro, oil,...), daily variations
- ▶ Electrical rules of the utility ≈ Grid codes
- ▶ Data at connection point



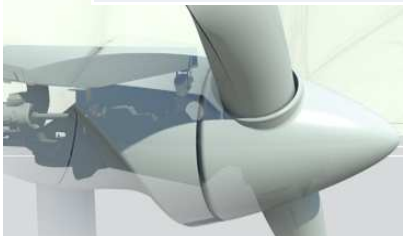
SAFE OPERATION

- ▶ WTG – Manufacturer data
- ▶ WTG – IEC 61400 reports as electrical ID card
- ▶ WTG – standard control behaviors

Farwind[®] - How does Vergnet identify weak grids?

Criteria are gathered from the utility and critical factors are defined :

Usual criteria values	Interconnected	Weak
Wind power ratio $S_{\text{wind to install}}/S_{\text{base consumption}}$ defines load fluctuation impact	< 30 %	> 30%
Wind power ratio $S_{\text{cc}}/S_{\text{windfarm}}$ defines power quality requirements	> 20	$4 < r < 15$
Voltage deviations continuous	$U_n \pm 5\%$	$U_n \pm 6 \text{ to } 10\%$
Voltage long-term deviations	$90\% < U_n < 110\%$	$90\% < U_n < 110\%$
Frequency deviations	$\pm 0,5 \text{ to } 1\% F_n$	$\pm 1,5 \text{ to } 2\% F_n$
Nb of voltage dips (<300ms)	≈ 70	≥ 1 per day
Nb of short-term outages (<3mn)	≈ 30	≥ 1 per week
Nb of long-term outages (>3mn)	≈ 6	≥ 1 per month
Frequency of load shedding	Rare	≥ 1 per week
Nature of Dispatching	Remote - $\frac{1}{2}$ automatic	Manual



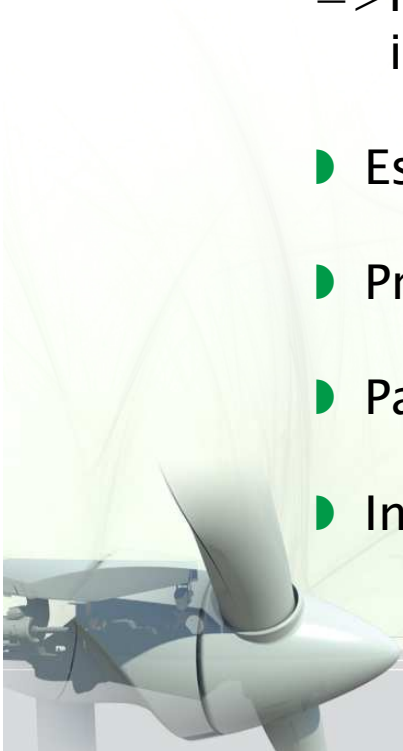
Utility support and studies

● Support local utilities in wind power issues means :

- ▶ Leading wind farm contribution studies (load-flow)
- ▶ Leading electrical quality studies (harmonics, flicker estimation)

=> Pb of responsibility limits, but safety of the network is the first issue

- ▶ Estimating energizing impacts (transient studies)
- ▶ Protecting from fault duties
- ▶ Participating to setting values
- ▶ Install sequential tripping



Utility support and studies

- Connecting to Farwind® grids by proposing suited control solutions
 - ▶ SCADA settable functions
 - ▶ Voltage control for stressed grids
 - Ex : Reactive supply or absorption until $40\%S_n$
 - ▶ Power control when wind power on consumption ratio is high
 - ▶ Power ramp adjustment
 - ▶ Telecommunication adjustments (precision, refreshing,.....)



Rethought concept ***the only 1 MW class WTG designed for FARWIND areas***

● **High energy production even in hurricane prone areas**

- ▶ Rotor diameter from 55 to 62 meters
- ▶ 70 meter high

● **Outstanding reliability in all conditions**

- ▶ Heavy duty design
- ▶ All terrain generator (-20 to 50 °C)
- ▶ 100% relative humidity, marine environment

● **Advanced technology**

- ▶ Full Scale Drive – IGBT with grid support
- ▶ High electrical and mechanical endurance
- ▶ Variable speed generator
- ▶ Electrical pitch regulation



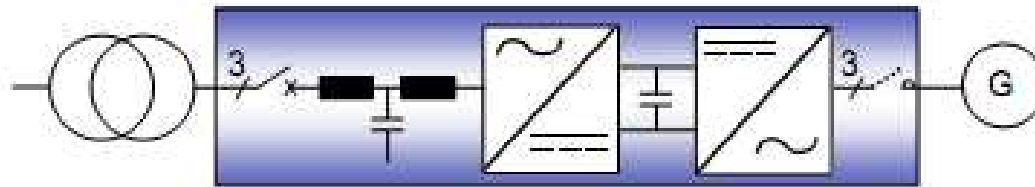
Rethought concept – Some examples of responses to weak grids issues

Worldwide grid codes as references

- ▶ E-ON – Germany
- ▶ AEMC – Australia
- ▶ REE – España
- ▶ EDF – France

High machine flexibility (1 / 2)

- ▶ Full-scale drive technology chosen

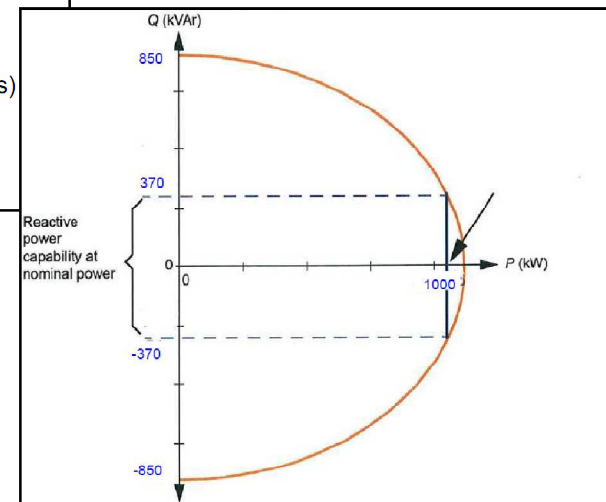
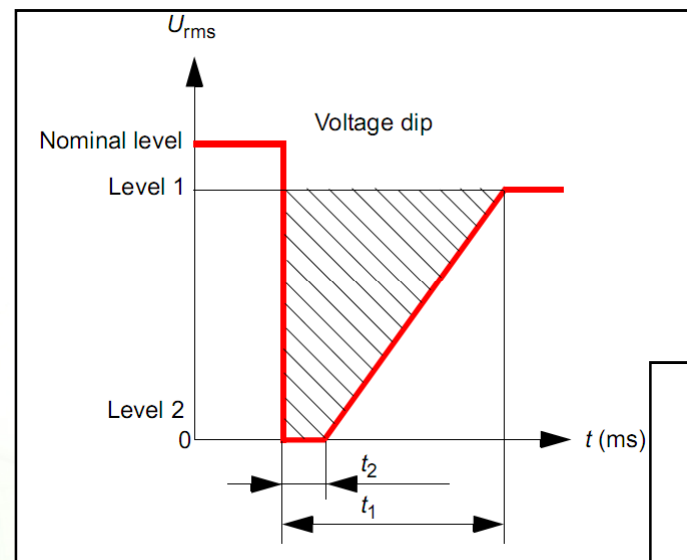


The grid only “sees” a modulated signal for full power conversion
=> decoupling of generator power quality issues.

Some examples of responses to weak grids issues

High machine flexibility (2/2)

- Adjustable LVRT function
- Large reactive power capabilities until 37% of the rated power
- Frequency following system



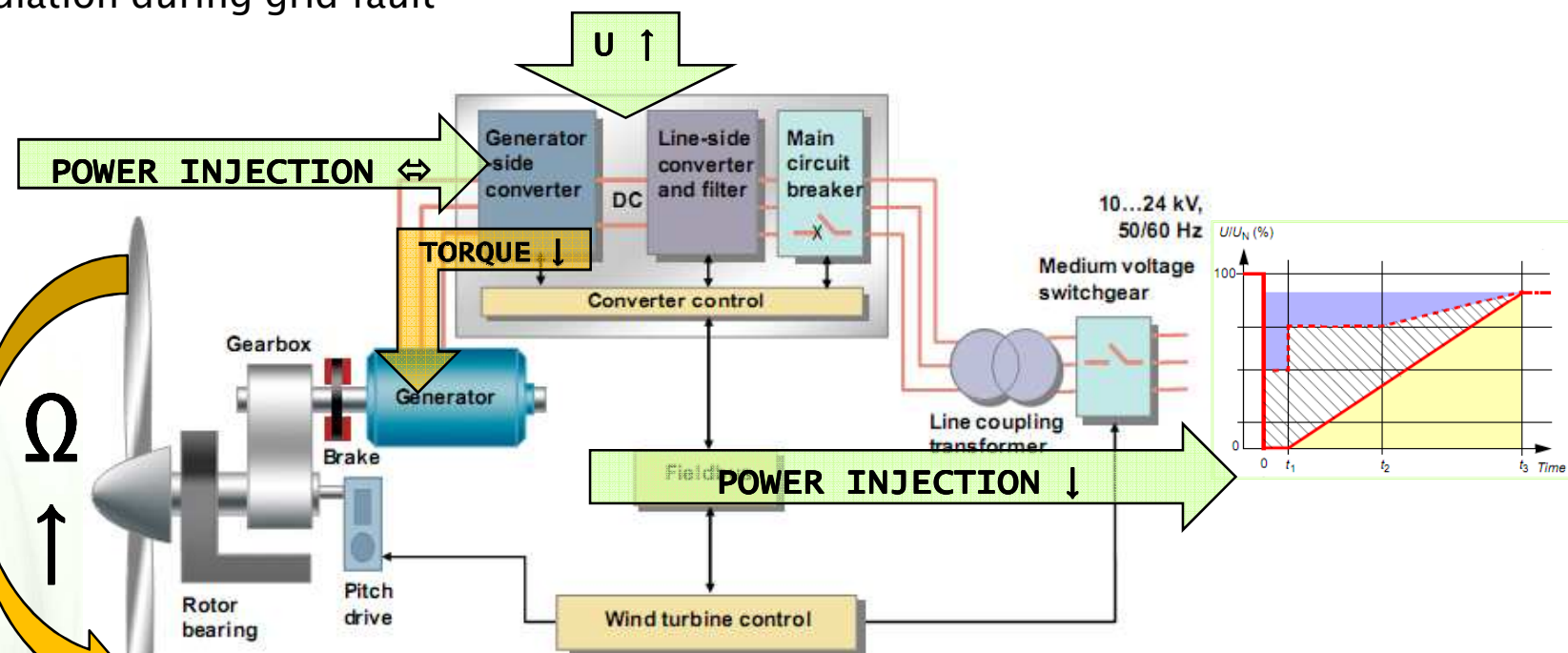
Rethought concepts

Some examples of responses to weak grids issues

DC Bus energy storage dynamic use

Over limit thresholds, DC bus is regulating energy until 420 or 1200 V (rating @ 1000VDC).

- Top threshold allows energy storage and higher speed torque control than pitch regulation during grid fault

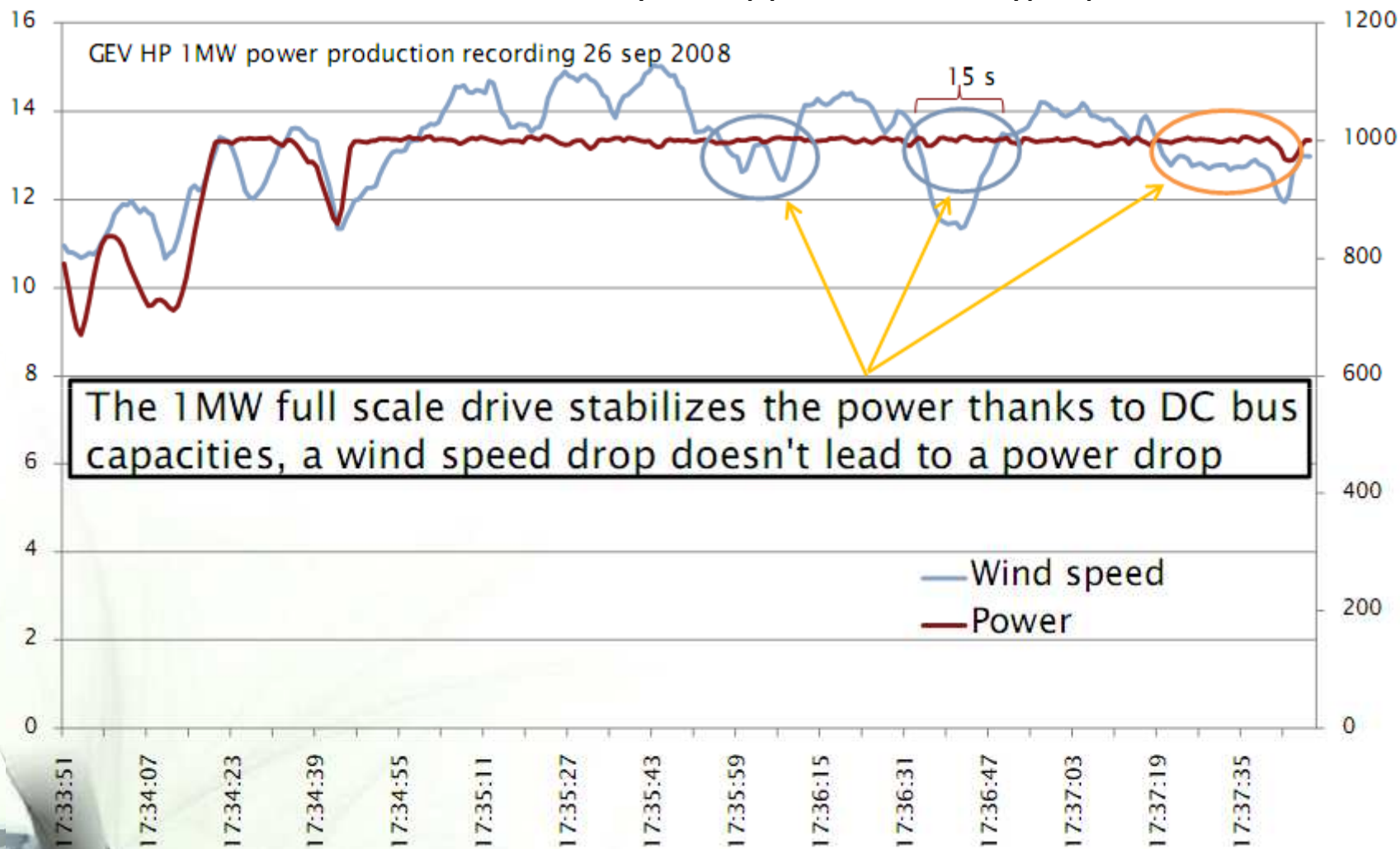


Rethought concepts

Some examples of responses to weak grids issues

DC Bus energy storage dynamic use

- The lowest threshold allows grid support and energy injection.



Other responses to weak grids issues

● Fast pitch regulation dynamics for fluctuant loads behaviors

- ▶ 0 to 80 % of maximum pitch demand in less than 100ms

● Large expanded industrial components choice

- ▶ High reliability of components and high spare availability rate

● SCADA optimization for PSTN connections

- ▶ Worldwide reliable access





Thank you for your attention

ANY QUESTIONS ?



Vanuatu Devil's point Wind Farm - 11 GEV MP