

# Double 'First' for Pauwels SLIM® transformer in Danish offshore wind-farm

**First liquid-filled transformer in an upper nacelle, first offshore application for Pauwels**



Elsam, a major Danish electricity utility, recently initiated an offshore wind-farm test project off the Danish coast near Frederikshavn. Part of the project, which started delivering power in 2003, is a 2,3 MW capacity Nordex N90 wind-turbine, one of the largest offshore wind-turbines in the world. In its upper nacelle, a 2,5 MVA Pauwels SLIM® transformer with DuPont™ NOMEX® thermal technology and silicone fluid coolant plays a key role.

In the competition to produce 'green' electricity profitably, offshore tur-

bines start with a handicap. Laying foundations on the sea-bed, erecting the tower at sea, laying a cable to the site, operation and maintenance: all these cost more than the corresponding items for onshore turbines. The outstanding reliability, high efficiency and long operating life of Pauwels SLIM® transformers help the Nordex N90 to compensate this handicap.

The concept of reliability embraces many facets. Apart from the factors affecting transformers in conventional onshore locations, the Pauwels units in the Nordex wind-turbine nacelles are subject to permanent vibration due to wind, waves and propeller movement. Liquid filled transformers are not subject to damage from vibrations and harmonic frequencies in the same way as alternative dry type solutions.

The corrosive ambient atmosphere of offshore locations, due to moisture, salt and condensation, is a further challenge to reliability. A hermetically sealed steel tank protects the SLIM® transformers from these influences, while dry-type transformers can be sensitive to water, micro-cracks, temperature variations, and pollution which can block cooling ducts.

Transformers in wind-turbines are subject to large load variations and overloads, because a turbine's power output is proportional to the cube of the wind-speed, i.e. when wind-speed doubles, power increases eightfold. Conventional types of



transformer, whether dry or liquid-immersed, must be designed to operate at maximum load. In contrast, Pauwels' advanced SLIM® transformers use NOMEX® thermal technology. This technology relies on the outstanding properties of NOMEX® products that with a temperature index of 220 °C, enable the transformers to sustain severe overloads without damage or failure. The use of silicone fluid as coolant in these transformers ensures a high degree of fire safety; the flash point of mineral-oil dielectric used in conventional transformers is about 150 °C; whereas silicone fluid's flash point is about 360 °C.



This double breakthrough for Pauwels – the first Pauwels transformer in an offshore application and the first liquid-filled transformer

in an upper nacelle – was achieved thanks to the compact dimensions, low no-load losses, high reliability and overload capacity of the SLIM® transformer with NOMEX® thermal technology.

Pauwels designed the 2,5 MVA SLIM® transformer in answer to Nordex's request for a new way to meet the demanding requirements of offshore installations.

The Belgian company, one of the world's leading transformer manufacturers, is now developing the SLIM® range for use with turbines of 3 to 4 MW.

**Technical description:**

Power (MVA)	2,5
Tension (V)	HV = 10000 V ± 2 x 2,5 % and LV = 660 V
No-load losses Po (W)	2400
Load losses at 75 °C (Pk) (W)	16 500
Load losses at 120 °C (Pk) (W)	18 000

**Dimensions:**

length (mm)	1950
width (mm)	965
height overall incl. bushings (mm)	2040

**Application:**

- 2,5 MVA transformer in offshore wind-turbine

**Requirements:**

- Compact size
- Reliability in aggressive environment, extended lifetime
- Low no-load losses
- Safety in use
- Overload potential

**Configuration:**

- Step-up transformer with silicone fluid and full NOMEX® insulation

DuPont de Nemours International S.A.  
P.O. Box 50  
CH-1218 Le Grand-Saconnex/Geneva  
Switzerland  
Tel: +41 22 717 5111  
Fax: +41 22 717 6218  
E-mail: info.nomex@che.dupont.com  
[www.nomex.com](http://www.nomex.com)



**Product safety information is available upon request.**  
This information corresponds to our current knowledge on the subject. It is offered solely to provide possible suggestions for your own experimentations. It is not intended, however, to substitute for any testing you may need to conduct to determine for yourself the suitability of our products for your particular purposes. This information may be subject to revision as new knowledge and experience becomes available. Since we cannot anticipate all variations in actual end-use conditions, DuPont makes no warranties and assumes no liability in connection with any use of this information. Nothing in this publication is to be considered as a license to operate under or a recommendation to infringe any patent right.



*The miracles of science™*