



# New trend in transformers for mobile substations

## ● What are mobile substations?

Mobile substations are fully equipped electrical substations mounted on semi-trailers. The most important advantages of these units are their rapid integration into the network and the ability to reuse them in different places. They are a tool for increasing operational flexibility and reliability. Utilities worldwide have therefore been showing ever increasing interest in substations of this type.

## ● Why use mobile substations?

The main applications for mobile substations are:

### As emergency units:

- in the event of equipment failure, for substations without spare transformer capacity
- in the event of maintenance or repair activities in existing substations
- in the event of natural disasters, for the supply of vital energy
- in cases where transmission lines freeze over, for de-icing purposes

### As a temporary solution for the supply of electric power:

- Owing to its short delivery time (10 to 12 months), a mobile substation can be used while a permanent installation is being built
- As stand-by units for peak-load periods

**As a substitute for conventional substations:** in areas where the demand for electricity rapidly expands beyond the scheduled increase in main system capacity

**As sources of power in isolated areas.**

## ● Optimization of mobility and manoeuvrability

Compact construction of all parts is important to the design of mobile substations, not only to increase the manoeuvrability of the unit but also to meet local road transport regulations. The transformer is the most important part of the substation, but also the biggest and heaviest part. Therefore a compact and light-weight transformer design would contribute to the mobility of a mobile substation.

However, it is of the utmost importance to maximise the power output per unit size and weight. Use of a transformer with a high temperature rise design can bring an outcome.

## ● NOMEX®

In a growing number of transformer designs for mobile substations, NOMEX® high temperature conductor insulating material is used in combination with conventional cellulose insulation. The use of NOMEX® as an insulation material for the windings allows power ratings to increase substantially while still meeting stringent dimensional restrictions.

## ● Conclusion

A transformer with a hybrid high-temperature insulation system consisting of NOMEX® and conventional cellulose insulation contributes significantly to the mobility and manoeuvrability of mobile substations.



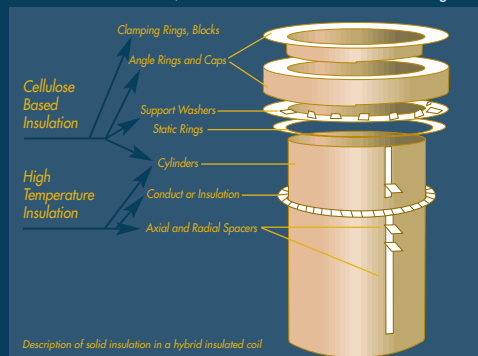
Mobile substation 25MVA, 115-66 kV/22-15 kV 95°C winding rise



Mobile substation 15 MVA, 132-66 kV/21-15.75 kV 95°C winding rise



Mobile substation 20 MVA, 115-67 kV/13.2-26.4 kV 95°C winding rise



	Conventional design	Hybrid design
Top oil temperature rise over ambient temperature (K)	65	65 65
Average winding rise over ambient temperature (K)	65	95 115
Winding hottest-spot rise over ambient temperature (K)	80	130 150
Cellulose hottest-spot rise over ambient temperature (K)	80	80 80
Ambient temperature (maximum) (°C)	40	40 40
Top oil at max. ambient temperature (°C)	105	105 105
Average winding temperature at maximum ambient temperature (°C)	105	135 155
Winding hottest-spot at maximum ambient temperature (°C)	120	170 190
Cellulose hottest-spot at maximum ambient temperature (°C)	120	120 120

Temperature limits for conventional and hybrid insulation systems

	Design with hybrid insulation	Cellulose design with the same power	Cellulose design with the same weight
Power (MVA)	45	45	31.5
Weight (T)	44.1	57.5	44.1
Impedance (%)	19,1	10,0	10,0
No load loss (kW)	11,9	10,0	8,0
Load loss (kW)	752	225	110
Temperature rises (K)	95	65	65

Comparison of different insulation techniques



**PAUWELS HYBRID TRAF0**

www.pauwels.com

info@pauwels.com

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