



Grid Solutions
a GE and Alstom joint venture

POWER TRANSFORMERS PRODUCT SOLUTIONS

Green power transformers

Answering our customers' environmental concerns through innovation.

Together, let's make the green choice!

HIGHLIGHTS

- Over 110 power transformers with our innovative hermetically-sealed tank design sold worldwide
- State-of-the-art factories around the world able to manufacture eco-efficient powertransformers

Eco-efficient and innovative

A sustainable range of green eco-efficient power transformers, from 10 to 500 MVA and up to 550 kV.

GE creates and delivers customer-valued network solutions for an energy-efficient future. Our environmentally-friendly solutions are aimed at meeting major energy challenges of today and tomorrow: energy efficiency, market efficiency, grid reliability and environmental concerns.

GE Green Power Transformers offer significant environmental benefits, including better product performance, covering the 3 phases of the product life cycle:

- Manufacturing: reduced consumption of natural resources
- Operation: lower CO₂ emissions, limitation of environmental-risk, noise reduction. space savings and energy efficiency
- End of life: recycling capabilities of products



A sustainable range of green eco-efficient power transformers, from 10 to 500 MVA and up to 550 kV



15 MVA 120/17.25 kV 16.7 Hz track-side hermetic transformers for railways



75 MVA 115 / 31 kV hermetic transformer with vacuum tap changer and MS3000 monitoring system for off-shore wind farm Alpha Ventus in operation since 2008

ECO-EFFICIENT POWER TRANSFORMERS

Based on customer demand for environmentally friendly products that improve life cycle costs with limited maintenance needs and increased service lifetime, GE introduces its Green Power Transformers to accompany and assist customers with today's eco-management challenges.

A Green Power Transformer (10 to 500 MVA and up to 550 kV) is a sustainable, eco-efficient product with the following functionalities:

- Filled with natural ester liquid instead of mineral oil
- Hermetically-sealed tank design, equipped with patented expandable radiators and OLTC with vacuum type tap changer
- Innovative technologies to reduce acoustic energy transferred and optimize design of the active part
- Optimized low loss levels
- Solvent-free painted

To complete the product range it is highly recommendable to include:

- On-line MS3000 monitoring system
- Resin Impregnated Paper (RIP) bushings with composite insulators
- Speed-controllable EC fans

KEY CUSTOMER BENEFITS

Green Power Transformers offer a new alternative for customers who want to preserve the environment by offering a lower carbon footprint, limited pollution risk and optimized life cycle costs thanks to less maintenance. Other advantages include reduced ageing, lower noise levels and increased fire safety.

To further maximise operational management and prevent faults and damages, advanced on-line monitoring systems can also be added.

Environmental and health benefits

One of the key benefits offered by the Green Power Transformers is the prevention of pollution through the use of natural ester liquid instead of mineral oil. Natural ester oil is naturally synthesized, come from renewable resources, and is also biodegradable and non toxic, limiting pollution risk during operation, installation and end of life.

Environmental benefits also include reduced noise levels to limit disturbance in urban or ecologically sensitive areas. Noise level reduction above 10 dB (A) is made possible thanks to our selection of high-performance materials and equipment, optimised design of active parts and innovative mechanical structures.

Increased safety

With a Green Power Transformer, fire safety is improved considerably, offering increased security, not only for operators but also for those in close proximity. Natural ester oil has a fire point above 350°C, more than twice as high as mineral oil. It is classified Green transformers are less flammable and reduce fire spreading.

High eco-efficiency

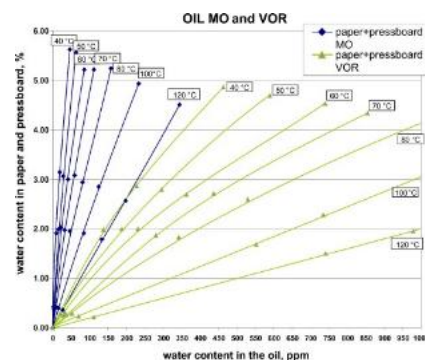
A major benefit of the Green Power Transformer range is its optimised life cycle cost. In our standardised process, design choice and high-performance materials achieve low losses for the optimal capitalised cost of the transformer.

GE's innovative hermetically sealed tank design, equipped with patented expandable radiators, goes a step further in reducing life cycle costs: it reduces maintenance, extends life time and increases overload ability by preventing contact between the oil and moisture, and oxygen in the atmosphere. Hermetically sealed tank design reduces cellulosic insulation and oil aging. It is further improved with the use of ester oil, which increases a transformer's insulation life, thanks to higher water solubility and (drying effect of paper) and higher thermal class (IEC 60076-14). Humidity equilibrium curves (Perrier-Lukic) show that moisture equilibrium is move towards the ester oil.

Maintenance costs are also reduced as a result of the hermetic tank design, which requires no oil conservator and no associated devices. The optional vacuum tap changers avoid contact erosion and further reduce maintenance needs.

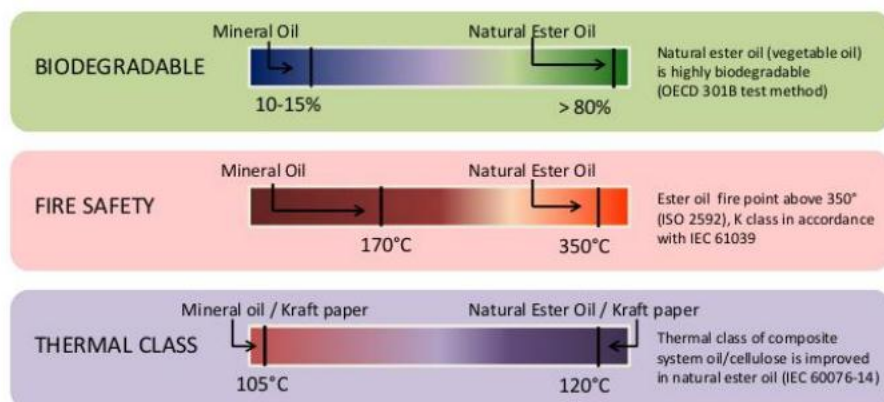


Green power transformer 136 kV, 31,5 MVA



Perrier-Lukic equilibrium curves for paper/pressboard in mineral and natural ester oils

COMPARISON BETWEEN CONVENTIONAL AND GREEN ECO-EFFICIENT POWER TRANSFORMERS



Key references

Bringing the bulk of energy closer to consumption centres and investigating green solutions

EDF Energy installed the first purpose-built 132/33 kV 90 MVA 3-phase Green Power Transformer filled with ester oil in the in the United Kingdom. Located in Luton's interconnection substation, it is equipped with our MS monitoring system to ensure the highest availability possible during operation. This power transformer is installed close to consumption centers, and the fluid is made from edible soya beans, which are fully biodegradable and have greater fire resistant properties.

Preserving the environment in sensitive areas and using renewable resources

Electronorte, one of Brazil's main utilities, bought and installed a 242 kV shunt reactor, filled with ester oil, to promote sustainable development in the protected Amazon region. This is, so far, the highest voltage application for natural ester oil transformers. The solution, developed with oil from renewable resources, also responds to customers' concerns about the use of petroleum-based fluids in high-voltage applications.

Green all the way from generation to transmission

EWO Energietechnologie GmbH in Germany bought Green Power Transformers that feature hermetically-sealed tank design, equipped with patented expandable radiators and with a vacuum tap changer and filled with ester oil for wind farm connection. On top of environmental benefits, reduced transformer maintenance is also a direct benefit of this green project.

Lowering maintenance and increasing service provision

In the past decade, the national German railway operator Deutsch Bahn purchased large series 10 and 15 MVA hermetically-sealed Green Power Transformers with patented expandable radiators and vacuum tap changers for reduced maintenance costs, optimised overload capacities and longer life time.

Low sound transformers for silent substations

PSE&G, one of the main utilities on the East Coast of the USA, needed to have 'silent' substations to be built close to consumption centres with high population densities in New Jersey State. GE's 550 MVA 230 kV auto-transformer with OLTC and ONAF cooling was the right solution. Noise reduction was achieved with optimised active part design, tank decoupling, tank designed for reduced transmission of energy, resonance absorbers and sound panels, up to -10 dB on load sound level.



Picture: 242 kV 22 MVA_r shunt reactor filled with natural ester oil for major Brazilian utility Electronorte



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