

## Siemens Transformers – Case Study

# Power transformer with waste heat utilization

Economical and safe operation thanks to ester-isolation

### The challenge

Safety, reliability and environmental impact are crucial for transformers, especially in large cities. Occupied premises must be safe from the risk of fire or explosion from installed electrical assets, supply disruption must be avoided though high network reliability and environmental considerations are a high priority. Space constraints also constitute a critical factor in cities.

British grid operator, National Grid, requested a high-performance solution for their 400 kV substation in North London, to combine safety and reliability with a heat exchanging device, to utilize heat loss from transformers to heat schools and other buildings in the neighbourhood. The project is the first of its kind in the UK using synthetic ester-filled transformers at 400 KV.

### National Grid

National Grid is an international electricity and gas company based in the UK and northeastern US. The company plays a vital role in connecting millions of people safely, reliably and efficiently to the energy they use. Being at the heart of one of the greatest challenges facing our society, they deliver clean energy to support our world long into the future.

National Grid works with all their stakeholders to promote the development and implementation of sustainable, innovative and affordable energy solutions.



Power transformer with ester insulation and heat exchanging device in the testfield

### The solution

Siemens has a successful track record in the use of alternative insulation fluids for power transformers. The company's expertise in this area, based on their own research and material tests, combined with excellent customer relationships made Siemens the clear partner of choice for this innovative project.

Together with the customer, National Grid, Siemens has developed an economic solution that allows waste heat from three power transformers to heat a school located next to the substation. Depending upon the electrical energy used in this area, more than 1 MW of waste heat from the transformers can be recovered to heat local homes, shops and schools in the future.

*„With this transformer project Siemens have set a new benchmark for innovation and environmental safety. “*

Stefan Pieper, Head of the transformer plant Weiz



### Technical features

#### 1. Ester-oil-filling

Synthetic ester insulation greatly reduced the risk of fire and explosion. The firepoint and flashpoint of synthetic ester are very high compared to mineral oil. In order to manufacture the transformers according to the performance level, di-electrical characteristics, isolation and lifetime, specialized constructive changes were analysed and implemented in the design phase. Synthetic esters are fully biodegradable, which adds to the environmental credentials and reduces risks to the environment.

Significantly less insulation fluid than usual is utilized in the respective units.

#### 2. Utilization of waste heat

Waste heat from the power transformers was harnessed using heat exchange devices. The planning and construction of this additional feature was performed in close collaboration between the transformer factory, the customer and the supplier of the heat exchange device.

#### 3. Low-Noise-Design

When installing transformers in urban areas, noise plays a key role, as does reliability and safety. The transformer and cooling devices need to operate silently regardless of transformer load. The transformer with ester-filling and waste heat utilization manufactured with a low-noise-design. Bespoke housing as well as noise-optimized cooling with frequency-regulated fans was added to the low-noise-concept. These measures result in units that are inaudible from the adjacent road and nearby flats in normal operation.

#### 4. Minimized footprint

Land in urban centres can be at a premium cost, and as companies like National Grid seek to secure the supplies in these areas, land availability can be a significant challenge, especially when the need for homes and jobs is high. This solution reduces the traditional land take by up to 40 %, by not having a traditional cooler bank, so more equipment can fit into ever smaller spaces. This also helps utilities deliver better value to their customers.

### Environmentally friendly solution for urban areas

Following numerous positive experiences of using alternative insulation fluids in transformers, Siemens considers this innovation a safe, reliable and sustainable solution, particularly for urban areas. The use of waste heat is also a significant benefit, both in terms of cost and the environment.

### Main characteristics of insulation fluids (average values)

Characteristics of insulation fluid	Mineral oil (IEC 60296)	Synthetic ester (IEC 61099)
Kinematic viscosity at 20 °C (mm <sup>2</sup> /s)	22	70
Fire point (°C)	170	325
Flash point (°C)	160	275
Easily degradable	No	Yes
Water hazard class	Yes	No
Di-electric properties	Well-known	Constructive changes needed
Raw material	Ceasing fossil source	Chemical interstage product

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