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Industry insight: How early transformer monitoring can stop the next Heathrow-like power blackout

This article was written for E+T Magazine by André Marais, Executive Vice President at H2Scan, hydrogen sensor solutions provider.

By André Marais, H2scan Corporation

Transformers are critical to a stable power grid, but aging infrastructure is driving a surge in blackouts as demand outpaces supply chain and manufacturing capacity. What is needed is a smart, affordable sensor monitoring solution that can detect faults early, extend equipment lifespan and help utilities avoid costly failures.

On 20 March 2025, a fire broke out at the North Hyde 275kV substation, which feeds most of Heathrow airport. What began as a fault inside an aging transformer soon turned into a major incident. Power was cut to more than 66,000 homes, over 1,300 flights were grounded, and the estimated economic losses climbed toward £100m.

While the Heathrow fire shocked many, engineers and grid operators could undoubtedly have seen it coming. This was the third transformer-related fire in the UK in less than a month and one of eight incidents in only ten weeks, reflecting a pattern where aging infrastructure and rising electricity demand make failures more frequent and costly.

Similar incidents will continue to occur unless transformer condition monitoring, and subsequent action becomes standard practice. Global electricity demand is increasing, driven by the electrification of transport, data centres, AI systems, and electric heating. In the UK, a 30% increase in electricity consumption is expected by 2030, which will

put more pressure on the already strained grid and its dated infrastructure, as nearly 40% of UK transmission equipment predates 1975.

The obvious answer would be to replace aging transformers, but this is challenging. These are typically large, sometimes custom-built apparatus that may take years to design, manufacture, and install. For the UK, local and global production constraints make replacement programs even harder, heightening the risk of grid related failures.

How monitoring can help

Transformers are essentially wire coils wound around a steel core, often immersed in oil for cooling and insulation. They are reliable but not indestructible. Over time, heat, electrical stress, moisture ingress, and mechanical strain breaks down the winding insulation. These faults are incipient, so they don't cause an immediate failure. But they leave traces. Transformers usually "whisper" before they "scream," and one of the earliest warning signs is the breakdown of the insulating oil that generates fault gases, with hydrogen being the first gas released.

Over time, degradation of the transformer's insulation effectiveness results in partial discharges or arcing inside the main tank, producing hydrogen that signals a developing issue. If detected early, transformer operators can take action to address the suspected cause of the issue before severe damage occurs. That action may include reducing the transformer load or removing it from service.

For decades, transformer monitoring has relied on the occasional collection of oil samples sent to laboratories for Dissolved Gas Analysis (DGA). While helpful, this approach has limitations. Tests are periodic, often conducted once every one to four years, and faults often develop unnoticed between inspections.

Sampling also requires access to the transformer, scheduling of technicians, sometimes taking an outage, and waiting for lab results. By the time problems are detected, the transformer may already be at risk, and in today's high-demand, high-risk power systems, this is no longer sufficient.

Modern technology offers a solution through compact, affordable monitoring solutions that can be mounted directly on transformers to measure hydrogen concentrations in the oil. They continuously monitor hydrogen levels in the insulating liquid, alerting operators immediately to the measurable levels of hydrogen production. This real-time insight allows for a timely intervention before faults escalate. Modern hydrogen sensors provide a zero maintenance, economic, and practical first line of defence against catastrophic failures. A small price to pay compared to the costly failures like the Heathrow fire.

Continuous transformer monitoring does more than just mitigate catastrophic failures. It helps utilities maximise the value of the equipment they already own. Moving from periodic or reactive repairs to predictive maintenance allows grid operators to improve resource utilisation (human and finances) by focusing on the assets that need repairs rather than being forced into expensive emergency replacements. Condition based maintenance has also been shown to extend the life of transformers by up to 20%. And perhaps the biggest added benefit is added safety measures for plant, personnel and the public.

The global push for net-zero emissions and the electrification of transport, heating, and industry means the power grid infrastructure can no longer run without condition monitoring. Smarter, connected monitoring systems are now available, and continuous monitoring plays a crucial role in this transformation. It's the reason operators across Europe are already using sensors in key locations, although failure rates suggest not enough is being done to avoid preventable incidents.

The Heathrow fire was a warning. The onus is now on critical services to take steps to prevent further damaging events. Continuous transformer hydrogen monitoring solutions are a simple, affordable, and effective solution. For power sector decision-makers, the question is no longer whether they can afford the technology, but whether they can afford not to have it.