

# The rising appeal of on-site service solutions: A game-changer for maximizing reliability and uptime

When a power transformer fails, the main operational challenge is the resulting downtime, which can cause significant bottlenecks in electricity supply



## ABSTRACT

Transformers are vital to the electrical grid but can face issues due to aging or overloading, leading to costly outages. On-site repair services, such as those offered by Siemens Energy, provide maintenance to extend transformer life and reduce downtime. A case study from a remote location in Brazil demonstrates the success of on-site repairs in improving power generation capacity and reliability while

also showcasing environmental benefits. These services support the resilience and adaptability of the electrical infrastructure, aligning with broader goals of environmental stewardship and economic prudence.

## KEYWORDS:

reliability, uptime maintenance, sustainability, efficiency, operation disruption

## The on-site repair solution emerges as the optimal choice for minimizing operational disruption

### Empowering reliability: The vital role and maintenance of power transformers

Power transformers serve as critical nodes within electrical systems, enabling the efficient transmission and distribution of electricity by converting voltage levels to suit different stages of the electrical grid. By stepping up voltage for long-distance transmission to minimize energy loss and stepping it down for safe local distribution and use, they enhance energy efficiency, ensure the safety of electrical appliances, and facilitate the integration of diverse power sources. Their role underpins the reliability, scalability, and economic viability of electrical systems, making them indispensable for maintaining continuous and adaptable power supply across various sectors of modern society. That is why it is so important to keep this asset running smoothly.

Power transformers are very reliable assets. Depending on the type of transformer, their average failure rates are between 0.5% and 1% per year [1]. However, these rates can spike due to aging infrastructure, inadequate maintenance, or overloading, leading to unplanned

outages and customer dissatisfaction. Additionally, as critical components of the electrical grid, power transformers command multi-million-dollar investment costs, reflecting their strategic importance and technological sophistication. Consequently, there is a strong emphasis on extending their operational lifespan as much as possible through rigorous maintenance schedules and careful monitoring to maximize the return on this substantial investment and ensure grid reliability.

When a power transformer fails, the main operational challenge is the resulting downtime, which can cause significant bottlenecks in electricity supply. This downtime not only affects consumer satisfaction but also imposes economic strains on industries that rely on a constant power supply.

Extending the life of existing transformers through repairs significantly reduces the demand for resources and benefits the environment by minimizing resource extraction and waste. This approach also promotes innovation in repair techniques and sustainability practices within the power industry.

The global challenge is now intensified by the current scenario where the production capacity for power transformers is at its brink, limiting the ability to quickly replace or augment existing units to meet growing demand or to replace failing units promptly. This scenario puts pressure on utilities to extend the life of existing transformers through meticulous maintenance while simultaneously addressing the challenges of doing so in an environmentally sustainable and cost-effective manner. In this way, the repair of power transformers presents as a reliable option for mitigating these challenges. Repairs can be executed either in a dedicated factory setting or directly on-site, depending on the specific requirements and conditions. Siemens Energy, with its comprehensive expertise, is equipped to carry out these complex repair tasks in both environments, ensuring that transformers can continue to operate efficiently and reliably.

Vast distances or poor transportation connections sometimes make it necessary to perform repairs on-site. Siemens Energy has developed a mobile repair solution for this purpose. The container-sized module provides all the necessary equipment for analyzing a transformer's condition, improving performance, and conducting electrical tests.

### When is on-site repair your best option?

The on-site repair solution emerges as the optimal choice for minimizing operation-

al disruption, avoiding the high costs and hazards of transportation, and addressing the challenges of remote locations, urgent response times, environmental concerns, and regulatory compliance, all of which are paramount.

- **Minimized downtime:** On-site repairs can often be completed more quickly than factory repairs since transportation time is eliminated. This is crucial for facilities where downtime directly impacts production and revenue.
- **Minimized transportation expenses and risks:** On-site repairs significantly reduce transportation expenses and ensure the safe handling of large or heavy transformers, eliminating the potential for further damage during transit.
- **Operational constraints:** In some industries, such as continuous manufacturing processes or critical infrastructure (e.g., hospitals, data centers), the transformer may be too critical to take offline for extended periods. Furthermore, the loss of redundancy (if applicable) will be minimized. On-site repair allows for quicker turnaround.

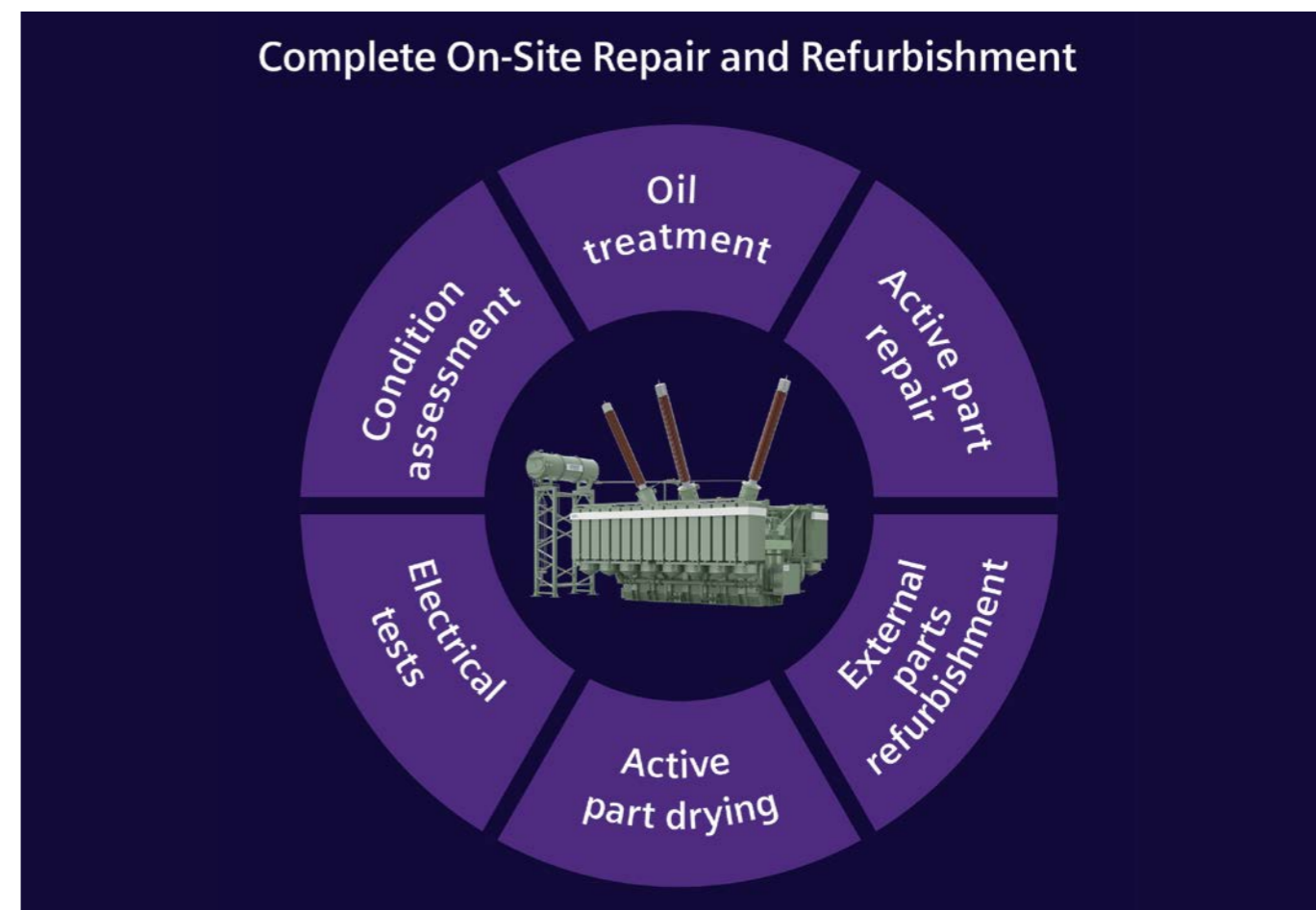
## Siemens Energy stands out in the field of on-site transformer services that address the full spectrum of transformer maintenance needs

### On-site service features

By offering a holistic suite of solutions tailored to ensure optimal performance and longevity of energy assets, Siemens Energy stands out in the field of on-site transformer services. Their comprehensive service packages deliver a robust on-site service experience that addresses the full spectrum of transformer maintenance needs.

The key to Siemens Energy's exceptional service capabilities is its team of highly qualified and well-trained personnel. The difference made by these skilled staff members cannot be overstated. Each technician and engineer brings in-depth knowledge and unparalleled experience, ensuring that every service, from routine maintenance to complex repairs, is carried out with the utmost precision and expertise.

- **Logistical challenges:** For transformers installed in remote or difficult-to-access locations, the logistical challenges and costs of transportation might make on-site repair the only feasible option.
- **Immediate response:** On-site repair teams can often respond quickly to emergencies, minimizing the impact of transformer failure on operations and safety.
- **Environmental considerations:** Removing a transformer, especially one containing oil, can pose environmental risks; additionally, heavy transportation contributes significantly to CO<sub>2</sub> emissions.
- **Regulatory and compliance issues:** In some cases, transporting the transformer could involve regulatory complexities due to the materials or components involved.



## On-site repair solutions, such as those offered by Siemens Energy, provide significant environmental benefits focusing on conserving resources and repair

- **Condition Assessment:** Our comprehensive diagnostic modules assess the transformer condition, providing transparent and objective evaluations for informed decision-making. With three levels of assessment, including inspection, diagnostics, and high voltage testing, DIAG offers a thorough analysis of transformer health, identifying risks and prioritizing maintenance actions. Our experienced service professionals provide detailed test reports with recommended actions.

- **Oil treatment:** Transformer oils directly interact with the paper insulation of the windings which in turn limits the lifetime of a transformer if the paper condition gets poor due to the impact of the oil condition. Siemens Energy offers a wide range of services for analyzing, cleaning, and regenerating the transformer oil: gas chromatography and physiochemical analysis; F2AL determination; filtration; filling in a vacuum; regeneration with REG and degasification; inhibition/passivation

through additives; stationary drying with DRY; long-term regeneration and drying with CLEAN.

- **Active part repair:** Active part repair is a specialized service targeting the restoration of the most crucial components within a transformer. Siemens Energy's expert technicians address issues such as damaged windings, core lamination problems, insulation deterioration, and any other component failures that can compromise the transformer's functionality and efficiency.

- **Active part drying:** The on-site methods, such as hot oil spray and vapor phase in the tank, ensure thorough moisture elimination using heat applications, while DRY provides an ongoing, in-service drying solution, leveraging adsorbent materials to sustain optimal moisture levels, with minimal disruption.

- **External parts refurbishment:** From modernizing control panels and renew-

ing electrical wiring and connections to replacing worn gaskets and upgrading cooling system components, also you can also opt for accessory updates and surface protection for optimal efficiency.

- **Electrical tests:** With the mobile test unit, we can test single-phase and three-phase transformers for all performance and voltage classes.

### Environmental benefits of on-site repair

On-site repair solutions, such as those offered by Siemens Energy, provide significant environmental benefits by conserving resources through the use of fewer new materials and components. This approach also leads to a substantial reduction in waste; by repairing what already exists, the cycle of discarding old transformers and manufacturing new ones is interrupted. The carbon footprint of on-site repairs is generally much smaller compared to the full life cycle of manufacturing, transporting, and installing new transformers, as the logistics involved have a significant environmental impact through emissions. Additionally, by extending the operational life of a transformer, on-site repair solutions reduce the need for frequent replacements, thereby reducing the environmental im-

pact associated with the production and disposal of electrical equipment.

For instance, when service is required in Singapore, mobilizing personnel locally, say from Jakarta to Singapore and back, results in approximately 0.2 tons of CO<sub>2</sub> [2] emissions per person. In contrast, international mobilization from Frankfurt to Singapore and back generates significantly higher emissions, around 2.8 tons of CO<sub>2</sub> [2] per person. Therefore, Siemens Energy, with its extensive global presence, is strategically positioned to minimize environmental impacts. The company can leverage its widespread local expertise, reducing the necessity for long-distance travel. Additionally, the use of advanced virtual tools for operations and troubleshooting further lessens the carbon footprint. Investing in the training and development of local teams across its global locations is important. This not only reduces travel-related emissions but also improves the speed and efficiency of on-site transformer services.

### Revitalizing hydroelectric power generation: A case study in transformer uprating and refurbishment

A client from a remote location in Brazil enhanced their hydroelectric plant's efficiency by refurbishing and uprating five step-up transformers from 112 MVA to 134.4 MVA. The complex project involved redesigning HV and LV windings, adapting connections, reformulating the insulation system, and resizing the cooling system. A new oil preservation system and modern control panel were also installed. The execution was done in stages under controlled conditions, including a

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specialized air-conditioned tent for humidity control.

Old insulating oil was disposed of, and the transformer's active parts were removed, inspected, and reassembled with new components. An innovative vapor phase in the tank process dried the active parts, followed by comprehensive testing to ensure reliability. This strategic refurbishment increased the transformers' power and longevity, **improved system reliability**, and provided **sustainable maintenance** for the electrical infrastructure.

The project achieved continuous power generation with **minimal downtime**, offered **cost savings** by upgrading existing units instead of full replacements and **minimizing environmental impact**. With modernized components and control systems, operational efficiency and resilience to future grid demands were significantly enhanced, **lowering the risk of failures** and **extending the lifespan** of the transformers. The project has thus enhanced the operational flexibility of the electrical grid, better equipping it to adapt to fluctuating power demands and the changing landscape of power generation, marked by the integration of renewable energy and evolving consumer behaviors.

### Elevating power transformer repair services for longevity and efficiency

In summary, Siemens Energy's on-site power transformer repair solutions provide a strategic response to the challenges of transformer failures, offering rapid support, minimizing disruptions, and avoiding high transportation costs and risks. By prioritizing environmental sustainability and utilizing advanced diagnostics and innovative techniques, Siemens Energy ensures the longevity, efficiency, and resilience of power transformers. The demonstrated benefits of on-site repair, showcased through a compelling case study, underscore the transformative impact of these services in enhancing energy grid adaptability while upholding environmental and economic prudence. Take action now to ensure the longevity and efficiency of your power transformers by contacting Siemens Energy for comprehensive on-site repair and refurbishment services.

### References

- [1] CIGRE WG A2.37, "Transformer Reliability Survey," Brochure 642, Paris, 2015.
- [2] All CO<sub>2</sub> values have been calculated with [www.carbonfootprint.com](http://www.carbonfootprint.com)



Take action now to ensure the longevity and efficiency of your power transformers by contacting Siemens Energy for comprehensive on-site repair and refurbishment services

### Author



**Fernando Melo** is a seasoned professional with over 20 years of experience managing large, multidisciplinary projects within challenging, multicultural environments. Currently serving as the Global Product Manager at Siemens Energy, he specializes in Service Lifecycle Management and power transformer design. Fernando holds a master's degree in Innovation and Project Management and a bachelor's degree in Industrial Engineering. He is also certified in Lean Six Sigma. Known for his strategic thinking and leadership, he is dedicated to driving innovation and delivering exceptional value to customers.