camlin energy

Monitoring and Expert Intervention Prevents 115 kV OIP Bushing Failure

CASE STUDY

CAMLINENERGY.COM

CHALLENGE

Protecting Transformers from Temperature-Driven Bushing Faults

OIP bushings can develop insulation contamination over time, including moisture ingress or particles. When this happens, the bushing's Power Factor (PF) rises in line with temperature, creating a fault that can follow seasonal patterns.

Traditional offline testing often misses these faults as transformers cool down before measurements, masking elevated PF levels. In the case of a 90 MVA, 500 kV-to-115 kV autotransformer in North America, the utility faced the challenge of detecting early signs of bushing failure before a potentially catastrophic in-service event.

EVENT

Early Detection with TOTUS

TOTUS online Bushing Monitoring was installed in 2021, providing continuous measurement of PF, capacitance, and partial discharge (PD). During summer 2022, TOTUS detected elevated PF on the X1 bushing during peak top-oil temperatures. Later in the year as cooler temperatures set in PF figures lowered to normal levels, indicating a temperature-driven fault.

Camlin Energy experts analysed the data and determined that internal moisture or insulation overheating was likely causing the abnormal PF trend. Without online monitoring, these subtle yet critical signals could have been overlooked, leaving the bushing at risk of in-service failure.

Figure 1:

TOTUS detected elevated PF on the autotransformer X1 bushing

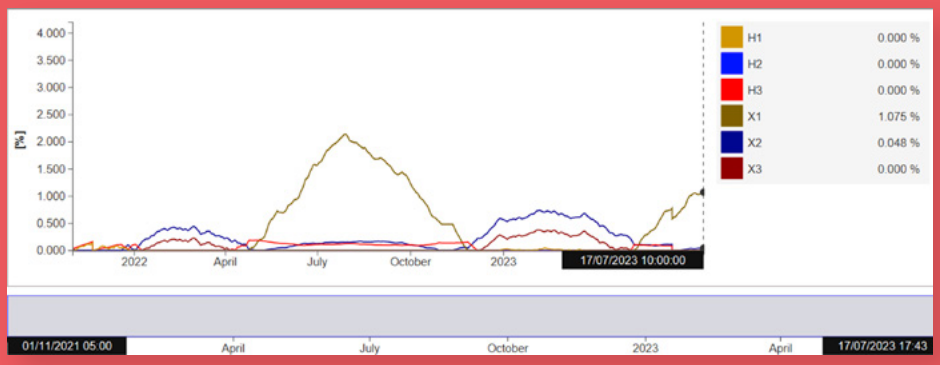
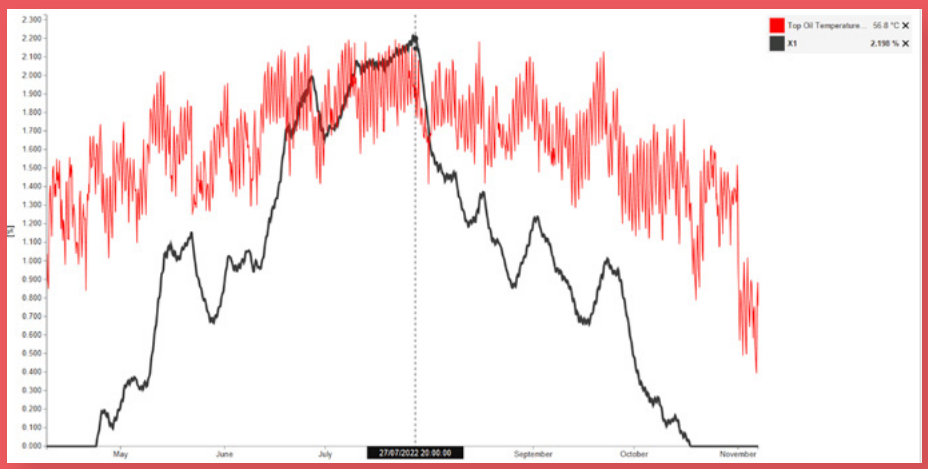


Figure 2:

Clear correlation between rising power factor and increasing top-oil temperature

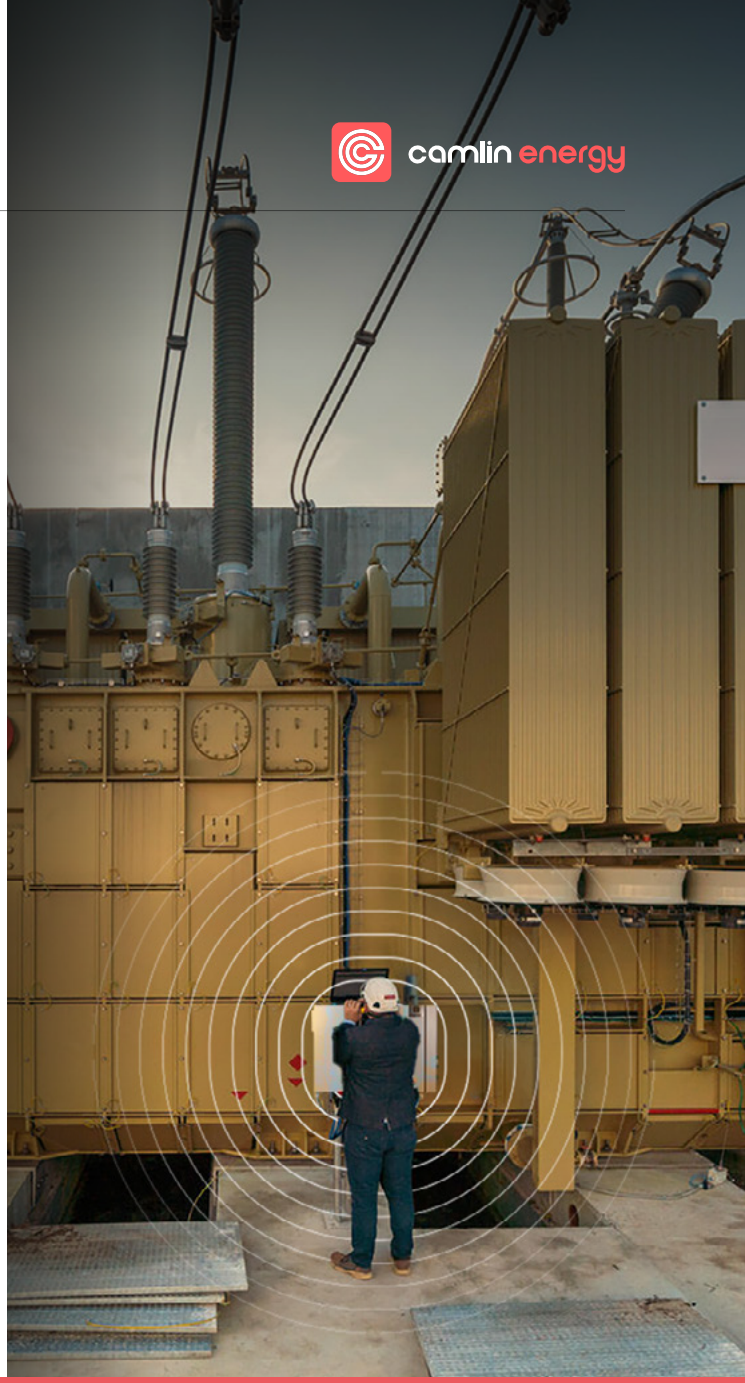


ACTION

Targeted Intervention

Based on the combined TOTUS data and expert interpretation, the utility scheduled a planned outage in summer 2023 to investigate the bushing condition during a period of high ambient and operating temperatures. Offline Power Factor testing confirmed losses above 1.0%, fully validating the online indications of deterioration. With the risk clearly identified, the X1 bushing was safely replaced under controlled conditions. Continuous monitoring throughout ensured the utility could act proactively, preventing any escalation in risk.

TOTUS provided the clear visibility the utility needed, while expert interpretation delivered the confidence to act. This enabled the utility to time the intervention correctly, avoid an emergency outage, and focus only on the affected bushing, resulting in a targeted and cost-effective outcome.



OUTCOME

Commercial Impact

Technical outcome:

- Early detection of a temperature-driven bushing fault
- Expert validation and guidance for safe, timely replacement
- Transformer remained operational without unplanned outages

Commercial & Operational Impact:

- **Avoided unplanned outages:** Emergency shutdowns and mobilisation costs avoided
- **Reduced repair costs:** Planned replacement prevented potential cascading damage
- **Mitigated operational risk:** Catastrophic failure, fire, or oil spill prevented
- **Optimised decision-making:** Data-driven actions gave confidence in proactive asset management