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CASE STUDY

Offshore circuit breaker testing

How Ventus Energy and Camlin Energy are working together to increase the reliability of wind energy projects

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Case Study: Offshore circuit breaker testing

How Ventus Energy and Camlin are working together to increase wind farm reliability

Background

Transformers in the wind energy network connecting turbines to offshore and onshore substations, and ultimately to the mainland electricity grid, are vitally important as they often represent single points of failure with little or no redundancy. One of the most critical assets on this network is the circuit breaker, which must operate correctly to protect the upstream grid during fault events, safeguarding the transformer from failure.

Impact of circuit breaker failure

Camlin Energy recently engaged with Ventus Energy, a leading utilities company, to implement first trip profiling using Camlin Energy's PROFILE P3 as part of their maintenance programme for offshore projects. This allowed them to identify potential defects that can be repaired during a planned outage and therefore ensured the circuit breaker would operate correctly when needed.

Ensuring the successful operation of circuit breakers is of critical importance; should a circuit breaker not operate or operate too slowly, a fault event can occur causing significant, even catastrophic damage to the assets on the network it is designed to protect. Such incidents could lead to prolonged outages lasting several months, resulting in significant revenue loss and other associated costs.

Ventus Energy

Ventus Energy is a leading provider of O&M services to the offshore industry and carries out both preventative maintenance and reactive repair work. Camlin Energy provides cutting edge technical solutions to monitor transformers, generators, and circuit breakers.

Average UK offshore wind farm revenue loss due to transformer failure

Project size	100 MW
Average loading rate	35%
Electricity price	£50/MWhr
Lead time for replacement transformer	18 months
Revenue loss	**£22 million**

Camlin Energy has pioneered the application of 'First Trip Circuit Breaker Profiling' over the last 25 years and this case study outlines how Ventus Energy is successfully utilising Camlin Energy's PROFILE P3 solution to identify problematic circuit breakers in offshore wind farms.

Circuit Breaker Testing

The correct method of testing circuit breakers is critical to detecting defects that can adversely affect trip operations due to downstream faults. This test must be carried out when the circuit breaker is in service to determine how it would have operated under fault conditions. It is known within the power industry as a First Trip Test.

Camlin Energy's PROFILE P3 is a handheld device that can capture data during a circuit breaker First Trip operation by connecting non-invasive sensors to the secondary control circuit. This data is analysed to determine key parameters that can indicate if the circuit breaker will operate correctly when required, to isolate a fault.

Ventus Energy are using the PROFILE P3 as part of their maintenance programme for offshore projects to identify potential defects that can be repaired during a planned outage and therefore ensure the circuit breaker will operate correctly. Ventus Energy have identified many instances that circuit breakers failed the First Trip Test.

The insights enabled by testing circuit breakers with PROFILE P3 have enabled Ventus Energy to develop a condition-based maintenance strategy that maximises efficiency and reliability for their OEM team.

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Examples of defects detected by a PROFILE P3

Below are two examples of defects that would cause a 'slow trip' operation. If a timing test were used, it would only indicate the circuit was slow but not what the cause was. This clearly demonstrates the benefit of First Trip Profiling where defects can be analysed, and the root cause identified.

INCREASED TRIP LATCH FRICTION

Example:

Circuit Break with slowing latch time.

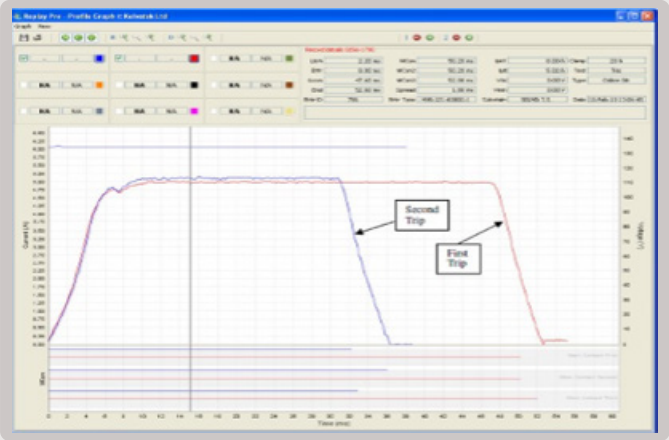
Observation:

Notice the difference in the latch times where the past trip is about 7 milliseconds faster than the present. The difference in the curves represents a trip coil that is taking longer to move the trip latch due to built up friction in the release mechanism. This affects the main part time as well, which results in a significantly slow trip.

Another supporting observation is that both curves show the same time from latch point to ACon is 11ms. This insinuates that the problem is indeed happening before full mechanical motion of the breaker.

Deviation:

The striker pin is experiencing restrictive forces from insufficient lubricant and/or misalignment of coil.



MAIN BEARING PROBLEM

Example:

The Circuit Breaker's main high contact part time is only apparent in the first trip.

Observation:

The first trip MCON 3 time of 52 ms is well out of the acceptable range of 30 milliseconds. As you can see, the breaker is coming off latch at the same time on both trips. The second trip was taken immediately following the first, and no maintenance was performed. In this case, the breaker's grease reconstituted for a much faster operation.

Most likely the mechanism will have to be disassembled for cleaning and re-greasing.

Deviation:

Insufficient lubricant on the main bearings.

Conclusion

Ventus Energy has benefited greatly from the addition of first trip profiling with Camlin Energy's PROFILE P3. Benefits include;

- Avoidance of slow tripping operations which can cause widespread loss of renewable energy generation and revenues.
- Reduction in maintenance and repair costs due to developing a more effective maintenance strategy based on a condition-based assessment of circuit breakers.
- Improved visibility of previously hidden risks in the balance of plant.
- Extended asset life by trending key circuit breaker key parameters.
- Can take maintenance actions immediately whilst offshore teams are on site rather than requiring a return offshore site visit.

About Camlin Energy

For over two decades, Camlin Energy has been working collaboratively across the global energy industry to accelerate network performance and drive a more sustainable future.

Partnering with world-leading wind generation farms, energy utilities and data centre operators, Camlin Energy provides industry-leading transformer monitoring solutions and services. We help operators of these facilities gain a deeper understanding of the risk, health, and performance of their transformer fleet through our secure, robust, and accurate, online monitoring solution TOTUS.

Monitoring the most critical components of a transformer, TOTUS delivers actionable insights which optimise proactive maintenance strategies, improve availability and uptime of assets, and significantly reduce the risk of sudden transformer failure, associated costs and lost revenues.

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