

Kelman Transfix DGA monitor detects problem with windfarm key inter-tie transformer



The Customer

The Alternative Resource Energy Authority (AREA) is owned by Berwick, Antigonish and Mahone Bay, three small towns in Nova Scotia, a province in eastern Canada, each having its own municipal electric utility. AREA currently owns and operates the 23.5 MW Ellershouse Wind Farm, which provides benefit to both its owner municipalities and the towns' electric customers by supplying over 40% of their annual energy requirements.



The Situation

The Ellershouse Wind Farm was developed in three stages between 2014 and 2017 with an original 20MVA rated transformer installed as the inter-tie for the single substation in the first phase. While a forced outage on a wind turbine generator can be tolerated, a forced outage on the inter-tie transformer completely shuts off the power plant resulting in a lengthy business interruption. With transformer replacement lead times of 8-12 months, AREA incorporated a GE Kelman Transfix DGA monitor in its original substation design to continuously monitor the health of the transformer and reduce the risk of an inter-tie transformer failure.

The construction of the third phase in 2017 took the total wind farm capacity from 16.45MW to 23.5MW (which is above the transformer's 20MVA nameplate rating). AREA performed a value analysis and determined that a partial "curtailment algorithm" (to restrict the windfarm output when the inter-tie transformer could not handle it) in fact provided better annual cash flow compared to the cost of replacing the existing 20MVA transformer.

The "curtailment algorithm" makes use of the transformer's increased capacity at lower ambient temperature (20MVA @ 25°C linearly to 24.5MVA @ 0°C). AREA felt comfortable because the GE Kelman Transfix had been successfully providing continuous monitoring since energization. Local technical consultants suggested that oil and winding temperatures (instead of ambient) should be used when they implemented the algorithm.



20MVA transformer with Transfix DGA monitor

The Problem

AREA became suspicious when no curtailment took place over the first twelve months of operations at the full 23.5MW. However, lab tests indicated acceptable dissolved gas analyses at the time of sample extractions. Only when the Kelman Transfix generated an IEEE stage-2 CO₂ (carbon dioxide) alarm did AREA's technical consultants investigate the CO₂ trend data from the on-line monitor. The IEEE stage-3 condition was in fact reached soon after!

AREA's self-performed analyses using the facility output and Transfix data suggested that the transformer cooling fans should switch-on earlier to maintain a lower oil temperature. AREA also determined that the oil and winding temperature probes were poorly designed and subsequently replaced them with an ambient temperature probe. The final step was to adjust the "curtailment algorithm" to use ambient temperature and be more conservative until AREA had a better understanding of consequences to the transformer lifetime.

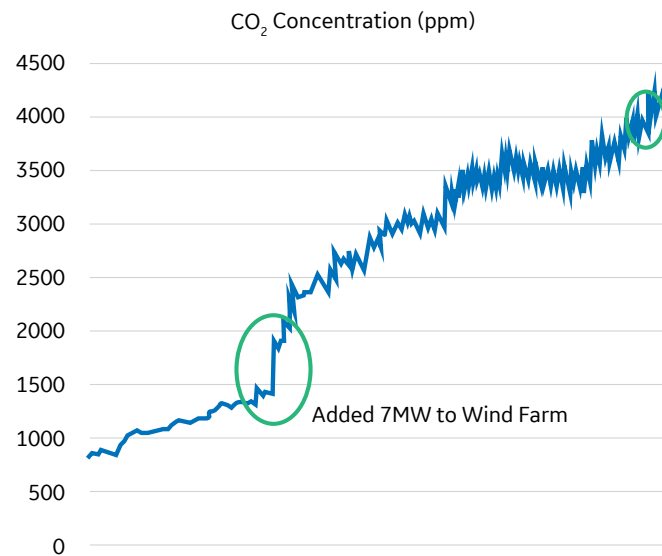


Success Story

AREA reached out to GE M&D (the monitor manufacturer) to provide operational guidance, given that existing relationships with the transformer vendor and local technical consultants yielded no results. Through the GE engagement, three key points became clear:

- Only with continuous, on-line DGA monitoring could AREA have timely identified the issues and properly adjusted its operations to avoid reducing the life of the inter-tie transformer,
- Renewable energy asset owners are best served by having ready access to their own quality data to self-perform analyses when existing relationships fail to deliver satisfactory insight,
- GE Monitoring & Diagnostics explained and demonstrated the use of the CO₂/CO (carbon dioxide to carbon monoxide) gas in oil concentration ratio as an early indicator of transformer health.

Since engagement with GE, the CO₂ concentrations have decreased and most importantly the CO₂/CO ratio has stabilized. GE and AREA are further collaborating to determine the optimal parameters to be used for the "curtailment algorithm".



Only GE M&D demonstrated an in-depth knowledge of the CO₂/CO gas ratio as an early predictor of transformer health. This ability, together with the online data from their Kelman Transfix multigas DGA monitor, enabled us to detect a problem with our curtailment algorithm and avoid a financially crippling premature failure of our inter-tie transformer.

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