SYSTEM PROTECTION
Electrical Engineers & Consultants
Consulting | Testing | Maintenance | Diagnostics

Case Study – How Vigilant Electrical Maintenance team saved a Power Transformer

Invest Just 10 Minutes to Prevent Costly Electrical Breakdowns!

Today, we bring you a **real-life case study** of a **Power Transformer failure**—a scenario rarely anticipated but one that unfolded in a plant. By sharing this experience, we aim to help **Maintenance Engineers** identify and mitigate similar risks, preventing major disruptions and financial losses.

This case study highlights how **vigilant engineers, preventive maintenance, and routine testing** played a critical role in **saving electrical equipment and protecting revenue worth crores**.

Background

A **31.5 MVA, 66/11 kV Power Transformer** was part of a power distribution system supplying utilities through an 11 kV switchgear. The plant had three identical transformers, all kept in charged condition. However, the 1st and 3rd transformers were heavily loaded, while the 2nd transformer was primarily used as a standby unit.

For nearly one year, all three transformers appeared to be functioning normally, operating at only 10-20% of their rated capacity. But what happened next was unexpected and alarming

Findings- at Site:

As part of the **annual preventive maintenance program**, a routine inspection was carried out on all three transformers. The maintenance team conducted a thorough check, and everything initially appeared to be in order. Oil samples were collected from each transformer and sent for **Dissolved Gas Analysis (DGA), Breakdown Voltage (BDV), and Water Content testing**.

When the DGA test results for Transformer #2 were received, an alarming discrepancy was found. Compared to its pre-commissioning test results, the ethylene (C_2H_4) content had risen to 402 ppm—8 times higher than the IEEE C57.104 standard limit of 50 ppm. This was a indication of thermal stress or overheating, which could lead to a serious failure if left unaddressed.

Recognizing the criticality of the situation, the maintenance team exercised caution before making a final decision on shutting down the transformer. To validate the findings, they sent additional oil samples to four independent laboratories—including two private labs, the OEM, and ERDA—to cross-check the accuracy of the readings. Interestingly, while all results confirmed an increase in C_2H_4 levels, significant variations were observed among different reports, adding further complexity to the assessment.

Below is the results of Oil test : -

SR.NO.	SYMBOL	NAME	Limit in PPM	Before charging	Own lab	Private	ERDA	private	OEM
				Sep-2016	Nov, Dec – 2017				
1	H2	HYDROGEN	<150	3	39	66	33	73	61
2	CH4	METHANE	<120	<1	140	84	27	95	98
3	C2H6	ETHANE	<65	Nil	47	30	3	18	28
4	C2H4	ETHYLENE	<50	Nil	402	409	50	1193	385
5	C2H2	ACETYLENE	<1	Nil	9	10	BDL	BDL	<1
6	CO	CORBON MONOXIDE	<350	29	280	166	61	140	162
7	CO2	CORBON DIOXIDE	<2500	282	866	788	200	691	808

COMPARISON OF DGA RESULTS

The Transformer was de-energized & OEM representative has been called out to the plant location to further scrutinize the case, the site team performed some electrical tests to ensure the healthiness, the test results were found in order.

The oil has been drained out of the transformer, the manhole covers were removed, the core yoke and tank shorting point disconnected/separated, IR test conducted between the separated points (Core & yoke frame) with respect to ground, a voltage of 2500 Volts is applied to check the healthiness of insulation.

As there is a complication to enter inside the transformer due to the space concern between the body and the core-coil assembly, the inspection window in three sides was opened for conducting the above test.

While conducting Insulation resistance test the voltage is notwithstanding/ building up normally, all of a sudden, the team noticed some chattering sound from inside the transformer, all the team members were inspecting the transformer from all three sides of inspection window, but the chattering sound/ spark is not accurately visible.

OEM recommended dispatching the transformer to their works for further investigation, the transformer is dispatched from the site and the site team also reached to OEM works for inspection.

CCA OF THE SAID TRANSFORMER

The core has been lifted from the body and visual inspection performed, no abnormalities found, IR between core & yoke frame conducted @ 2500 volts, chattering sound observed.

Finally, the case was concluded, one washer found resting on the bottom of a center limb of core and touching the yoke frame resulting in sparking/chattering.

Pic of the washer which was resting in the bottom of the center limb.

OMG! How did this washer end up inside the transformer?

At this stage, it is difficult to determine the exact point of entry. The washer could have made its way inside the transformer either during manufacturing at the OEM facility or during installation at the site. While it may appear to be sheer negligence or poor workmanship, such incidents, though rare, can occur.

Upon removal of the washer, an IR test was conducted, yielding values exceeding 500 Mega-ohms, confirming the integrity of the insulation. Following this, the transformer was repacked, subjected to thorough testing, and found to be in optimal condition. With everything performing as expected, it was successfully commissioned and is now in service.

Conclusion that can be drawn from this incident:

The plant's maintenance team proposed a solution that, while unconventional, could have saved significant time and costs if implemented.

Key Considerations for Power Transformer Commissioning (Based on This Case Study):

1. Upon transformer receipt, always check the insulation resistance of the core and yoke frame earthing points individually against the ground/body.

2. If these points are not externally accessible, remove the manhole cover, isolate all three points, and conduct an insulation resistance test.

3. Conduct DGA testing at key intervals: before charging, after 24 hours of no-load operation, under full load after 24 hours, and again after a month (if online DGA is unavailable).

4. If oil test/DGA reports are outside prescribed limits, verify results with at least one NABL-accredited lab before concluding.

5. During transformer erection and accessory installation, ensure strict material handling protocols. Double-check that no foreign objects fall inside the transformer tank before sealing and oil filtration/charging.

Also, if your Plants Power Transformers are in operation since more than 5 years, Go for Diagnostic testing of transformers than Routine/General testing of transformers.

We, as an Electrical asset consultant and service provider always suggest what is best to run your industries smoothly and without hiccups of maloperation and breakdown.

And if you are looking for a dedicated agency that understands the direct link between your assets and your revenue, call/write to us, we will be happy to assist you.

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