Application Brief

Testing Power Transformers with Acoustic Emission

Power Transformers represent the largest portion of capital investment in transmission and distribution substations. The financial consequence of losing a single unit can have a multimillion-dollar impact.

Acoustic Emission (AE) is a well-known technique that is used to detect and locate acoustic sources in power transformers.

Do you have a gassing transformer?

Would you like to know the location of the fault?

Without taking the transformer out of service?

Can't afford taking the unit(s) out of service for inspection and need to know the condition of your equipment?

Do you want to monitor your transformer during special operating conditions (overload, solar storms, commissioning)?

You can use AE!!!

Advantages of this technique Include:

- Applied on-line
- Noninvasive
- More sensitive than electric methods for on-site tests
- Locate the source(s) in a three-dimensional plot
- Can be used on manufacturer facilities or repair/ refurbishment shops to locate a defect when detected by electric methods
- The performance of this technique is enhanced when used in conjunction with Dissolved Gas Analysis (DGA).

AE Detects:

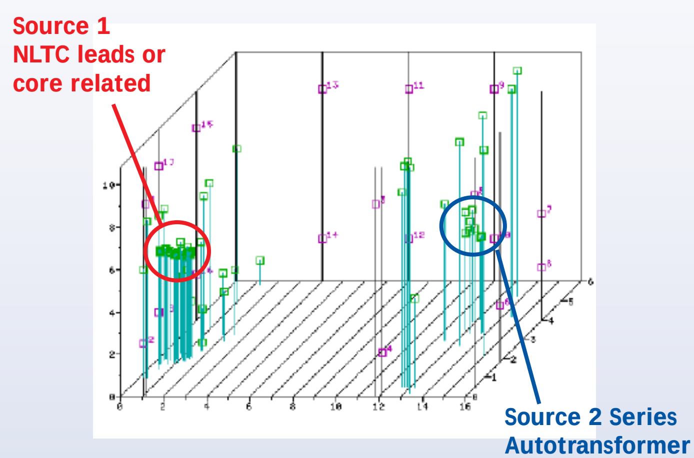
- Partial discharge
- Hot spots
- Static electrification in GSU Transformers
- Arcing
- Loose connections
- Core clamping problems

Other parameters (load current, pump current, temperature, load tap changer motor current) are acquired along with acoustic emission data in order to correlate this information with the operating conditions on the transformer during the test.

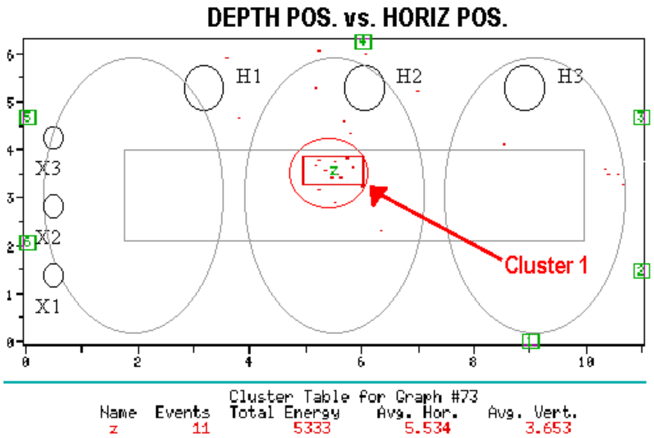
Case Histories:

1. GSU TRANSFORMER, 362.5 MVA, 500/24 kV, SHELL FORM. This unit was tested during the first 36 hours after commissioning to detect PD/ Arcing due to static electrification. A sister unit failed catastrophically 2 years before, just minutes after commissioning due to this phenomena. Discharges resulting from static electrification were detected and located in the lower and upper part of the high voltage coil.

2. TRANSFORMER, 85 MVA, 230/13.8 kV, CORE FORM. This transformer was tested during an induced voltage test in a refurbishment shop. RIV and electric PD detection techniques indicated partial discharges in Phases A and C. However, acoustic emission test results detected and located an acoustic source in the lower part of Phase B coil. Internal inspection revealed discolored insulation in low voltage (LV) and load tap changer (LTC) leads of Phase B. The same discoloration was found in LV and LTC leads of Phase A, but not in the same degree as Phase B. Phase C insulation did not show any degradation.



Three-dimensional plot showing the location of two different sources.



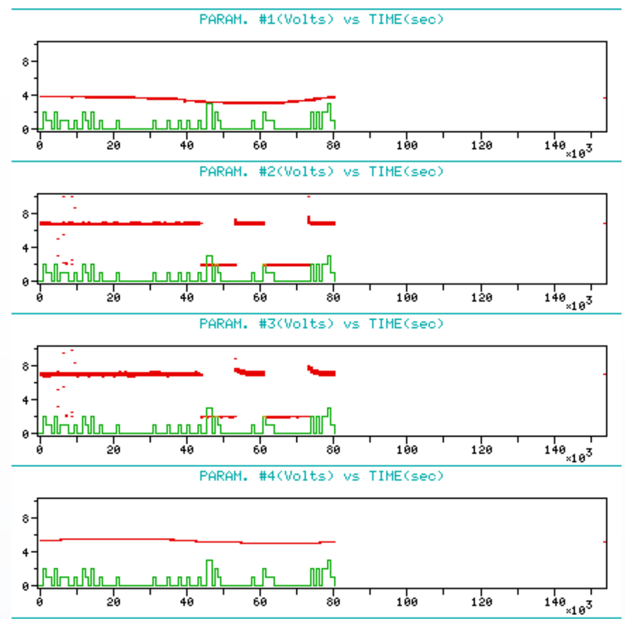
Location of one source in a two-dimensional view.

3. AUTOTRANSFORMER, 243 MVA, 500/230/13.8 kV, SHELL FORM. This unit was tested twice. The first test revealed an acoustic source of low amplitude located in the middle of the high voltage wall. The second test (one year later) indicated the same source in the same location, but with higher-amplitude and higher-energy characteristics. An internal inspection performed in that area indicated that the acoustic activity was generated by degradation on the no-load tap changer (NLTC) leads.

4. GSU-TRANSFORMER, 784 MVA, 25/500 kV, SHELL FORM. An AE test was performed because this unit was gassing heavily. The detection and location of one low-amplitude source was obtained close to the top of the core and a low voltage bar. Acoustic activity was particularly intense just before the second group of pumps operated and diminished a few minutes after both cooling groups were running. This behavior indicated the existence of a thermal problem that corresponded with the diagnosis obtained by Dissolved Gas Analysis (DGA).

5. GSU-TRANSFORMER, 784 MVA, 25/500 kV, SHELL FORM. Sister unit of the previous case. This unit was not gassing and no acoustic activity was detected in the area where the acoustic source was detected for its sister unit.

6. TRANSFORMER, 400 MVA, 500/161/13.8 kV, SHELL FORM. Several areas of acoustic activity were detected in this transformer. After filtering extraneous noise and performing the data analysis, one acoustic source was located at the bottom of the unit, in the core. Internal inspection results located the origin of this activity: overheating in the connection between ground and core laminations, several inches away from the calculated location.



Load Current, Current of Pumps # 1 and # 2 , and Temperature.

MISTRAS Services Division has experience using acoustic emission for the condition assessment of power transformers and throughout the years, a large database has been developed that allows data comparison between similar designs. MISTRAS is also an active participant on the ongoing EPRI TC project *"Development of a new acoustic emission technique for the detection and location of gassing sources in power transformers,"* intended to improve upon this technique.

Find out more about testing Transformers with Acoustic Emission, call (609) 716-4000 today!

195 Clarksville Road, Princeton Junction, NJ 08550 USA
Phone: (609) 716-4000 • Fax: (609) 716-0706
Email: sales.services@mistrasgroup.com • www.mistrasgroup.com