Transformer Monitoring

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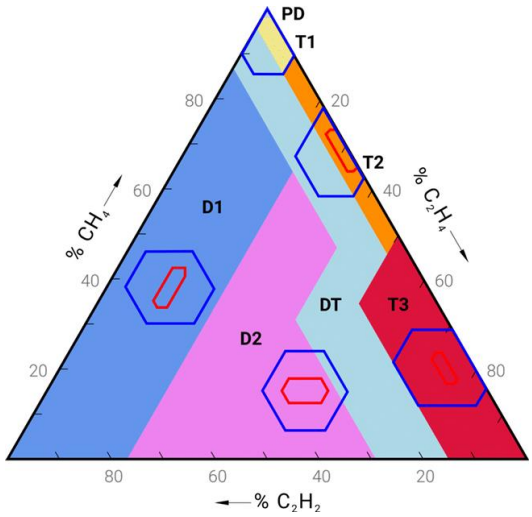
PowerView
Testing & Monitoring Equipment

Pioneering the future of power testing and monitoring

Transformer online DGA

DGA background

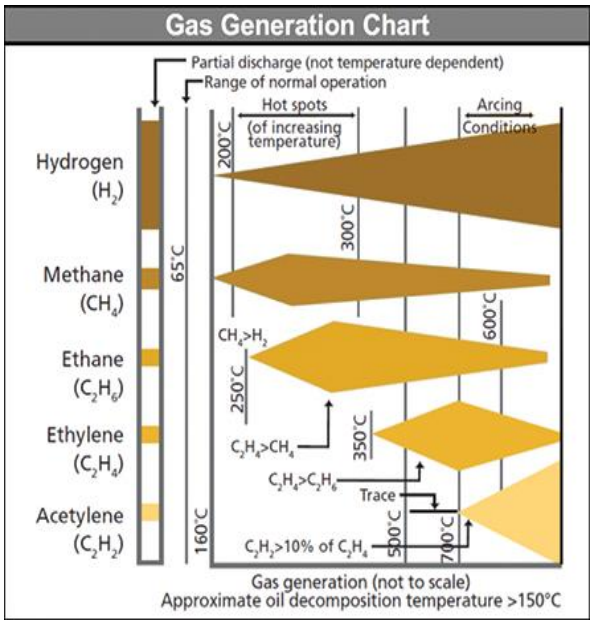
Dissolved gas analysis for transformer has been used for decades as a reliable tool for indication and prevention serious damage caused by transformer faults.
According to international standards for maintenance of transformers- this analysis is mandatory.
Dissolved gas analysis (DGA) monitoring is the most powerful tool for transformer early phase fault detection and trending.
Proven diagnostic tools (such as Douval triangle and Roger's ration) help determine nature of the fault by analyzing different gas presence.



Douval triangle

Gasses formation

Gases in oil are created by breaking the molecular bonds of oil molecules caused by electrical stress, partial discharges, hot spots, oxidation, decomposition of insulation, etc.).
Molecules of insulating oil in high voltage equipment break down under the influence of the thermal and electrical stresses to produce hydro-carbon gases, hydrogen and carbon oxides.
According all diagnostic tools and standards there are 7 known fault gasses Hydrogen, Carbon monoxide,
Carbon dioxide, Methane, Acetylene ,Ethane Ethylene + nitrogen and oxygen (which are formed due to pour sealing)



Water formation and importance

Water can be present in transformers due to pour dehydration in production, inappropriate handling, poor sealing (water ingress), chemical water (which comes as a by product from various chemical reactions of materials.

Oil degradation

Transformer Oils are prone to degradation from electrical stress and various chemical reactions between coper, oxygen, water and particles released from insulation decomposition and different molecular re-bonding.
Transformer oil quality is generally assessed by oil laboratory testing .Breakdown voltage which is critically connected to water content tan delta, particles and acidity gives most valuable information in this regard to oil contamination and degradation .
Oil degradation is a catalytic process which speeds up snowball effect which leads to sludge formation.

Gases formation different temperature

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Transformer oil complete DGA monitoring

Why transformers fail

Transformers, like any other equipment, are susceptible to faults caused by the factor of imperfection and premature aging of materials, imperfection in making human errors in maintenance and manipulation.
Depending on the value of the transformer, these faults, if not detected on time, develop into more expensive faults (more expensive repair and lost production if the fault is not repaired in early stage).

Yearly maintenance lab DGA addresses slowly developing faults .
When is has been indicated (by Lab testing or fault monitor) that a fault is developing inside a transformer a fully diagnostic all fault gasses DGA is the best solution which helps faulty transformer stay in service (until repaired) .

With the FDM the fault development is monitored 27/7 and any significant change in the fault can be noted in an early stage.

This monitoring solution saves money , helps better understand fault and helps preventing expensive faults , and helps planning and optimizing service intervals.

An additional limitation of laboratory analysis is the time required to sample, analyze and obtain results (for example if a decision needs to be made to re-enable a transformer after an outage.

This monitoring system has no consumable, moving parts, spare parts, parts with a limited-service life (less than 15 years), no need for recalibration or any maintenance.

No spare parts consumables or recalibration

Absolutely no consumables or spare parts for diagnostic complete fault gas DGA

Fast response to fault

Fast response time for quick developing faults due to immersed tank sensor technology

Proven Hydrogen monitoring sensor and technology

ABB , SIEMENS, use the identical sensors and measurement technology

Measured parameters

Online DGA on diagnostic fault gases
This system provides online measurement of all 7-transformer fault diagnostic gases:

- Hydrogen (H2);
- Carbon monoxide (CO);
- Carbon dioxide (CO 2);
- Methane (CH 4);
- Acetylene (C 2 H 2);
- Ethane (C 2 H 6);
- Ethylene (C 2 H 4);

Additionally, the system detects tank sealing problems (air leaking problems) (N2 , O2 gasses) by measuring total tank pressure.

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Transformer DGA and Oil Quality Monitoring

Technology

This monitoring system uses the Vaisala NDIR Sensor and Tunable filters technology for detection of 6 fault gases while hydrogen is measured directly at the oil tank(for best response) .

It connects with external hoses to 2 flanges and uses Vacuum extraction (which is proven as the most effective extraction technology for getting the dissolved gasses outies the oil.

The gasses are than exposed to NDIR sensor with tunable filters which require absolutely no need for recalibration or spare parts replacement in full lifecycle. .

The Immersed Tank Sensor is a DGA monitoring unit. It is capable of monitoring hydrogen, temperature , moisture and oil degradation directly from the transformer tank by permanently mounting on a flange .

It has no moving parts (like pumps membranes gears etc. and uses solid state nickel palladium sensor for H2 measurement .

No spare parts maintenance or recalibration are required in the min 15-year lifetime.

Technical Specification

Parameter	Range	Accuracy	Repeatability
Methane (CH4)	0 ... 10 000 ppm_v	±4 ppm or ±5 % of reading	10 ppm or 5 % of reading
Ethane (C2H6)	0 ... 10 000 ppm_v	±10 ppm or ±5 % of reading	10 ppm or 5 % of reading
Ethylene (C2H4)	0 ... 10 000 ppm_v	±4 ppm or ±5 % of reading	10 ppm or 5 % of reading
Acetylene (C2H2)	0 ... 5000 ppm_v	±0.5 ppm or ±5 % of reading	1 ppm or 5 % of reading
Carbon monoxide (CO)	0 ... 10 000 ppm_v	±4 ppm or ±5 % of reading	10 ppm or 5 % of reading
Carbon dioxide (CO2)	0 ... 10 000 ppm_v	±4 ppm or ±5 % of reading	10 ppm or 5 % of reading
Moisture (H2O)	0 ... 100 ppm_w	±2 ppm or ±10 % of reading	Included in accuracy

Hydrogen Measurement range (in oil)	0 ... 5000 ppm_v	Oil type	Mineral oil / Natural ester oil /Synthetic, ester oil
Accuracy (in oil temperature range -20 ... +60 °C (-4 ... +140 °F))	±15 % of reading or ±25 ppm_v (whichever is greater)	Operating temperature (electronics)	-40 ... +60 °C (-40 ... +140 °F)
		Storage temperature	-40 ... +60 °C (-40 ... +140 °F)
		Operating humidity	0 ... 100 %RH, condensing
		Pressure tolerance (probe, short-term)	Max. 10 bara
Repeatability	±10 % of reading or ±15 ppm_v (whichever is greater)	Pressure tolerance (probe, continuous)	Max. 4 bara
Minimum detection limit	25 ppm_v	Temperature tolerance, sensor head	-40 ... +120 °C (-40 ... +248 °F)
Typical long-term stability	3 % of reading / year	Integrated protection for short power outages	> 3 s
Cross sensitivity to other gases	< 2 % (CO2, C2H2, C2H4, CO)	EMC standard EN61326-1, Industrial environment; CISPR22 class B emission limits when DC powered	Fulfills the requirements of IEC 61000-6-5 in the following tests: IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6, IEC 61000-4-8, IEC 61000-4-11, IEC 61000-4-12, IEC 61000-4-16, IEC 61000-4-17.
Response time	63 % of full response: 2.5 h (when sensor is not in reference cycle) 90 % of full response: 17 h		
Warm-up time	2 h, 12 h for full specification		
Sensor	Catalytic palladium-nickel alloy film solid-state sensor		

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Outputs

RS-485 Interface

Supported protocols	Modbus RTU, DNP3 (optional feature)
Galvanic isolation	2 kV RMS, 1 min
Ethernet Interface	
Supported protocols	Modbus TCP, HTTP, HTTPS, DNP3 (optional feature), IEC 61850 (optional feature)
Galvanic isolation 4 kV AC (50 Hz, 1 min)	4 kV AC (50 Hz, 1 min)
Relay outputs	
Number of relays	3 pcs, normally open (NO) or normally closed (NC), user selectable

Power supply

Operating voltage	100 ... 240 VAC, 50 ... 60 Hz, ±10 %
Overvoltage category	III
Maximum current consumption	10 A
Maximum power consumption	500 W
Typical power consumption at +25 °C (+77 °F)	100 W

Measurement operation

Total dissolved combustible gases (TDCG)	Combined total of H2 , CO, CH4, C2H6, C2H4, and C2H2
24 h average	Available for single gases, moisture, TDCG, and total gas pressure
Rate of change (ROC)	Available for single gases and TDCG for 24 h, 7 d, and 30 d periods
Gas ratios	Available ratios: CH4/H2 , C2H2/C2H4, C2H2/CH4,C2H6/C2H2, C2H4/C2H6 , CO2/CO

Trigger type	Gas alert with user selectable limits
Galvanic isolation	2 kV RMS, 1 min
Max. switching current	6 A (at 250 VAC) 2 A (at 24 VDC) 0.2 A (at 250 VDC)
User interface	
Interface type	Web based user interface, can be operated with standard web browsers

Transformer oil type	Mineral oil
Required minimum fire point of transformer oil	+125 °C (+257 °F)
Transformer oil pressure at oil inlet	Max. 2 bar_{abs} continuous Burst pressure 20 bar_{abs}
Transformer oil temperature at oil inlet	Max. +100 °C (+212 °F)
Ambient humidity range	0 ... 100 %RH, condensing
Ambient temperature range in operation	-40 ... +55 °C (-40 ... +131 °F)
Storage temperature range	-40 ... +60 °C (-40 ... +140 °F)

Measurement cycle duration	1 ... 1.5 h (typical)
Response time (T63)	One measurement cycle
Warm-up time until first measurement data available	Two measurement cycles

Initialization time to full accuracy	Two days
Data storage	At least 10 years
Expected operating life	> 15 years

Mechanical specifications

Oil fitting	Stainless steel Swagelok fitting for 10 mm (0.39 in) outer diameter tubing. See list of accessories for adapters available.
Max. length of oil pipe to transformer	Max. 10 m (33 ft) with 7 mm (0.28 in) inner diameter tubing Max. 5 m (16 ft) with 4 mm (0.15 in) inner diameter tubing
Material	Marine aluminum (EN AW-5754), stainless steel AISI 316

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