WG C57.139 Guide for the Interpretation of Gases generated in Liquid-Type Load Tap Changers
Fall 2024 Meeting Minutes
Unapproved

Chair Rainer Frotscher
Vice Chair John Pruente
Secretary Paul Boman
Meeting: St. Louis MO USA Tue October 29, 2024 3:15 – 4:30 PM
Attendance record: Total: 55, Members: 24, Guests: 31, with 14 requesting membership.
Attendees list: see end of these Minutes.

Agenda

- Welcome
- Membership / Quorum
- Approval of Agenda
- Call for Patent Claims / IEEE SA Copyright Policy
- Approval of Meeting Minutes S24
- 5-letter Classification
- Revision of C57.139 – Report of Task Forces TF1 - TF4
- Presentation by Niklas Gustavsson (HE) on “Gas generation in vacuum on-load tap-changers”
- New Business
- Closing Remarks / Adjourn Meeting

Minutes

1. The WG met Tue, Oct 29, 3:15 pm. Chair asked for approval of the agenda; motion by Mark Newbill, 2nd by Ed Casserly => agenda was unanimously approved.
2. Chair showed membership list containing 39 members, with an initial count of 24 members attending => Quorum was achieved.
3. Chair asked for Essential Patent Claims => none stated.
4. Slides for Participant Behaviour and IEEE Copyright Policy were shown.
5. Spring 2024 Meeting Minutes: motion to approve by Marcos Ferreira, 2nd by Deanna Woods.
6. Chair then explained the 5-letter classification, as agreed in the previous meeting. All attendees should get familiar with this classification, as this is now, after the anonymization of data, the only descriptor to identify an LTC design.

I	In-tank (LTC mounted inside transformer tank)				
O	On-tank (LTC mounted at the side wall of the transformer)				
	A	Arcing (arcing contacts with switching arcs occurring in oil)			
	V	Vacuum (arcing contacts with switching arcs occurring in vacuum interrupters)			
		R	Resistor type (transition through resistors)		
		X	Reactor type (bridging through a reactance)		
			S	Selector compartment only	
			C	Combined compartment (selector and diverter in same compartment)	
			D	Diverter compartment only	
				S	Sealed tank (with or without pressure relief device)
				B	Non-sealed (breathing)

Craig Colopy mentioned that, in LTC Standard C57.131, on-tank type LTCs are named “compartment types”. Chair answered that this definition is confusing and therefore will be re-defined. In C57.139, the word “compartment” describes the different oil compartments from which DGA samples are analyzed.

Craig further recommends using “OLTC” instead of “LTC”, to comply with C57.131.
Chair will check if “OLTC” is going to be defined as alternative to “LTC” in future editions of C57.12.80 (Terminology Standard).

Jesus Sanchez…? asked how DGAs from selector tanks which communicate with the transformer main tank shall be handled. Chair said that they fall under transformer DGA.

7. Task Force Reports

7.1. TF1 LTC Data Collection and Evaluation
- TF leader Zach Draper was not present, so results were presented by Chair.
- Data collection has been completed, data were anonymized and cleaned, so ~130’000 samples are ready for further processing.
- Basic Statistics and Calculation of Ratios were performed on important LTC classes (OAX*B, OAR*B, OVX**, IAR*B, IVR**; with “*” = wildcard for existing variants to be compared).
- Box Plots showing the data distribution of single gases and ratios of some of these LTC classes were presented. They clearly show if it is possible to derive limit or 90/95% values for the respective class – or not. The evaluation is ongoing.
- ROC curves could help to identify meaningful gases which allow a failure detection. Examples were shown for increments and rates of the OAXCB class.

7.2. TF2 Revision of General Section (Chapters 1-4) – Florin Faur reports:
- Edits on Scope, Purpose, Normative References and Definitions (chapters 1-3) are completed.
- Draft 4 was distributed Sep 2024 and discussed within TF2.
- Chapter 4 (Nature, purpose and basis for LTC DGA) needs further revision, e.g. on LTC faults; edits will be done by John Pruente.

7.3. TF3 Revision of Basic Rules for LTC DGA interpretation (Chapter 5) – presented by Deanna Woods:
- Chapter 5 contains the 5-letter classification.
- The classification is supplemented by Annex A, which is a list with elementary LTC model names and their classification.
- Text and graphics were added to explain the most meaningful gases/ratios, and how to identify a worsening condition.
- The value of additional data (old data, frequency of operation, …) are explained.
- Chapter 5 will hold the Tables with limit values and 90/95% values, based on the data analysis from TF1. They are meant to give initial orientation, when no individual statistics of a specific LTC population exists.
- Discussion about meaningful ratios. Ratios in the current version of the Guide were revised.
- Bill Whitehead stated that hydrogen is unfavorable in ratios as well as in absolute values, as it is so volatile. It is not helpful to be used in laboratory DGA but gives good information in online DGA diagnostics.

7.4. TF4 Revision of Chapter 6: Interpretation of LTC DGA Data – William Solano reports:
- The existing Result Code was supplemented by a 4th stage “Alarm” – to specify imminent faults. Recommendations for actions should be added.
- Further revisions in Chapter 6 and Annexes C (Case Studies) and D (use of Duval Triangle) to be done.
- Luis Cheim stated that Duval Triangle #2 must be used with caution, as different LTC classes may show their normal gassing outside of the standard “N” zone.
- Toni Mellin presented an example of contour plots, showing the density distribution of data in the Duval Triangle. This could be used to identify the “Normal” area for LTC classes which do not match with the standard “N” zone of Triangle 2. Further work on this is to be done.

8. Presentation by Niklas Gustavsson (Hitachi Energy) on “Gas generation in vacuum on-load tap-changers”
- Questions from customers asking about low levels of hydrogen or acetylene in vacuum tap-changers with very few operations led to investigations to understand the origin of these gases.
- For normal (fault-free) LTC operation, three gas sources were identified:
  a) Generation of low amounts of sparking or arcing gases, caused by internal by-pass or change-over selector contacts.
  b) Retrofit installations where residual, gas-contaminated oil from the traditional arcing-in-oil diverter

remains in the tap-changer compartment, pipes and conservator.
c) Materials used in OLTCs may release or generate gases.

- Laboratory investigations were performed which revealed that polyester laminates, SMC materials and varnishes can emit significant amounts of hydrogen and methane, with values going beyond 100ppm. Additionally, welded steel structures can emit acetylene, resulting from the welding process (~40ppm).
- Brian Sparling added that galvanized steel surfaces may lead to catalytical reactions in combination with dissolved water, producing hydrogen.
- There was a common understanding of the WG to address these gas sources in the Guide.
- Paul Boman stated that, similar to C57.104, a baseline sample prior to energizing the equipment would help to identify such sources. Additional DGA samples during the first year of operation will give additional information.

9. Chairman will retire Nov 30, 2024, but stays under contract with MR until July 2026. Currently examining legal requirements under which sponsoring by MR is possible to continue work in IEEE.
   From now on, email address rainer.f@ieee.org should be used.
10. Meeting was adjourned at 4:30 pm.

Attendees list:

First Name	Name	Affiliation	Status/ Membership Request
Anthony	Alexander	Hitachi Energy	Guest*)
Robert	Allison	Dominian Energy	Guest
Piotr	Blaszezyk	STC	Guest*)
Paul	Boman	The Hartford Steam Boiler	Secretary
Jones	Braxton	SD Myers	Guest
Edward	Casserly	Ergon	Member
Marcelo	Catugas	Neil Service Inc.	Member
Luiz	Cheim	Hitachi Energy	Member
Craig	Colopy	Retired from Eaton	Guest
Roberto	da Silva	MR	Guest*)
Sami	Debass	EPRI	Member
Marco	Espindola	Hitachi Energy	Member
Egui	Espitia	Reinhausen Mfg.	Guest
Florin	Faur	Prolec SPX Waukesha	Member
Zlatan	Fazlic	Camlin Energy	Member
Todd	Felton	MVA Diagnostics	Member
Marcos	Ferreira	Quanta Technology	Member
Marc	Foata	MR	Guest*)
Rainer	Frotscher	MR	Chair
Joshua	Garner	Independant Dielectrics	Guest
Alireza	Gorzin	Black and Veatech	Guest*)
Niklas	Gustavsson	Hitachi Energy	Member
Attila	Gyore	MIDEL	Member
Thang	Hochanh	BC Hydro	Guest*)
Traci	Hopkins	H2Scan	Member
Patrycja	Jarosz	IEEE SA	Guest
Kurt	Kaineder	Trench Austria	Guest
Andreas	Kurz	MR	Guest
Ashwini	Labh	Hitachi Energy	Guest*)
Stefan	Lembacher	Siemens Energy	Guest
Tiffany	Lucas	Prolec SPX Waukesha	Member
Stephanie	Mabrey	AVO Diagnostics	Member
Francis	Mantoan	Siemens Energy	Guest
Lee	Matthews	Howard Ind.	Guest
Mama	Mbouombono	Hitachi Energy	Guest*)
Toni	Mellin	Vaisala	Member
Mark	Newbill	Hitachi Energy	Member
Nick	Perjanik	AVO Diagnostics	Member
John	Pruente	Prolec SPX Waukesha	Vice Chair
Sebastian	Rehkopf	MR	Member
Mickel	Saad	Hitachi Energy	Member

Jesus	Sanchez …?	Voltyx	Guest
Alfons	Schrammel	Siemens Energy	Guest
Jonathan	Sinclair	Black and Veatech	Member
William	Solano	Voltyx	Member
Brian	Sparling	Kinetrics	Guest*)
Daniel	Weyer	Monolith	Member
Leon	White	Hedrich	Guest
Bill	Whitehead	H2Scan	Member
Kayla	Whitesel	DeltaX Research	Guest*)
Christopher	Whitten	Hitachi Energy	Member
Deanna	Woods	Prolec GE Waukesha	Member
Shuzhen	Xu	FM Global	Guest
Joshua	Yun	Virginia Transformer Corp.	Member
Peter	Zhao	Hydro One	Guest

*): requesting membership