Workshop
Study Committee D1

Frontiers in Partial Discharge (PD) Diagnostics

U. RIECHERT (Session Chair, Advisory Group D1.02: High Voltage and Current Testing and Diagnosis), G. BEHRMANN, W. KOLTUNOWICZ, M. BELTLE, L. HÖFER, A. CAVALLINI, N. MAHATHO, TIAN LAN

Time: **Tuesday 25 August 2026 | 14:00–17:00**
Location: **Palais des Congrès de Paris**
2 Place de la Porte Maillot 75017 Paris
Room: **Regency 15 (location see page 9-10)**

CIGRE Sessions

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One of the most effective means of testing insulation systems in high-voltage/high-field electrical systems is using partial discharge (PD) measurement; it is often the case that PD measurement is the only effective means of determining the health of the insulation system while energized. The detection and analysis of PD are among the fundamental measurements performed on high-voltage components and have a long history. Due to the continuous advancement of PD applications under both laboratory and field conditions, there is an ongoing need to support this technology with guidelines for PD detection and testing which describe both proven and new methodologies.
As a result, PD measurement has become a globally recognized method for insulation diagnosis and a
mandatory part of acceptance testing for most AC high-voltage installations. Furthermore, this diagnostic method is also gaining importance in the MV sector, HVDC installations, and power electronics/drives.
In this workshop, we aim to present the current state of knowledge from a CIGRE perspective, with a focus on current trends, new applications, and new technical approaches, all combined with insights from the field of standardization.

Program

14:00 – 14:05	**Opening / Session Chair** ***Uwe Riechert, Hitachi Energy, CIGRE SC D1, Switzerland***
	Program Part 1 – Standardization
14:05 – 14:30	**PD Measurement: The Need for Standardization** ***Glenn Behrmann, High Voltage Testing and Engineering Commission of Switzerland, IEC TC 42, CIGRE D1.78, Switzerland***
	Program Part 2 - Equipment
14:30 – 14:55	**Requirements and application of UHF partial discharge monitoring systems for GIS** ***Wojciech Koltunowicz, OMICRON Energy Solutions GmbH in Berlin, CIGRE D1.66, Germany***
14:55 – 15:15	**Advances in PD measurement on Power Transformers** ***Michael Beltle, University of Stuttgart High Voltage Laboratory, Institute for Power Transmission and High Voltage Technology (IEH), CIGRE JWG A2/D1.51, Germany***
15:15 – 15:25	**Coffee Break**
	Program Part 3 - New Applications / Methods
15:25 – 15:45	**Partial Discharge Detection under DC voltage stress** ***Lucas Höfer, PFISTERER Kontaktsysteme GmbH, CIGRE WG D1.63, Germany***
15:45 – 16:05	**PD measurement on insulation systems stressed from HV power electronics** ***Andrea Cavallini, Dept of Electrical, Electronic, and Information Engineering "Guglielmo Marconi" Bologna, CIGRE D1.74, Italy***
16:05 – 16:25	**Optical Corona Measurement and Detection** ***Nishal Mahatho, Eskom, Research, Testing & Development, CIGRE D1.61, South Africa***
16:25 – 16:35	**Optical Spectral Sensing for Partial Discharge Detection in Gas-Insulated Equipment** ***Tian Lan, Department Leader of Intelligent Sensing and Measurement at GEIRI Europe GmbH, Berlin, CIGRE D1.83, China***
16:35 – 16:50	**PD behavior of SF6-alternative gases using a new compact test-cell** ***Glenn Behrmann, High Voltage Testing and Engineering Commission of Switzerland, IEC TC 42, CIGRE D1.78, Switzerland***
16:50 – 17:00	**Discussion** ***Uwe Riechert, Hitachi Energy, CIGRE SC D1, Switzerland***

Summary of Presentations / Abstracts

Opening

Opening and Session Chair

Uwe Riechert, Senior Principal Engineer, Hitachi Energy, CIGRE SC D1, IEC TC 122, IEC TC 17C, Switzerland

Uwe Riechert earned his Ph.D. in 2001 from the Technical University of Dresden with a thesis on polymer-insulated HVDC cables. He has been with ABB Switzerland, now Hitachi Energy, since 1999. He works as senior principal engineer and project manager for gas-insulated HVDC and HVAC substations and circuit-breaker. Uwe Riechert is a member and project / working group leader of different CIGRE and IEC working groups. He currently chairs the CIGRE AG D1.02 advisory group 'High Voltage and Current Testing and Diagnosis', IEC TC 122 WG 3 'UHV AC transmission systems: Commissioning', and IEC TC 17C / MT42 'DC gas-insulated metal-enclosed switchgear for rated voltages including and above 100 kV' as well as national committees in Germany and Switzerland (DKE and CES).

Part 1 - Standardization

PD Measurement: The Need for Standardization

Glenn Behrmann, High Voltage Testing and Engineering Commission of Switzerland, IEC TC 42, CIGRE D1.78, Switzerland

The operational and ‘remote’ nature of PD measurement, the stochasticity of the PD signal itself and the persistent difficulties with interference combine to make it a complex undertaking.
Yet customers and manufacturers use PD measurements to assess the quality of insulation systems – indeed, they are often the basis for accepting or rejecting those systems.
This presentation looks at the nature of the PD signal and its measurement to highlight both the need for standardization and some of the guidance available to workers in the field.

Glenn Behrmann (S’78, M’79, L’24) received the BSEE from Union College, Schenectady, New York, in 1979. He began working in RF engineering and mixed signal processing at MIT Lincoln Laboratory in Lexington, Massachusetts. In 1992 he began his work in partial discharge at ABB Corporate Research in Baden, Switzerland under Bernhard Fruth and Lutz Niemeyer, then at ABB High Voltage Technology in Zurich. He has worked over 20 years in PD measurement and monitoring on GIS and rotating machines at ABB/Hitachi, Alstom (now GE), and now at the FKH (High Voltage Testing and Engineering Commission) using conventional, UHF, and acoustic techniques. Along with patents, papers, and other work (D1.37, JWG D1/B3.57, D1.63, IEEE 2426, IEC 61869-1, CIGRE WG C4.45), he coauthored the IEEE/Wiley book 'Practical Partial Discharge Measurement on Electrical Equipment'. He currently chairs IEEE PES/SA P454, is Co-Secretary of CIGRE D1.78, and Secretary of IEC TC42 MT14 (IEC TS 62478) and MT23 (IEC 60270).

Part 2 – Equipment

Requirements and application of UHF partial discharge monitoring systems for GIS

CIGRE TB 933

Wojciech Koltunowicz, OMICRON Energy Solutions GmbH in Berlin, CIGRE D1.66, Germany

This Technical Brochure prepared by CIGRE WG D1.66 presents new drivers and expectations for condition monitoring systems as well as the hardware and software requirements of modern UHF PD Monitoring (PDM) systems. It is based on abundant collected knowledge from the field combined with understanding the expectations and needs of end-users. A PDM system should reliably detect, monitor, and interpret the signals from incipient malfunction PD defects, so that asset managers can take prompt and appropriate actions to prevent equipment failure. This TB provides technical guidance for more effective use of UHF PDM systems. A novel alert procedure as one of the most pressing challenges facing PDM systems is presented to significantly reduce the number of false alarms. It recommends using the results from the CIGRE TB 654 UHF sensitivity check.

Wojciech Koltunowicz received his M.S., PhD and Dr. habil. degrees in electrical engineering from the Warsaw University of Technology in 1980, 1985 and 2004 respectively. From 1987 to 2007, he worked at CESI in Italy, where he was mainly involved in the HV testing and diagnostics of electrical equipment. In 2007, he joined OMICRON Energy Solutions GmbH in Berlin, Germany, where he is involved with the monitoring of HV equipment. He is convenor of CIGRE WG D1.66 and a member of CIGRE Advisory Group (AG) D1.02 "High voltage and current testing and diagnostic" and AG D1.04 "Insulating Gases". He is also a member of IEC TC42 (MT14) and senior member of IEEE.

Advances in PD measurement on Power Transformers

CIGRE TB 861

Michael Beltle, University of Stuttgart High Voltage Laboratory, Institute for Power Transmission and High Voltage Technology (IEH), CIGRE JWG A2/D1.51, Germany

CIGRE Technical Brochure 861 reviews recent advances in partial discharge (PD) measurement on power transformers. Best practice recommendations for charge-based PD measurement according to IEC 60270 are presented. The electromagnetic (UHF) method is introduced, addressing its advantages and inherent challenges, with particular focus on a proposal for the UHF calibration procedure required to ensure reproducible results. The advantages of a combination of both charge-based and UHF PD measurement is discussed, leveraging the strengths of both methods for Factory and Site Acceptance Tests of power transformers.

Dr.-Ing. Michael Beltle studied electrical engineering at the University of Stuttgart and received his PhD in 2022 on the topic on mechanical vibrations on power transformers. He is an active member of CIGRE and contributes to different working groups including the here presented TB 861. Currently, he is involved in research regarding partial discharges in alternative gases (WG D1.78) and power electronics (D1.74). Since 2017 he is responsible for the HV-Laboratory of the University of Stuttgart and is head of the research group electromagnetic compatibility (EMC) at the Institute of Power Transmission and High Voltage Technology. He is also member of the German chapter of IEC and active in different standard maintenance teams (MT).

Part 3 – New Applications / Methods

Partial Discharge Detection under DC voltage stress

CIGRE WG D1.63

Lucas Höfer, PFISTERER Kontaktsysteme GmbH, CIGRE WG D1.63, Germany

Partial discharge measurements are a trusted and proven tool for health diagnosis of AC apparatus for decades. Under DC voltage, there is no phase. This leads to an “irregular” appearance of the partial discharge events and hides the fault type as there is no phase correlation possible. Additionally, under DC voltage stress different types of discharges appear**,** and the impulse polarity gives location hints.
The WG D1.63 discussed and presented the physics behind the DC partial discharges in general as well for the relevant insulation material families solids (mainly XLPE), liquids and pressurized gases.

Lucas Höfer studied Electrical Engineering and Information Technology at the Technical University of Munich, focusing on Electrical Drives, Power Systems and High Voltage Technology from 2008 to 2013. From 2014 to 2019 he worked with the chair of High Voltage Technology on the research field of partial discharges under DC voltage stress under the supervision of Professor Kindersberger. He was Member of CIGRÉ WGs D1.55 and D1.63.
He joined the R&D team at PFISTERER in Winterbach, Germany in 2019, where he continued his research activities on HVDC, more focusing on material topics. His additional areas of interest are thermal distribution and optimization of HV apparatus, general interface optimization and dry terminations.

PD measurement on insulation systems stressed from HV power electronics

CIGRE WG D1.74

Andrea Cavallini, Dept of Electrical, Electronic, and Information Engineering "Guglielmo Marconi" Bologna, CIGRE D1.74, Italy

The presentation will review PD measurements on electrical systems fed by power electronics. The review will focus on the applicability of AC voltage waveforms versus impulsive waveforms and on the feasibility of using different types of sensors.

Andrea Cavallini is a full professor at the University of Bologna. His main research interests are focused on partial discharge phenomena. He is active in the IEEE DEIS (Adcom member, Transport Electrification technical committee chair, Education committee chair, DEIS Italy chapter chair), CIGRE, IEC TC 2 MT 10 (Italian representative), and SAE. He is an IEEE Fellow.

Optical Corona Measurement and Detection

CIGRE D1.61

Nishal Mahatho, Eskom, Research, Testing & Development, CIGRE D1.61, South Africa

This work works by examining the application of optical corona detection as a diagnostic tool. Contributions from multiple regions were consolidated and supported by a coordinated round-robin test (RRT), conducted to evaluate the consistency and comparability of measurements under controlled conditions.
The study confirms that optical corona detection is best applied as a qualitative or comparative diagnostic tool, rather than as an absolute measure of discharge severity. It highlights the need for improved standardisation of test procedures, environmental normalisation, and data reporting practices to enhance the reliability and comparability of results. Such developments are necessary to support the broader adoption and effective use of optical corona diagnostics in high-voltage asset management.

Nishal Mahatho holds a Master of Science in Electrical Engineering from the University of Witwatersrand, Johannesburg. He has been in the employment of Eskom, Research, Testing & Development since 1996 and currently holds the position of Transmission Research Manager, focusing on the development and execution of research and strategies for the National Transmission Company. He also specializes in insulator research, system performance, UAV and robotics inspections. He is a member on a number of CIGRE working groups and is convener of WG D1.61 - Optical corona detection and measurement, and B2.74 on UAV for Powerlines. He has authored a number of national and international papers, is an active IEEE reviewer, registered as a professional with the Engineering Council of South Africa (ECSA) and also currently a Senior Member of the South African Institute of Electrical Engineers (SAIEE).

Optical Spectral Sensing for Partial Discharge Detection in Gas-Insulated Equipment

CIGRE WG D1.83

Tian Lan, Department Leader of Intelligent Sensing and Measurement at GEIRI Europe GmbH, Berlin, CIGRE D1.83, China

This presentation provides an overview of optical sensing technologies for partial discharge and arc detection in electrical equipment, covering their fundamental principles, implementation approaches, and the performance of existing commercial solutions. It also highlights GEIRI Europe’s latest developments and practical applications in photon detection.

Dr.-Ing. Tian Lan is Department Leader of Intelligent Sensing and Measurement at GEIRI Europe GmbH in Berlin. His research focuses on intelligent sensing and condition monitoring for high-voltage and HVDC equipment, particularly optical, UHF and acoustic partial discharge detection, SiPM-based weak-light sensing and multimodal diagnostics. He has led multiple international R&D projects with European universities, Fraunhofer institutes and industrial partners. He received his Dr.-Ing. degree from Technische Universität Berlin.
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PD behavior of SF6-alternative gases using a new compact test-cell

CIGRE WG D1.78

Glenn Behrmann, High Voltage Testing and Engineering Commission of Switzerland, IEC TC 42, CIGRE D1.78, Switzerland

The CIGRE D1.78 working group is planning extensive round-robin tests examining partial discharge (PD) behavior of non-SF6, environmentally friendly insulating gases and gas mixtures using charge-based (IEC 60270), UHF, and other PD measurement methods. Here we present the key questions we want to answer, the main goals, selection of defects, and experimental parameters for a series of round-robin tests being carried out. We present a newly developed, compact PD test-cell and some initial results for three typical GIS PD defect types: needle-plane, free-moving (‘hopping’) particle, and ‘particle-on-insulator’.

Glenn Behrmann (S’78, M’79, L’24) received the BSEE from Union College, Schenectady, New York, in 1979. He began working in RF engineering and mixed signal processing at MIT Lincoln Laboratory in Lexington, Massachusetts. In 1992 he began his work in partial discharge at ABB Corporate Research in Baden, Switzerland under Bernhard Fruth and Lutz Niemeyer, then at ABB High Voltage Technology in Zurich. He has worked over 20 years in PD measurement and monitoring on GIS and rotating machines at ABB/Hitachi, Alstom (now GE), and now at the FKH (High Voltage Testing and Engineering Commission) using conventional, UHF, and acoustic techniques. Along with patents, papers, and other work (D1.37, JWG D1/B3.57, D1.63, IEEE 2426, IEC 61869-1, CIGRE WG C4.45), he coauthored the IEEE/Wiley book 'Practical Partial Discharge Measurement on Electrical Equipment'. He currently chairs IEEE PES/SA P454, is Co-Secretary of CIGRE D1.78, and Secretary of IEC TC42 MT14 (IEC TS 62478) and MT23 (IEC 60270).

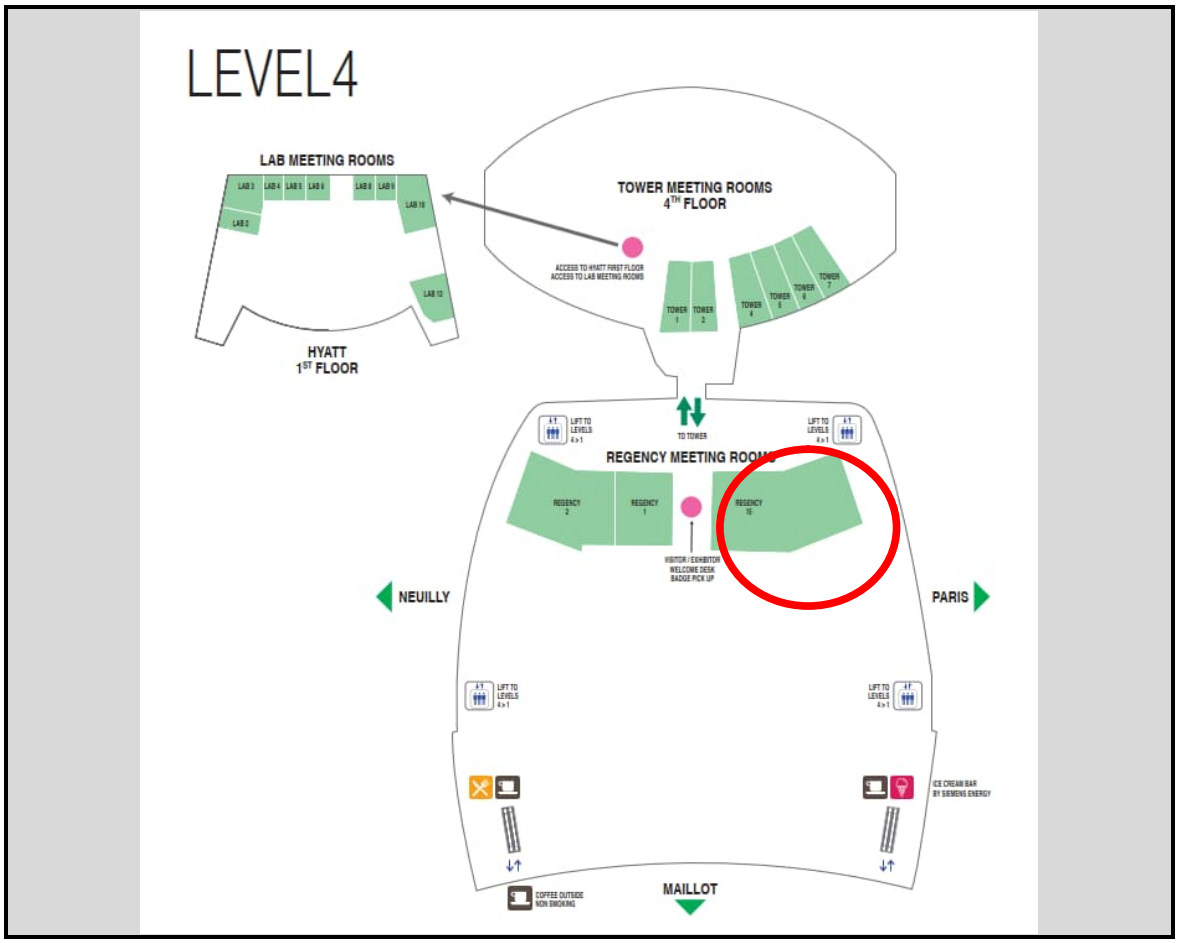
SC D1 Agenda

During the CIGRE week there are many opportunities to participate in the activities of SC D1, including one tutorials, a workshop and a joint workshop, the poster session and Group Discussion Meeting (GDM). The poster session is your opportunity to meet the authors of the Session papers and discuss their work. The GDM is where the questions posed in this Special Report are discussed; anyone is free to contribute, and we encourage you to do so.

Here is a brief summary of the SC D1 activities to help you plan your week:

Date	Time	Room	Description
24/08/26	08:30 – 12:30	Halle Ternes	**Poster Session**
25/08/26	08:30 – 10:30	Room 342AB	**Joint Workshop** A3/B3/D1 SF6 replacement and alternatives
25/08/26	10:40 – 12:30	Bordeaux	**Tutorial** Latest developments of test methods for polymeric insulating materials under high-voltage outdoor conditions
25/08/26	14:00 – 17:00	Regency 15	**Workshop** Frontiers in PD Diagnosis
26/08/26	08:45 – 18:00	Havane	**Group Discussion Meeting (GDM)**

Room location



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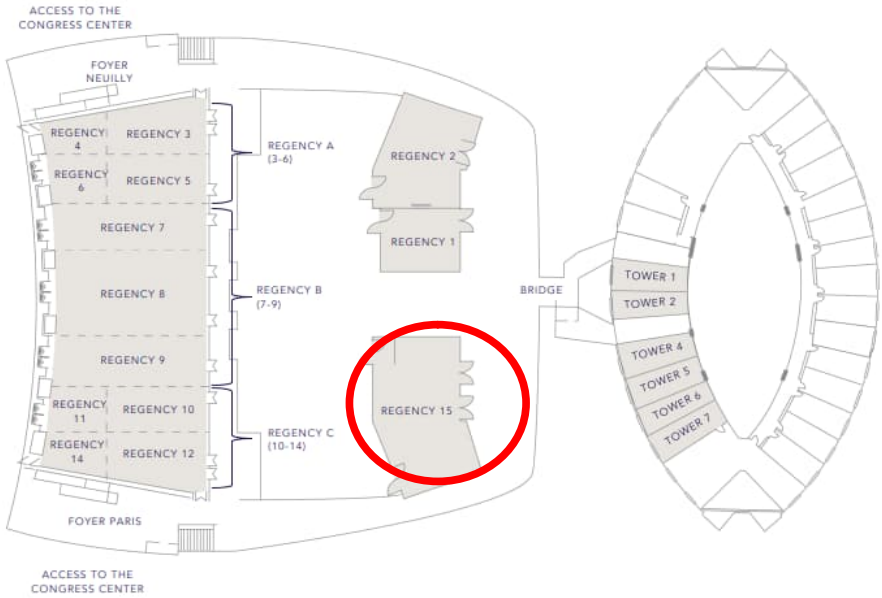

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