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OFIL SYSTEMS

# NEWSLETTER

## In this newsletter:



Previous Newsletters

OFIL ACADEMY

### Electrical Utilities Course

For electrical utilities, grid reliability is everything. Detecting and analyzing Corona Partial Discharge (PD) early can prevent costly failures and extend asset lifespan. Gain industry-recognized UVographer Certification and take your expertise to the next level!

📍 **Location: USA**
📅 **Date: September 23-25**

### Rotating Machines Course

CITI training course focused on Partial Discharge detection in rotating machines, taught by industry expert Dr. Nancy Frost. This course is designed to equip professionals in rotating machines repair & manufacturing, power generation, and electric vehicles with critical insights into PD theory, failure mechanisms, and hands-on detection techniques.

📍 **Location: Online**
📅 **Date: September 15–18**
**(~4 hours per day)**

Registration on our website

# Powering the Digital Backbone: Why Electrical Resilience and Predictive Maintenance Are Mission-Critical for Data Centers

IIn the digital era, data centers have become an essential infrastructure, supporting critical services such as cloud computing, artificial intelligence, financial transactions, and public-sector operations. As operators expand capacity and deploy increasingly power-intensive workloads, electricity consumption is rising sharply. This places significant pressure on the entire electrical infrastructure, from incoming utility feeds and HV transformers to switchgear, circuit breakers, cables, generators and UPS systems.
In the United States alone, data centers accounted for approximately 4.4% of total electricity consumption in 2023, with projections suggesting this could rise to 6.7–12% by 2028 (U.S. Department of Energy). Modern facilities consume up to 50 times more electricity per square foot than conventional buildings, making uninterrupted power supply both a technical and strategic priority.

**The Expanding Power Footprint of Data Centers**
At the core of a data center's electrical infrastructure lies a complex sequence of high-voltage and medium-voltage systems designed to reliably step down, distribute, and condition power. Utility-scale high-voltage lines feed on-site substations and large step-down transformers, often custom-built with long procurement lead times. These transformers convert power from 138–345 kV to medium-voltage levels (typically 11–33 kV). From there, MV switchgear distributes power to transformers feeding LV switchgear, PDUs, and eventually racks of IT equipment.

Critical components along this path include:

- **HV and MV Transformers**, which serve as the backbone of voltage conversion.
- **MV Switchgear and Circuit Breakers**, providing controlled distribution and protection.
- **High-Voltage Cables and Busbars**, connecting assets across long distances and high current loads.
- **LV Systems and UPS Modules**, ensuring short-term power stability and clean switchover
- **Generators**, providing long-duration backup power during utility outages and forming the foundation of redundant power architecture.

### The Role of AI in Driving Power Demand

A major contributor to the accelerating electricity demand is the rapid growth of AI workloads. Training large-scale AI models and running inference at scale require massive computing resources, often relying on high-density GPUs or specialized AI accelerators that draw significantly more power than traditional CPUs. AI-driven applications such as generative models, real-time analytics, and autonomous decision-making systems are now deployed across sectors, further increasing the energy intensity of data centers.

As AI adoption grows, so does the need for robust and scalable power infrastructure capable of supporting higher densities and continuous uptime.

In this context, the reliability of the entire electrical backbone—including on-site substations, HV and MV transformers, switchgear, circuit breakers, cables, generators and UPS systems—becomes not only a technical concern but a business-critical priority. Failures at any point in the power chain can result in service outages, equipment damage, and substantial financial losses.

This growing threat highlights the need for joint resilience planning between utilities and data center operators, along with smarter, predictive maintenance practices to reduce preventable failures and ensure power continuity in an increasingly AI-driven world.

### The High Cost of Power Failures in Data Centers

**52%**
of major data center outages are power-related
– *Uptime Institute*

**$740,000+**
Average cost of an unplanned outage
$1 million+ for major events
– *U.S. Department of Energy*

**$10M–$1B+**
in downtime losses reported in recent years by: Amazon, Facebook, Alibaba and others

### Predictive Maintenance: A Frontline Defense

While long-term grid resilience is essential, predictive maintenance of on-site electrical systems offers the most immediate and cost-effective defense. Traditional inspections are no longer sufficient in an environment where even minutes of downtime can cost hundreds of thousands or even millions of dollars.

Predictive strategies use advanced diagnostics to detect emerging faults before they escalate. Among the most critical indicators are partial discharge (PD) and arcing activity, both early signs of deterioration in high-voltage and medium-voltage systems.

This is where **OFIL's solar-blind UV cameras** come into play. Unlike thermal imaging, which detects issues only after heat has built up, OFIL's cameras reveal PD and arcing in their earliest stages. They work in full daylight and without requiring any equipment shutdown. In generators, the cameras can identify insulation degradation and faults in windings, supporting uninterrupted generator availability during utility failures.

When combined with **OFIL's Gridnostic platform**, operators gain a powerful diagnostic ecosystem that:

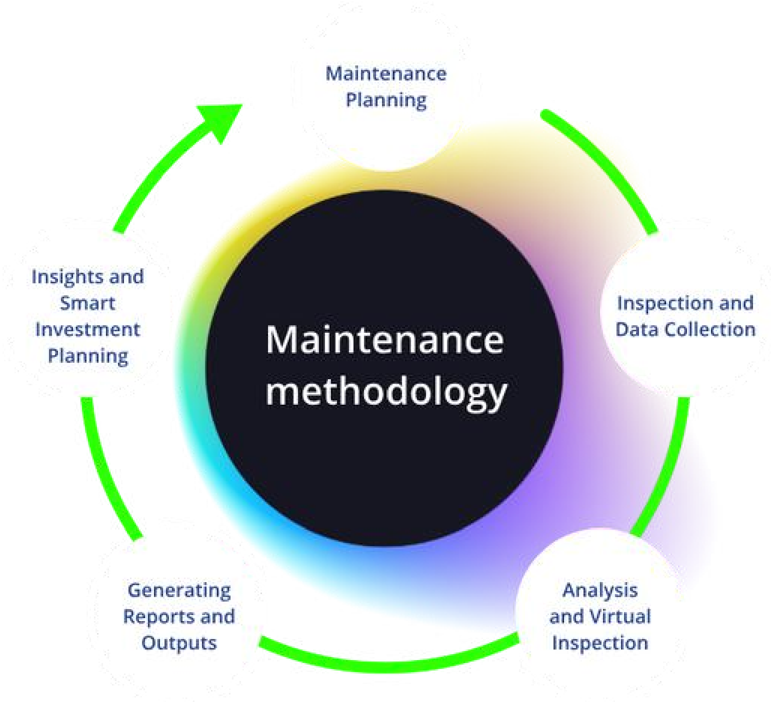
- Assigns severity scores and trends based on historical and multi-sensor data.
- Supports prioritized maintenance planning and resource allocation.
- Helps reduce risk and extend asset life.

**Conclusion: Preventing the Avoidable**

As digital infrastructure continues to grow, the tolerance for unplanned downtime shrinks. Substations and other HV/MV components, such as switchgear, transformers, cables, and generators are both critical vulnerabilities and strategic opportunities.

By adopting predictive inspection technologies like OFIL UV cameras and the Gridnostic platform, data center operators gain early fault detection, continuous condition monitoring, and actionable insights that protect both uptime and reputation.

In a world where power stability is mission-critical and outages can cost millions; proactive substation management is no longer optional - it's essential.



# Detecting Partial Discharge in EV Motors: The Hidden Challenge of PWM Inverters

As electric vehicles (EVs) evolve to deliver higher power density, efficiency, and compact designs, one challenge remains largely unseen—partial discharge (PD) in motor insulation systems. PD is a localized electrical breakdown that does not immediately cause failure, but over time, leads to insulation degradation, unexpected motor breakdowns, and expensive downtime.

**What Are Adjustable Speed Drives, IGBT-Based PWM Inverters, and Their Impact on Motor Insulation?**

Modern electric vehicles rely on adjustable speed drives (ASDs), also known as variable frequency drives (VFDs), to control motor speed and torque efficiently. These drives include a crucial component called a pulse-width modulation (PWM) inverter, often built using insulated-gate bipolar transistors (IGBTs), which converts DC battery power into AC with precisely controlled voltage and frequency.

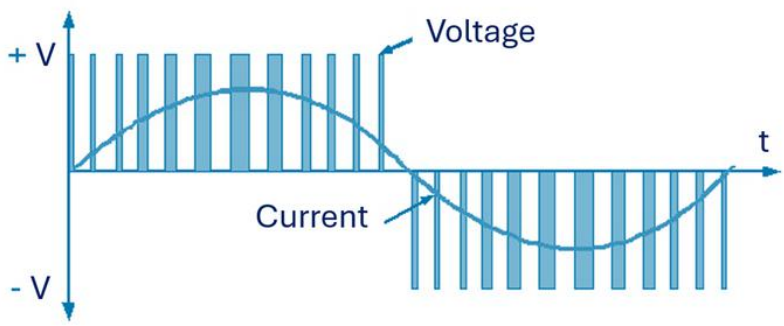
While PWM inverters enable efficient motor operation, the use of IGBTs introduces fast switching frequencies and steep voltage rise times (high dv/dt), which create electrical stresses that challenge motor insulation systems. These stresses significantly increase the risk of partial discharge within motor windings, especially as application voltages and switching speeds continue to rise.

**Why is PD a Growing Concern in EV Motors?**

Unlike traditional AC motors, EV motors driven by PWM inverters experience:

- Uneven voltage distribution across motor windings, leading to insulation breakdown.
- Higher likelihood of PD inception under fast switching transients compared to sinusoidal AC voltages.
- Accelerated insulation aging as PD activity increases with switching frequency and dv/dt.

Studies show that under PWM voltage, PD does not behave the same as it does under AC supply. PD pulses often occur near switching events, making traditional offline or sinusoidal AC-based testing insufficient for real-world insulation assessment.



**Why is Traditional PD Detection & Measurement Challenging Under PWM?**

Detecting PD in PWM-driven motors is technically demanding due to:

- **Switching noise masking PD signals**: The electrical noise generated by fast inverter switching is often orders of magnitude stronger than PD pulses.
- **Sensor limitations**: Conventional electrical or acoustic PD sensors can become saturated or fail to distinguish PD from switching transients.
- **Limited visibility of internal defects**: Some detection methods require controlled environments or cannot detect PD occurring inside insulation layers.

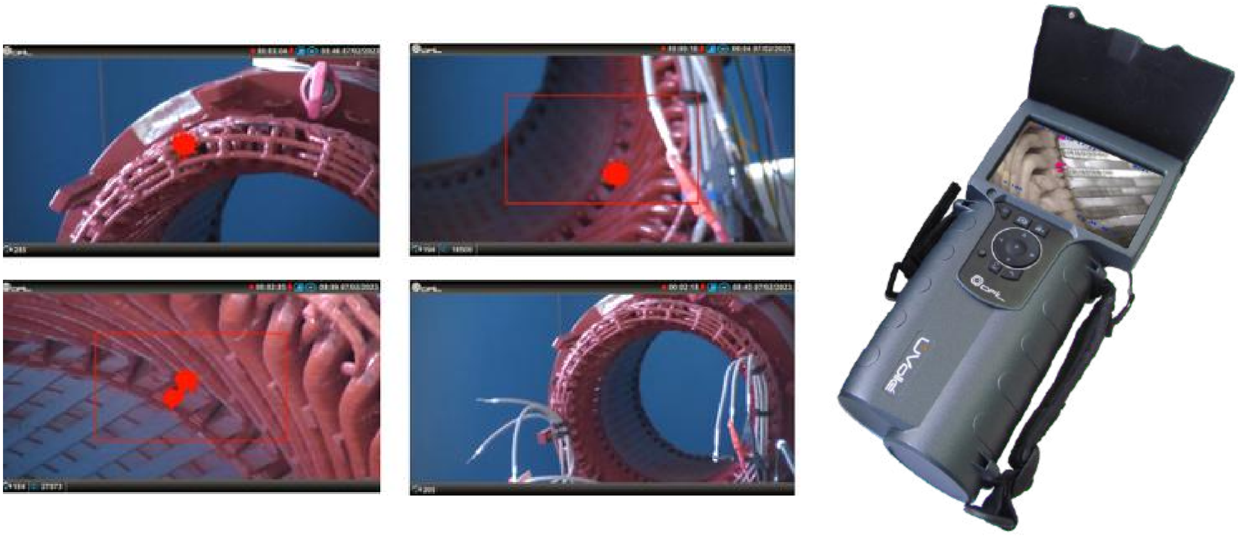
Researchers are exploring advanced filtering, high-pass UHF antennas, and optical methods to overcome these limitations, but each comes with constraints in practicality, cost, and implementation complexity.

**A Unique Approach: UV Imaging for PD Detection**

Unlike electrical sensors, UV cameras detect the ultraviolet light emitted by corona and surface PD discharges - a method immune to electromagnetic interference from inverter switching. Solar-blind UV cameras:

- **Bypass switching noise completely**, delivering clear, unambiguous detection results.
- Provide **visual pinpointing of discharge locations**, aiding in targeted repairs and condition assessments.
- Operate effectively in **daylight** and do not require system shutdowns or blackout tests.

UV imaging provides a powerful, non-contact method for identifying surface and corona PD - critical for preventing early-stage insulation degradation.



**Moving Forward**

With the shift towards high-voltage, fast-switching powertrains in EVs, PD detection is no longer optional. Integrating reliable, noise-immune detection tools like UV cameras alongside electrical measurement systems offers manufacturers a more complete insulation health assessment strategy.

# Pinpointing Corona Discharge: Why Accurate Localization with UV Cameras Matters

In high-voltage systems—whether overhead lines, substations, switchgear, or rotating machines—partial discharge (PD), and specifically corona discharge, often serves as one of the earliest indicators of insulation degradation. Detecting corona is important, but without knowing exactly where it occurs, the insight has limited operational value. Effective maintenance requires accurate pinpointing of the discharge source to assess risk, determine corrective action, and minimize unnecessary downtime.

### Why Precise Pinpointing Is Essential

- **Determine Operational Risk**: The exact location of corona PD activity directly influences how urgent the response should be. Discharge on an arcing horn or metal fitting may require monitoring, while activity on a bushing interface, or insulator sheath could signal an impending failure that demands immediate attention.
- **Enable Focused Maintenance**: Identifying the precise component and the specific area affected - such as the top disc of an insulator string or the sealing end of a bushing—allows teams to address the root cause without broad exploratory work. This leads to shorter outages, reduced labor time, and more confident decision-making.
- **Enable Trend Analysis**: Precisely locating the discharge allows for consistent monitoring of specific fault locations over time, supporting predictive maintenance strategies.
- **Avoid Misleading Signals**: Many PD detection methods rely on indirect signals that can reflect, couple, or propagate, resulting in uncertainty. Only a direct visual confirmation at the emission site eliminates ambiguity.

### True Pinpointing vs. Area-Based Detection

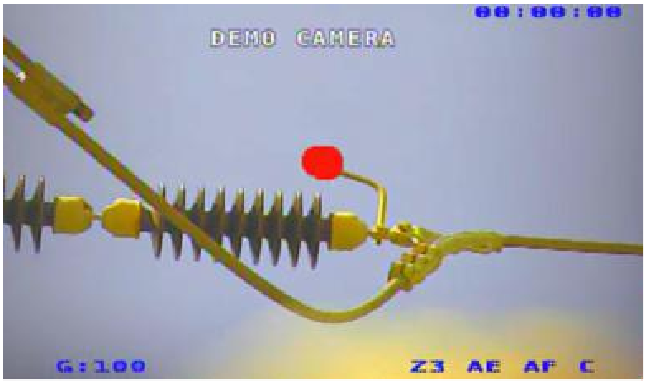
Some technologies offer only regional detection—identifying general zones or components that may be affected, which often still requires a follow-up UV inspection to find the actual fault. In contrast, solar-blind UV cameras detect ultraviolet photons emitted directly from corona activity, delivering spatially precise, real-time imagery that highlights the exact fault location.

### Corona PD on Bushing Seal

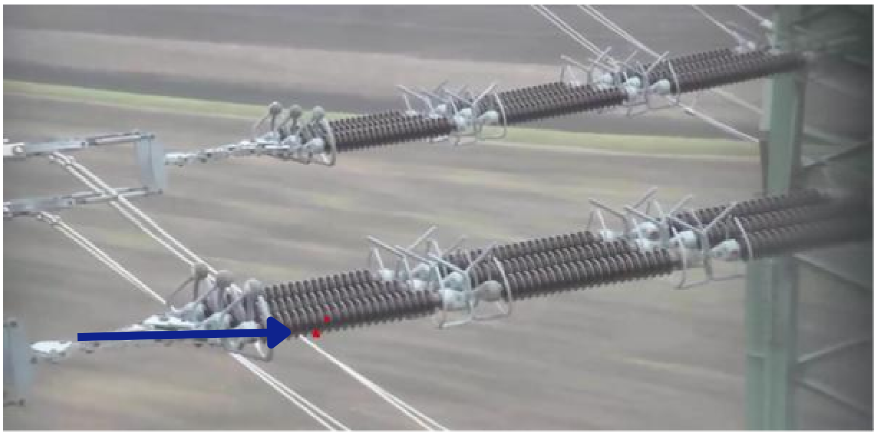
Discharge detected around the sealing area of a bushing suggests degradation of the seal. This can allow moisture ingress, increasing the risk of internal failure or flashover.

**Corona PD on Circuit Breaker Collar**
Corona seen around the metal collar of a circuit breaker, especially where the cement has degraded or cracked, points to compromised insulation or poor bonding.
This may lead to further surface erosion or internal partial discharges.


**Corona PD on Arcing Horn**
Corona activity on the arcing horn is generally acceptable and does not require intervention. However, if the discharge is detected on the insulator sheath or individual sheds, it may indicate insulation degradation or surface contamination, which can progress into more serious faults if not addressed.




**Corona PD on Specific Insulator Sheds**
Localized corona discharge on two specific sheds of an insulator highlights early-stage deterioration or contamination.



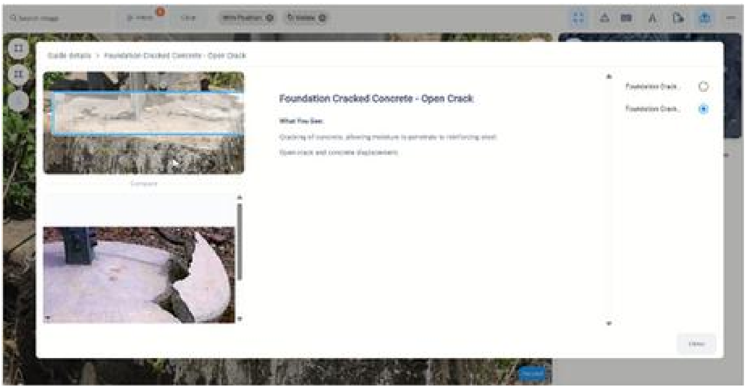
**Conclusion**
When every minute of unplanned downtime carries a high price, the ability to accurately pinpoint corona partial discharge makes solar-blind UV cameras indispensable. For utilities, manufacturers, and industrial operators, integrating true pinpointing UV imaging into inspection workflows helps extend asset life, improve system reliability, and optimize resource use.

# Introducing EPRI Inside: Trusted Guidance Built into Gridnostic

Gridnostic's Severity Diagnostic tool just got smarter - with EPRI Inside, you now have direct access to trusted EPRI reference material as part of your evaluation workflow.
As you go through the severity assessment, you'll see relevant images, explanations, and examples pulled from Electric Power Research Institute (EPRI) guidelines - the gold standard in the electrical utility world.

For example, when evaluating a cracked concrete foundation, you'll be presented with EPRI's visual references for tight crack vs. open crack, including clear descriptions of each case.


You can even compare your own inspection image side-by-side with EPRI's example, helping you choose the most accurate match.




**Why this matters:**

- You don't need years of experience to make informed decisions, the built-in examples help you confidently evaluate even unfamiliar cases.
- It supports technicians across different experience levels, especially valuable with the growing skill gap and workforce turnover in utilities.
- Your team works with more consistency, following the same reference points across regions and crews.
- The process becomes faster, more intuitive, and aligned with industry standards, no more flipping through manuals or second-guessing decisions.

With **EPRI Inside**, you're not just checking boxes — you're making expert-informed decisions, every time.

Gridnostic

EPRI ELECTRIC POWER RESEARCH INSTITUTE

# OFIL Selected to Lead Tutorial at IEEE ECCE 2025:

## Rotating Machines: Insulation and Partial Discharge Inspection Full-Day Tutorial – October 2025

OFIL is proud to announce its selection to lead a full-day technical tutorial at the prestigious IEEE Energy Conversion Congress and Exposition (ECCE) 2025.
The tutorial, titled "Rotating Machines: Insulation and Partial Discharge Inspection," will be delivered by Dr. Nancy Frost and OFIL's CTO, Eran Frisch.

This tutorial provides an in-depth overview of insulation systems and partial discharge behavior in high, medium and low-voltage rotating machines. It covers insulation design, material types, PD mechanisms, PD detection and measurement methods, and the conditions that lead to PD activity, combining theoretical concepts with practical techniques for detection, measurement, and interpretation.

The program combines expert-led lectures, real-world case studies, and a live demonstration of UV camera use, enabling participants to recognize early-stage faults and adopt proactive inspection strategies. Whether in machine design, quality assurance, commissioning, or in-service maintenance, this tutorial equips engineers, reliability specialists, and asset managers with the skills and insights needed to prevent costly failures, optimize machine performance, and extend asset life.

**Instructors:**

**Dr. Nancy Frost** is a distinguished expert in electrical engineering with a Ph.D. from Clarkson University. She is the President of Frosty's Zap Lab, LLC, specializing in dielectric materials and high voltage testing. Dr. Frost has extensive experience in the field, having held significant positions at General Electric R&D Center, Gerome Technologies, Von Roll, Krempel, and Metsco Energy Solutions. Her research focuses on dielectric material aging, high voltage testing, and insulation systems for motors and generators.

**Eran Frisch**: Eran is serving as the CTO at OFIL. With a strong background in physics and electro-optics engineering, Eran has been pivotal in advancing our understanding of PD and its impact on electrical insulation systems. His expertise and dedication have significantly contributed to the development of innovative solutions for PD detection and mitigation.

ECCE 2025

IEEE ENERGY CONVERSION CONGRESS & EXPO PHILADELPHIA, PA, USA OCT. 19-23