

## Prysmian PRYCAM™

Innovative wireless technology for  
Partial Discharge diagnosis services



## Linking the future

As the worldwide leader in the cable industry, Prysmian Group believes in the effective, efficient and sustainable supply of energy and information as a primary driver in the development of communities.

With this in mind, we provide major global organizations in many industries with best-in-class cable solutions, based on state-of-the-art technology. Through two renowned commercial brands – Prysmian and Draka – based in almost 50 countries, we're constantly close to our customers, enabling them to further develop the world's energy and telecoms infrastructures, and achieve sustainable, profitable growth.

In our energy business, we design, produce, distribute and install cables and systems for the transmission and distribution of power at low, medium, high and extra-high voltage.

In telecoms, the Group is a leading manufacturer of all types of copper and fibre cables, systems and accessories – covering voice, video and data transmission.

Drawing on over 130 years' experience and continuously investing in R&D, we apply excellence, understanding and integrity to everything we do, meeting and exceeding the precise needs of our customers across all continents, at the same time shaping the evolution of our industry.

## What links power grids to sustainability?

**From Asia-Pacific to the Americas, and from Europe to the Middle East to Africa, Prysmian cable solutions sit at the heart of the development of power grids worldwide, helping major utilities in transmitting and distributing power to their customers.**

**Unmatched in our manufacturing capabilities and with an unwavering commitment to R&D, we design, produce and install low, medium, high and extra-high voltage underground and submarine cables and systems, along with network components and value-added engineering services.**

**Always aware of the need to minimize our impact on the planet, we're constantly driving innovation in our industry, aiming to optimize supply chain processes, reduce total cost of ownership for our customers and help them achieve sustainable, profitable growth.**



# Introducing **PRYCAM™** technology

*Pry-Cam™* is a breakthrough technology for PD diagnosis services. Thanks to its exclusive wireless technology, Pry-Cam instruments detect, acquire, processes and classify Partial Discharge (PD) phenomena without any contact with the equipment under test, allowing on-line measurements with the highest accuracy and safety for operators. Partial Discharge (PD) measurements are effectively used to predict and prevent faults on medium and high voltage electrical systems and components, such as cables, terminations, joints, GIS, transformers, rotating machines, etc. Pry-Cam™ instruments allow to easily perform accurate and reliable diagnostic measurements either in a spot mode or as a continuous monitoring.

Partial Discharge (PD) is an essential procedure for assessing the condition of electrical systems and it is one of the critical parameters evaluated during product manufacture, installation and operation. Traditional technologies for PD testing require to switch off the electrical components, to install special sensors on the test equipment and then to perform measurements. All traditional procedures require the equipment under test to be idle for several hours during measurements.

On the contrary, *Pry-Cam™* innovative technology allows to perform “wireless” measurements, without direct connection to the parts under test, even operating at a distance. Therefore it is now possible to take on-line measurements without supply disconnection. Thanks to the patented wireless sensor for PD, *Pry-Cam™* allows to acquire in few minutes the whole PD pulse pattern, resulting in the best accuracy ever for field PD measurements.

Three *Pry-Cam™* families are now available:

- *Pry-Cam™ Portable*, designed for wireless on-line spot measurements
- *Pry-Cam™ Grids and Drives*, designed for continuous PD monitoring of power cables, network components and rotating machines.

Examples of PD measurements with *Pry-Cam™*:



On power cables



On power transformers



In front of termination

## Product features

- Portable instrument for spot measures or fixed instrument for continuous monitoring
- Wireless technology, without galvanic connections to the equipment under test, allowing on-line measures without supply disconnection
- Innovative and patented wireless sensors able to remotely detect the small signals irradiated by PD phenomena
- Wireless phase synchronization does not require additional external sensor (i.e. no need of CTs, Rogowski coils or capacitive couplers);
- The Ultra-WideBand acquisition system is able to acquire and process entire PD pulse waveforms
- Robust noise filtering algorithms and reliable alarm detection schemes available
- Innovative web based architecture for performing remote measures, storage, analysis, diagnosis, trending, etc.

## Key advantages for Customers

- Maximum safety for operators thanks to the galvanic isolation with equipment under test
- On-line measurements without supply disconnection
- Accurate and detailed PD diagnosis thank to the high resolution PD pattern acquisition
- Fast PD measurements thanks to the patented wireless sensors
- Maximum flexibility to test several components with one device

*Pry-Cam™* can be effectively used to prevent failures (and their related costs) by assessing the state of electrical components while in operation. Defects can be easily localized, leading to quick corrective actions implementation.

The high-performance portable equipment allowing measurements in any location on powered electrical equipment



*Pry-Cam™ Portable* is a small and rugged high performance PD acquisition system specifically designed for on-line in-field measurements.

It is a highly integrated unit, including the Prysmian exclusive wireless electromagnetic sensor for PD signals detection and phase synchronization, a digital acquisition unit and a WiFi interface. It is powered by a Lithium battery that allows *Pry-Cam™* operation without any wired connection.

It is simply pointed or located near an electrical component (with the aid of a hook stick, if required) and it is immediately able to stream PD data to a PC via a WiFi link.

The PDiscover software running on the PC is used to control the instrument, displaying, storing and processing PD data in real-time.

Thanks to the patented wireless PD sensor and the wireless set-up, *Pry-Cam™* can perform PD measurements on a powered component in few minutes instead of hours as with traditional instruments. This makes the *Pry-Cam™ Portable* the ideal choice for spot or periodic measures on critical assets. The acquired data allow to precisely assess the state of the components or to draw useful trends for component life cycle management, network reliability and quality analysis.

## Prysmian PD diagnosis services

Due to its unique features, *Pry-Cam™ Portable* is used by Prysmian to provide fast, accurate and cost effective PD diagnosis services.

*Pry-Cam™ Portable* is typically used for:

- on-line measurements on HV/MV assets,
- commissioning of HV/MV circuits,
- periodic assessment on HV/MV components,
- spot testing for specific diagnosis purposes.

*Pry-Cam™ Portable* is used to perform deep and accurate diagnosis and precise defect localization in cables or components when required. A complete PD measure on a single component typically takes 10 to 20 minutes. This allows a very high measurement throughput and lower direct and indirect costs compared to traditional measurement procedures. Field measurements are analyzed by a Prysmian PD experts with the help of PDiscover and the extensive Prysmian PD DataBase.

A comprehensive report is provided to the Customer in a short time, recommending corrective actions and highlighting potential criticalities.



## Technical description

*Pry-Cam™ Portable* has been designed as a high performance ultra-wideband system, able to precisely acquire the whole PD pulse waveform without distortion. This is obtained by employing a patented ultra-wideband electromagnetic sensor and a high speed acquisition unit, allowing a time resolution of 5 nanoseconds with a bandwidth of 100 MHz.

*Pry-Cam™ Portable* provides all the information on PD activity, allowing to:

- provide insights about the physical mechanisms involved in the PD generation,
- reject the background noise,
- identify and separate all different kind of defects present at the same time in the system under test,
- localize defects .

During the measurement, PDiscover allows the rejection of background noise, isolation of pulses with different shapes (and usually different origins or locations), and separately process them with classification, identification and diagnostic algorithms. This assessment provides a complete description of all kind of defects present in the system under test and the aging/wear level, so providing an estimations of the residual lifetime of the component under test.

The identification of the physical phenomena causing the discharge is carried out by a specific classification algorithm based on an adaptive neural network.

## Hardware specifications

Sensor	
Type:	Electromagnetic, based on a patented Ultra Wide Band antenna, also providing AC synch signal
Bandwidth:	0.5 – 75 MHz
PD sensitivity:	Down to 1 pC
Synch sensitivity:	Down to about 150 VAC (at 10 cm)
Synch frequency:	From 10 Hz to 1 KHz
Working range:	From 1 cm up to 200 cm (depending on the PD activity level)
Acquisition unit	
Sampling frequency:	200 MS/s
Bandwidth:	100 MHz
Gain:	From 0 dB to 40 dB
Trigger:	Digital, fully configurable
Synch resolution:	16 bit (5 µs)
Timestamp resolution:	5 ns
Processing:	Real-time filtering, high-speed pattern only, TDR
<b>REPETITION RATE</b>	
- Full pulse waveform:	Ethernet > 10,000 pps, WiFi: >3,000-6,000 pps
- Pattern only:	Ethernet >50,000 pps, WiFi: >10,000 pps
Interfaces:	Wireless 802.11b/g (WiFi), Optical Fiber Ethernet (100-Base FX, optional)
Remote synch:	Wireless RF interface @ 868MHz (optional)
Working mode:	Local, remote and monitoring
Power supply:	12 V, 200 mA
Backup battery:	Li-Po 7.4 V, 2200 mAh
Autonomy in battery mode:	About 5 hr
Weight:	About 400g (depending on options)
Working temperature:	from -25°C to 70°C
Dimensions:	160 x 120 x 130 mm (LxWxH)
Case:	Rugged ABS plastic with IP67 protection rating



Fixed and autonomous PD monitoring instruments for HV and MV assets



The *Pry-Cam™ Grids/Drives* are integrated, autonomous Partial Discharge (PD) monitoring systems for electric components (cables, joints, terminations, GIS, transformers, etc.) and rotating machines (motors, generators, etc.) based on the exclusive Prysmian *Pry-Cam™* wireless sensing technology. They make possible to monitor the conditions of High Voltage and Medium Voltage assets by continuously tracking the Partial Discharges activity.

Thanks to the Prysmian exclusive PD wireless sensing technology, the system is easy to be installed on powered assets, very safe to operate, accurate and reliable. The system performs periodic PD measurements that are locally analyzed, stored and optionally sent to a remote server.

This information can be shared and/or integrated with any kind of existing monitoring system (SCADA, etc.) or asset management software. The monitoring system automatically

analyzes each measure and is able to send an alarm if an anomalous condition is detected. The measurements can be remotely viewed and controlled from any location via an Internet connection. If needed, a remote diagnosis from a Prysmian expert can be requested.

The *Pry-Cam™ Grids/Drives* is composed by an high speed acquisition unit, an embedded computer handling the measurement process, analysis and communication tasks, a solid state local data storage and an optional communication module with the remote server (GPRS/UMTS or LAN connection). The system can handle up to 3 PD sensors (either proprietary or common HFCTs) and it can operate in supervised or continuous and autonomous mode.

*Pry-Cam™ Grids* has been designed for power grid components (either HVAC and HVDC systems) while *Pry-Cam™ Drives* has been specifically optimized for rotating machines.

## Product features

- High resolution acquisition of the entire PD pulse waveforms, providing enhanced diagnostic capabilities and noise rejection
- Innovative sensors able to remotely detect small PD pulses
- PD synchronization does not require additional sensors (i.e. no need of CTs, Rogowski coils or capacitive couplers)
- Local storage and automatic processing of acquired data
- Robust noise filtering and robust alarming algorithms available
- Intuitive control software for live acquisition and data post-processing
- Web-based interface for monitoring control

## Key advantages for Customers

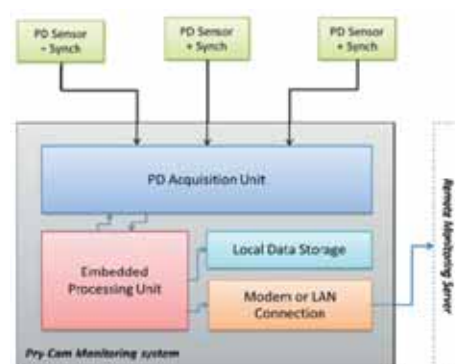
- Suitable to prevent failures and associated costs on critical electrical components
- Maximum safety for operators thanks to the galvanic isolation with equipment under test
- On-line measurements without supply disconnection
- Accurate and detailed PD diagnosis thank to the complete PD pattern acquisition
- Maximum flexibility to test several components with one device
- Easy and quick to install without supply disconnection, allowing a convenient retrofit of existing assets
- Only 10W power consumptions, supplied by Customer or Prysmian harvesting device

## Technical description

The *Pry-Cam™ Grids/Drives* systems employ special proprietary electromagnetic sensors and a high performance data acquisition unit that jointly allow to acquire the actual PD pulse waveforms with a time resolution of few nanoseconds. This allows to collect a very rich set of diagnostic information for every acquisition. The special sensors offer another unique and unprecedented feature: they are able to sense the AC power supply electric field, so providing a correct phase reference for PDs. Since the phase reference is aligned with electric field, there are no unpredictable offsets due to varying loads as usually occurring with CTs or Rogowski coils. Moreover each sensor provides the correct phase reference for the PD pulses it detects.

This technology provides more information on the phenomena under test compared to other technologies (e.g. peak pulse detection, frequency band analysis, etc). In fact the accurate pulse waveform provides insights about the physical mechanisms involved in the PD generation, allowing to identify different kind of defects (even present at the same time) and noise.

During the measurement, the control software allows the removal of environmental noise, the separation of different pulses with different shapes (and usually origins and locations), and separately process them with classification, identification and diagnostic algorithms. This process leads to a complete assessment of all kind of defects present in the system under test, its wear level, and to estimate the residual lifetime of the tested system.



## Hardware specifications

Proprietary Sensors	
Type:	Electromagnetic, based on a patented Ultra Wide Band technology, also providing AC synch signal
Bandwidth:	0.1 – 50 MHz (Grids) / 25 MHz (Drives)
PD sensitivity:	Down to 1 pC
Synch sensitivity:	Down to about 150 VAC (at 10 cm)
Synch frequency:	From 10 Hz to 1 KHz
Working range:	From contact up to 10 cm (depending on the PD activity level)
Power supply:	3.3 - 5V DC, 7.5 mA (from acquisition system)
Weight:	About 50 gr (depending on the configuration)
Dimensions:	160 x 90 x 8 mm (LxWxH), flat and flexible tipe
Acquisition unit	
Sampling frequency:	200 MS/s
Bandwidth:	100 MHz(Grids) / 25 MHz (Drives)
Gain:	From 0 dB to 40 dB
Trigger:	Digital, configurable
Synch resolution:	16 bit (5 µs)
Processing:	Real-time filtering, ultra-precise timestamp (5 ns)
REPETITION RATE	
Full pulse waveform:	Ethernet > 10,000 pps, WiFi: >3,000-6,000 pps
Pattern only:	Ethernet >50,000 pps, WiFi: >10,000 pps
INPUT	
PD channels:	3x100 Ohm diff., 1.5Vpp (overvoltage protected)
Synch channels:	3x1 MOhm, 5V + 1 x line (overvoltage protected)
System	
Processor:	Based on ARM™ architecture
Interfaces:	Ethernet or Wireless 802.11b/g (via USB adapter)
Modem:	GSM/UMTS modem (optional)
Local storage:	Solid State Technology, up to 64GB
Working modes:	Live, remote on demand or continuous monitoring
Power supply:	110-230V, 50-60Hz AC / 12V DC
Power consumption:	< 5W
Weight:	About 2.5 kg (depending on options)
Working temperature:	From -25°C to 90°C
Dimensions:	250 x 210 x 100 mm (LxWxH)
Case:	Aluminium with IP67 protection rating
Mounting:	Flange/srew, orientation horizontal/vertical

## Easy to stick PD sensors: the most convenient and easy solution for fixed PD monitoring



*Pry-Cam™ Wings* sensors are the most recent evolution of the Prysmian electromagnetic PD sensor technology. They are flat and soft PD sensors, designed to be “sticked” to most kind of assets to sense the PD activity for spot measures or continuous monitoring. They can be installed on the component in a safe area, even without a direct contact with the component to test.

They are able to sense the electromagnetic pulses generated by PDs and the electric field of the AC voltage supplying the component: this allows to perform a complete PD measure without the need of additional sensors and wires.

The PD Patch Sensors can be used in place of traditional capacitive couplers or HFCTs, featuring the same performances but a greater flexibility and a lower cost. They can be easily installed without supply interruption, they are waterproof and can even be buried.

Compared to capacitive couplers or HFCT, PD Patch sensors are active sensors: they amplify the signal when received, allowing an increased sensitivity (better than 1 pC) and a greater immunity to noise. PD Patch Sensors can be connected to all the *Pry-Cam™* families, and they are the best choice for *Pry-Cam™ Grids* and *Drives*.

Example of applications include: cables, joints, terminations, transformers, GIS, HVAC and HVDC systems, electric motors and generators.

## Technical specifications

Type:	Electromagnetic active sensor, also providing AC synch signal
Bandwidth:	0.1 – 50 MHz / 25 Mhz (higher on request)
PD sensitivity:	Down to 1 pC
Synch sensitivity:	Down to about 150 VAC (at 10 cm)
Synch frequency:	From 10 Hz to 1 KHz
Working range:	From contact up to 10 cm (depending on the PD activity level)
Power supply:	3.3-5 V DC, 7.5 mA (from acquisition system)
Weight:	About 50g (depending on the configuration)
Dimensions:	160 x 90 x 8 mm (LxWxH), flat and flexible type
Packaging:	Silicone rubber, IP67 protection





Remote temperature measurement units:  
the smartest way to closely track the performance of your asset

*Pry-Cam™ DLog* allows to constantly monitor temperature, current or voltage in a specific point of a HV or MV circuit or component. Each unit performs a specific measurement at programmed time intervals, and send data to a central server. This allows to remotely display the data, to set alarms, or to export time series for advanced processing (such as profiling, performance evaluation, diagnosis, etc.).

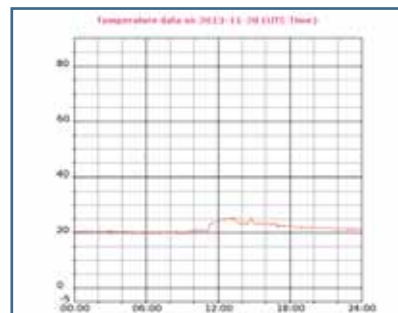
When dealing with large or distributed assets, like HV transmission lines or MV distribution networks, a large number of units can be used to monitor as many points as needed: the large amount of collected data will be always available through the central server as aggregated, structured, ordered and easy to look up information. Each measurement unit is provided with 4 inputs for PT-100 sensors, current or voltage transformers, and it can be connected to a local Ethernet or WiFi network, or via a GPRS/3G modem.



Collected data are sent to the specified central server and stored in an internal non-volatile memory. In case of temporary loss of connection, the internal data is used as a backup, allowing a complete and automatic re-synchronization when the connection will be available again. This prevents data lost and integrity. The system is fully integrated with the Prysmian Web Infrastructure and DataBase.

## Technical specifications

Input channel number:	Up to 4
Supported sensors:	PT-100 DIN IEC 751 (4 wires) - (Voltage, Current and 4-20mA sensors type on request)
Temperature range:	-100°C - 600°C
Accuracy:	0.1°C (limited by sensor)
Resolution:	16 bit
Sampling frequency:	1 sec - 24 h
Internal memory:	4 - 16 GB (SSD)
Interface:	USB 2.0 Host (multi-class support)
Network:	Ethernet LAN; WiFi, GPRS/UMTS modem (external)
Dimensions:	13 x 10 x 3 cm
Weight:	<300 g
Package:	Rugged aluminium
Power supply:	12V DC, 200 mA, 2.5W
AC/DC power adapter:	110-240V AC, 50-60Hz (optional)



# Prysmian PD Web Infrastructure and DataBase

Retrieve everything from everywhere

Performing regular measures or continuous monitoring on large assets can be a challenging task: a large amount of data need to be collected from different locations, transferred, ordered, classified, processed, shared, stored, retrieved and displayed in the most effective and convenient way.

To help Customers in all these tasks, Prysmian has implemented an innovative Web infrastructure specifically addressing all these needs.

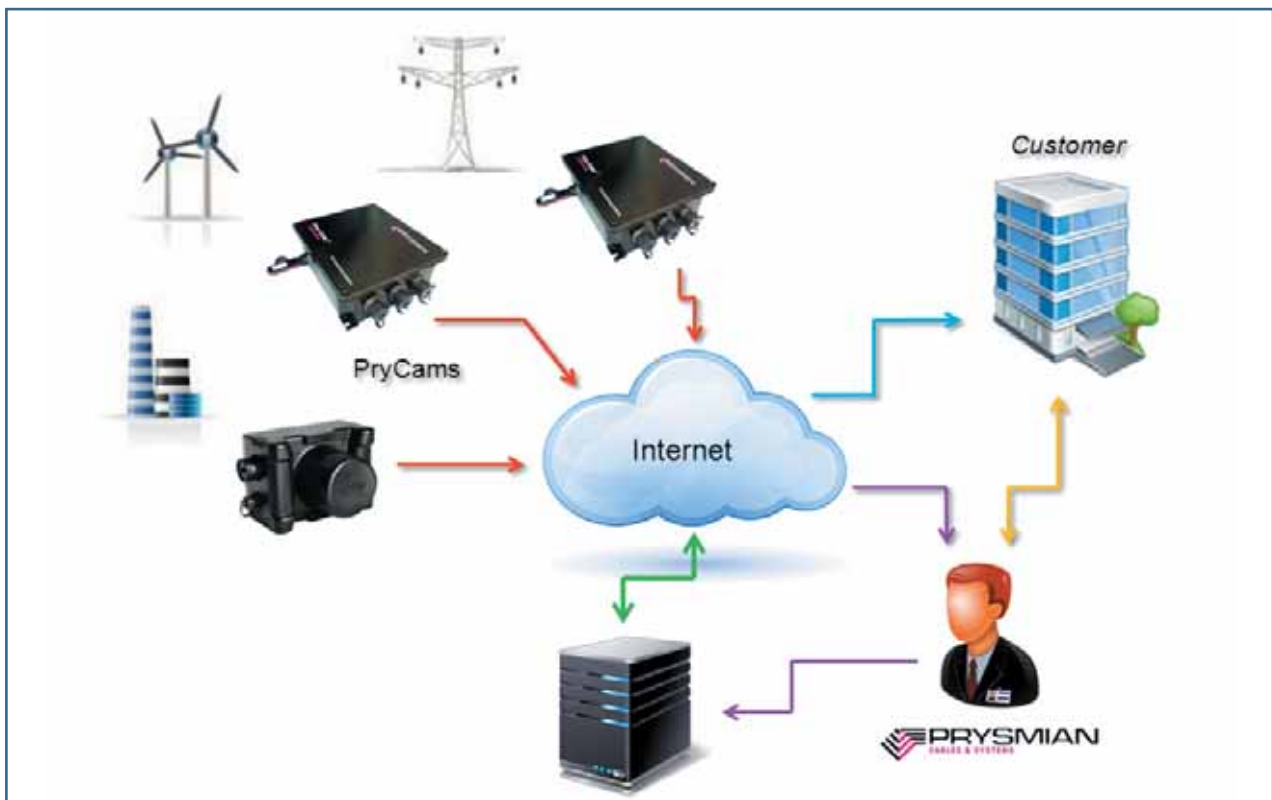
Prysmian web infrastructure allows to:

- store multiple measures and data for each component,
- order and organize monitored objects (circuits, lines, components, etc.),
- easily retrieve and display specific data, also from a remote location,
- share data among geographically distant users,
- extract key parameters from measures (PD level, diagnostic indices, etc.),
- draw historical trends on selected parameters,
- set customized alarms for monitored components,
- export data or integrate data with third party asset management software,
- request and perform remote diagnosis or consulting services,
- reduce or eliminate local storage needs,
- manage data with secure and safe procedures.

Monitoring instruments (either measuring PD or temperature/current) are usually remotely connected to the web infrastructure and automatically and continuously upload their data. Users only have to browse through components to display latest data and historical trends.

To suite all Customer needs, different levels of service customization are available, allowing to choose the storage policy, the security options, the access and control features.

Also customized applications and functions can be created to better integrate and exploit the data. For more detailed information ask to a Prysmian expert.



# Fields of application

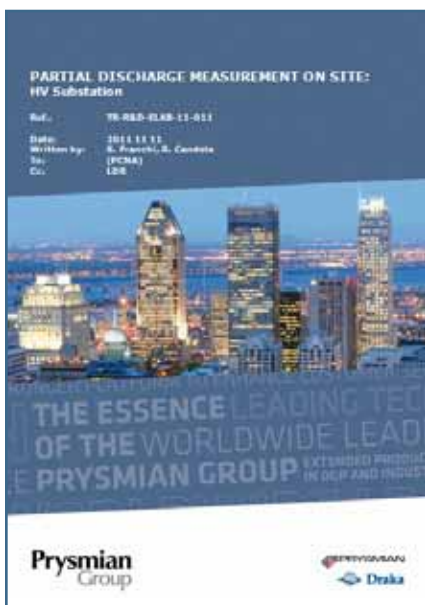


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- Endesa Generación
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- REE
- SAMPOL
- FRANCE**
- EDF
- ERDF
- UK**
- National Grid
- USA**
- ConEd
- ComEd
- Florida Light&Power
- CANADA**
- Hydro Quebec
- MEXICO**
- CFE
- ARGENTINA**
- Endenor
- MIDDLE EAST**
- Kahramaa
- KOREA**
- Samsung
- SINGAPORE**
- Singapore PowerGrid

# Services and options

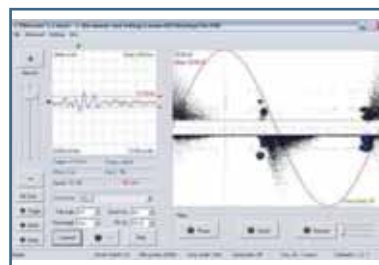
Prysmian offers a rich set of services and tools to assist clients in planning, performing, managing, interpreting PD measures and diagnostics.



PD measurements or remote diagnosis can be requested to Prysmian experts, that will give a very prompt response in every part of the world.

A clear, comprehensive and detailed report will be provided at the end of the service, collecting information on PD activity for each cable section or for each specific tested component.

The report provides comments about the kind of PDs detected, its relevance and recommendations for corrective actions (if required).



**Prysmian Group**

Table with 5 columns: Measurement, HV line, Date, Time, and HV components. The table contains data for three different measurements (Measurement 1, Measurement 2, Measurement 3) across various HV components like cables and transformers.

Measurement	HV line	Date	Time	HV components
Measurement 1	110kV	2014-11-11	10:00	Cable 1, Cable 2, Transformer 1
Measurement 2	110kV	2014-11-11	11:00	Cable 1, Cable 2, Transformer 1
Measurement 3	110kV	2014-11-11	12:00	Cable 1, Cable 2, Transformer 1

# Linking power grids to sustainability

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