

# MONTRANO

# Continuous monitoring system for power transformers



# Condition monitoring to extend transformer life



Damaged transformer after a bushing explosion

### Knowing the dielectric condition of insulation is vital

Dielectric flashover of insulation in bushings and inside transformers is one of the most frequent causes of failure in power transformers. Bushings and windings often fail due to the aging of their insulation over many years of service.

Aging insulation progressively degrades to the point that it can no longer withstand electrical stress. This can cause bushings to explode, transformer destruction and long outages for repair.

#### Early detection prevents failures

The continuous monitoring of the dielectric state of bushing and transformer insulation is therefore essential for managing transformer health. It allows you to obtain continuous information about insulation condition status, to detect negative trends, and to plan corrective action early.

Such online assessments ensure safe, reliable operation during the intended transformer service life.



# MONTRANO at a glance

#### Monitors critical defect indicators

MONTRANO continuously monitors critical dielectric indicators of progressive insulation breakdown in power transformers:

- Capacitance and dissipation/power factor of bushings
- > Transient over-voltages
- Partial discharge (PD) in bushings and inside the transformer

#### Reliable online results

MONTRANO provides bushing capacitance and dissipation/ power factor monitoring with lab accuracy in the field. It achieves this by using absolute measurement references.

Additionally, MONTRANO employs advanced noise suppression techniques for reliable PD source recognition. It also detects transients directly at the bushings to assess their impact on transformer health.

#### Actionable data to optimize maintenance strategy

MONTRANO provides you detailed trend data and early warnings well before failures occur. Using this actionable data, you can assess the risk of dielectric failure and optimize your maintenance strategy accordingly.

#### Flexible system design & easy implementation

MONTRANO can be implemented at any point of time during a transformer's lifetime. The system's modular design allows it to be easily customized and expanded to match your exact monitoring requirements.

#### Web-based data access & visualization

MONTRANO provides a web interface for convenient data access and monitoring system management from a central computer. It allows you to schedule monitoring, set alarm and warning thresholds and check system status.

You can view data anytime to determine the actual dielectric condition of insulation in bushings and inside the transformer. Trend charts show you how their condition has changed over time.

#### Complete expert support & advice

You do not have to be a high-voltage expert to benefit from MONTRANO's powerful monitoring capabilities.

Our dedicated team of HV engineers provides you complete guidance and support. This includes onsite consultations to evaluate your monitoring needs; system installation, setup and training; as well as data evaluation support.

# Your benefits

- Continuous assessment of insulation state
- Absolute C, DF/PF monitoring ensures lab accuracy in the field
- Advanced noise suppression for reliable PD source detection
- > HV transients detected directly at bushings with complete waveform
- > Detailed trend data for modern transformer health management

# One system for complete dielectric assessment

## MONTRANO system overview

The complete MONTRANO monitoring system for power transformers includes a set of bushing tap adapters, UHF sensor, acquisition units, a central computer and monitoring software. The system can be customized and expanded over time to meet your exact monitoring needs.

## 1 Bushing tap adapters



- > Robust, modular design for different types of bushings
- > Safe and multiple redundant high-voltage protections
- Synchronously captures signals for capacitance, dissipation/power factor, transient over-voltages and partial discharge (PD)
- > Built-in temperature sensor for temperature compensation of measured values



- Highly sensitive PD measurements inside the transformer
- > Operates in UHF frequency range
- > Results can be correlated to the bushing signals





## 3 Acquisition unit/transformer



- > 4-channel, simultaneous acquisition of data from the bushing tap adapters and UHF sensor
- > Advanced signal processing for capacitance, dissipation/ power factor, transient over-voltages and PD calculation

#### 5 Fiber optic communication

- Used to connect each acquisition unit to the central computer
- Provides uninterrupted data transmission over long distances
- Complete galvanic isolation eliminates electrical interference and ensures personal safety
- > Monitoring Control Unit (MCU) provides USB connection to the central computer

#### 6 Central computer & monitoring software

- State-of-the-art database system ensures long-term data storage and retrieval
- Performs intelligent data post-processing to provide useful information about condition status
- > Manages monitoring parameters and defined thresholds for warning and alarm levels
- > Visualization and classification of events and trends
- > Accessible via web browser interface





#### 4 Acquisition unit/reference

> Provides reference signal for absolute capacitance,

 Connects with up to three voltage transformers or three power transformer reference bushings

dissipation/power factor measurement



# Reliable and early detection of defects

## Capacitance & dissipation/power factor

Typical defects in bushing insulation can be detected by changes in bushing capacitance and dissipation/power factor (DF/PF). Recordings are made by MONTRANO at the bushing taps to determine the state of the bushing insulation.

MONTRANO uses the individual phases of a nearby voltage transformer as an absolute reference. The bushings of a second transformer can also be used alternatively for comparison. The provided accuracy allows you to use the recommended DF/PF reference values of your bushing supplier to determine bushing insulation condition.

### Transient over-voltage recording

Transient over-voltages originate from nearby switchgear or events in the power grid. Due to their magnitude and frequency, they can cause stress to bushing and transformer insulation.

MONTRANO detects transient over-voltages directly at the bushings where dielectric stress occurs. It records transients on all three phases, including their waveforms. This enables you to determine their impact on the transformer. The IEEE compliant export format is supported (COMTRADE C37.111-1999).





Transient over-voltages with oscillations



### Reducing the level of uncertainty

Changes in grid unbalance (phase shifts) can have a misleading impact on relative measurements for capacitance and dissipation/power factor. MONTRANO reduces uncertainty by using measurement references to detect aging in individual bushings reliably. Using a voltage transformer reference provides an absolute measurement.



Relative measurement (bushing-to-bushing comparison)

OMICRON

## Partial discharge detection

Partial discharge (PD) reveals weak spots in the insulation caused by aging. It is a reliable early indicator of defects in dielectric insulation.

MONTRANO monitors PD at the bushing taps and inside the transformer tank. The system uses synchronous, multi-channel recording. This captures not only PD signals in bushings but also inside the transformer, using non-conventional UHF methods.

Advanced PD denoising and source separation using selectable center frequency, 3PARD and 3CFRD enable the system to effectively suppress external noise, like corona.





PD diagrams of three phases without separation









Separated PD activity





Absolute measurement (voltage transformer reference)

# Monitoring packages to fit your specific needs

<b>Choose the solution right for you</b> The following MONTRANO monitoring packages are examples of possible system configurations. Our team of monitoring specialists can assist you in customizing		State of the state	•
the perfect monitoring solution, based on your needs.	CPL 843 bushing tap adapter	UVS 610 drain valve sensor	UHF converter
MONTRANO Package 1			
<ul> <li>Capacitance, disipation/power factor, transients &amp; partial discharge (PD)</li> </ul>	•	•	•
> Voltage transformer reference	× 3	× 1	× 1
MONTRANO Package 2	•	•	
<ul> <li>Capacitance, disipation/power factor, transients &amp; PD</li> </ul>	-	-	-
> Option A: bushing-to-bushing comparison, or	× 3	× 1	× 1
<ul> <li>Option B: dual transformer comparison</li> </ul>	× б	× 2	× 2
MONTRANO Package 3	•		
<ul> <li>Capacitance, disipation/power factor &amp; transients</li> </ul>	-		
> Voltage transformer reference	× 3		
MONTRANO Package 4	•		
<ul> <li>Capacitance, disipation/power factor &amp; transients</li> </ul>	-		
> Option A: bushing-to-bushing comparison, or	× 3		
> Option B: dual transformer comparison	× 6		

### User-friendly monitoring software

The MONTRANO monitoring software is easy to use via a convenient web-based interface. It enables you to configure and schedule monitoring, set warning and alarm thresholds, and generate reports from a central computer.



#### System configuration & control

- > Topology views of the monitored assets
- > Configuration of all monitoring-related parameters
- > Continuous measurement configurations





OMICRON Welcome, Admin!	N M	Ionitoring Sof	OMICRON Help   Settings   Logout			
A Data Analysis					Monitoring System Status	
vent Log						
Date/Time -		Level -	Measuring Point	Event	Status +	
10/10/2013 12:51:46 PM		Critical	U	Transients	open	
10/10/2013 12:51:46 PM		Critical	U	Transients	open	
10/10/2013 12:51:47 PM		Warning		Qiec Rule	open	
10/10/2013 11:56:26 AM		Critical	U	Transients	confirmed	
10/10/2013 11:47:48 AM		Critical	U	Transients	confirmed	
Ga ⊨ ∈ 1 2 3 4	ьн	- Qiec Rule (Alert)	- Qiec Rule (Warning) 🛧 TRAI	FO1/HV Bushing/U	Displaying items 1 - 5 of 19	
1.00.00 pC		Thursday, October 11 Maximum Value: 776 TRAFO J INV Bushing Minimum Value: 27.3	0, 2013 12:50:00 PM 11 pC 10: 106:49 μC 8 μC			

#### Warnings and alarms

- > Defined threshold settings for alarm notifications
- > Real-time display of current alarm level
- > View of events that triggered alarm



#### Data visualization

- > Trend charts show data for each monitored parameter
- > Data visualization for C, DF/PF, PD and transients
- > All data records and corresponding charts can be exported

# Dedicated support for your monitoring needs

# Why OMICRON monitoring solutions are different

MONTRANO is not only a set of excellent system components. Our knowledged experts are working for you to support you in all stages of your monitoring project.

In simple words: We provide you with peace of mind while matching the actual needs of your HV equipment over its operational lifetime.

# High-quality support at every stage of your project

We start the implementation of your monitoring system by understanding your needs and challenges. With this input, the system can be designed according to your needs. Our team of specialists then installs the system for you on-site.

During the commissioning of the system, its performance and measurement sensitivity are verified. You are then trained on how to use the system and take maximum advantage of its features.

The measured data is stored, processed and visualized by the monitoring software. Our high-voltage experts are available to help you interpret and analyze the data. We can also provide you regular asset condition reports and recommendations for further action.

### Flexibility

Project-specific monitoring system design to match your requirements



#### Competence

On-site monitoring system installation, calibration & commissioning



#### Knowledge

Customer training in system operation and data analysis



# Monitoring project knowledge and expertise you can rely on

- > Evaluation of monitoring requirements
- > Project-specific monitoring system design
- > Integration of monitoring system into existing infrastructure
- > Installation, commissioning and calibration of the monitoring system
- > Monitoring system and data evaluation training
- > Dielectric failure analysis and follow-up based on monitoring data
- > High-voltage expert assistance
- > Worldwide customer service & hotline

# Availability

Worldwide customer support, system upgrades & HW/SW maintenance



## Expertise

Support in condition assessment and data evaluation



OMICRON is an international company serving the electrical power industry with innovative testing and diagnostic solutions. The application of OMICRON products allows users to assess the condition of the primary and secondary equipment on their systems with complete confidence. Services offered in the area of consulting, commissioning, testing, diagnosis and training make the product range complete.

Customers in more than 140 countries rely on the company's ability to supply leadingedge technology of excellent quality. Service centers on all continents provide a broad base of knowledge and extraordinary customer support. All of this together with our strong network of sales partners is what has made our company a market leader in the electrical power industry.



For more information, additional literature, and detailed contact information of our worldwide offices please visit our website.