

DOBLE ON-LINE MONITORING SOLUTIONS

Know the Condition of Your Transformers

CONDITION INTELLIGENCE FOR POWER TRANSFORMERS

IDENTIFY PROBLEMS | PREVENT FAILURES | MANAGE RISK



DOBLE ENGINEERING COMPANY

Bringing Clarity to the Complexity of Condition Monitoring.

DOBLE ON-LINE MONITORING SOLUTIONS

Identify Problems | Prevent Failures | Manage Risk



THE CHALLENGE

How do you get all the information you need to understand the condition of your transformers? You need condition monitoring tools that provide accurate data, robust analysis and reliable alerts. This allows you to effectively identify developing problems, prevent transformer and bushing failures, and manage risk.



CHOOSE DOBLE

Doble brings clarity to the complexity of condition monitoring. By choosing a Doble online monitoring system, you gain the power of knowing:

- Data is accurate and reliable
- Analytics are based on industry standards, best practices and nearly a century of Doble expertise
- Alerts and alarms are meaningful and useful
- Support is a phone call away

GETTING STARTED

Unsure about where to begin? We want to help make your condition monitoring program a success. We can work with you to help determine the most effective approach for your organization. We offer package and custom options to address all situations, whether you are looking to monitor large, generator step-up transformers or smaller distribution and industrial units. We also provide support options from commissioning through training and decision support.



Identify Problems

DOBLE ON-LINE MONITORING SOLUTIONS



MEASUREMENT PARAMETERS

Select the appropriate measurement parameters to support your condition monitoring decisions

BUSHING LEAKAGE CURRENT with the doblePRIME IDD

High, low, tertiary
Add voltage reference for True Power Factor™

PARTIAL DISCHARGE with the doblePRIME PD-GUARD

Bushings
Main tank
Neutral

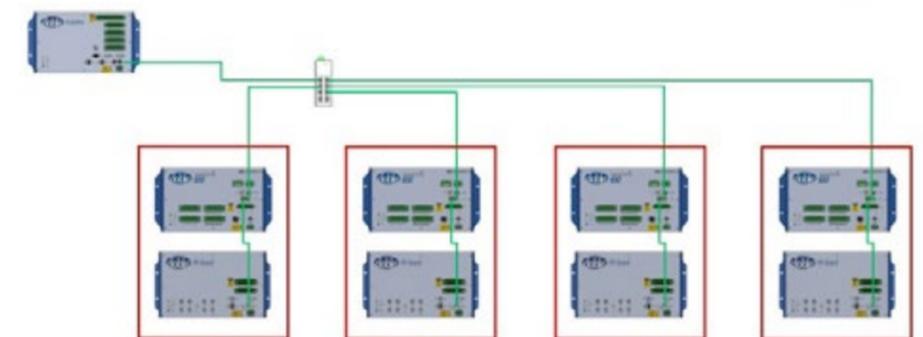
OPERATIONAL PARAMETERS with the doblePRIME iO & Analytics

Tap position
Load
Voltage
Temperatures
Pumps & fans status
Vibration
Oil level

DGA with the Morgan Schaffer Calisto
Main tank
Optional tap changer

CONNECTING THE DATA

In this example, four transformers are being monitored at one substation. Bushing and PD data is collected via a local network, analyzed, and backed up in the doblePRIME Analytics module. Data from each monitor and asset can be overlaid for review and analysis.



DOBLE ON-LINE MONITORING MODULES



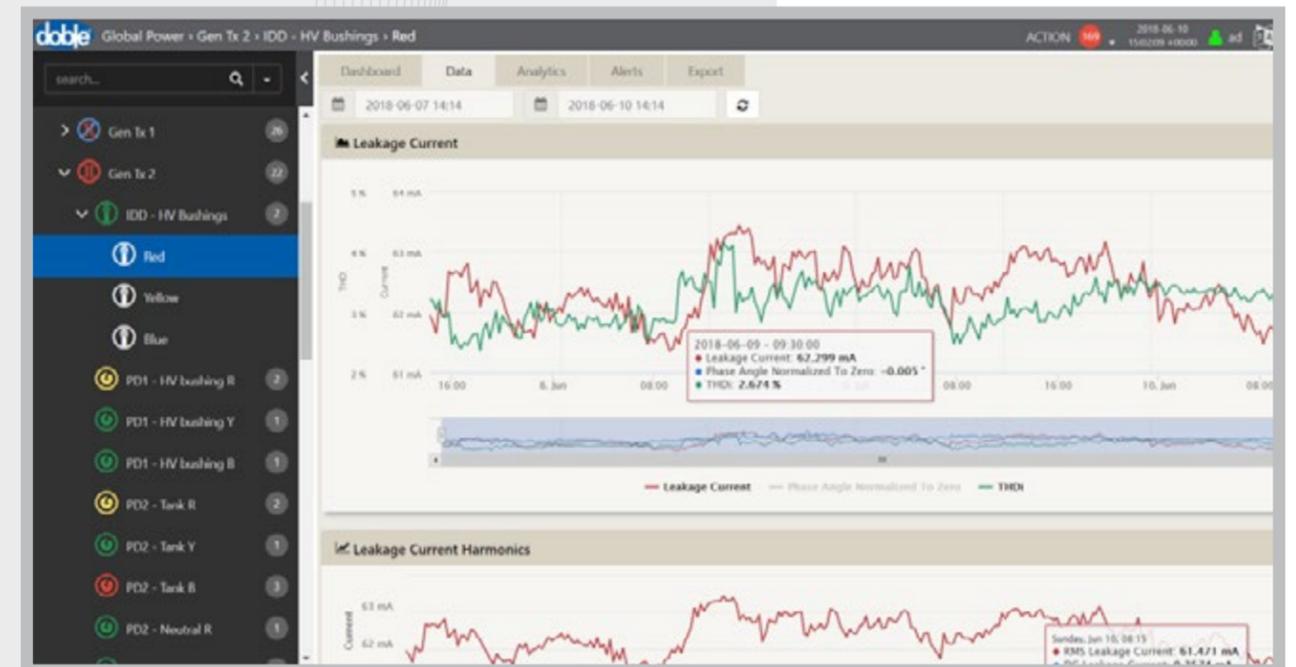
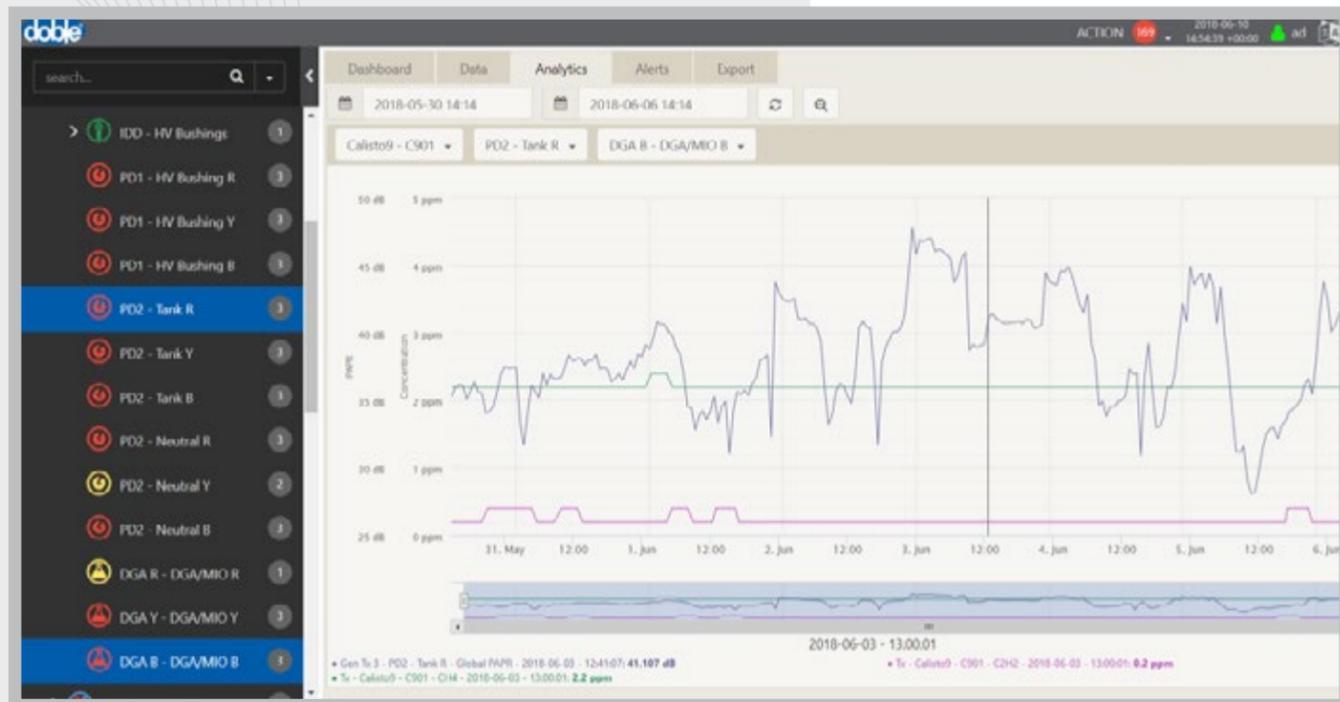
Morgan Schaffer Calisto Dissolved Gas Analysis Monitoring

- Highly accurate and reliable Dissolved Gas Analysis (DGA) monitors
- Fully functional even in the harshest environments
- Identical installation approach makes it easy to upgrade between Calisto models for optimal fleet deployment strategies
- Models include:
 - Calisto 2: hydrogen, moisture and carbon monoxide
 - Calisto 5: 5 fault gases plus moisture
 - Calisto 9: 9 key gases plus moisture



doblePRIME IDD Bushing Monitoring

- Industry-leading bushing monitor: records data for individual bushing current and phase which relate directly to failure modes
- Measures and displays individual bushing leakage current waveforms and performs harmonic analysis for deeper condition investigation
- Doble's True Power Factor™ option brings in a voltage reference to provide unparalleled analysis
- Embedded expert system learns what is normal for your bushings, accounting for local voltage and system variation which are unique to your application
- Alert State Machine™ identifies levels and trends which are key for deterioration detection and failure prevention



DOBLE ON-LINE MONITORING MODULES



doablePRIME PD-Guard Partial Discharge Monitoring

- Provides PD and EMI detection and diagnostic capability to detect ongoing insulation degradation
- Includes IEC equivalent measurements, and extends them for enhanced monitoring capability
- Spectral analysis using both PD and EMI techniques, permitting focused analysis tools for each application
- Detailed diagnostics for analysis of possible PD sources include Phase Resolved PD analysis
- Alert State Machine™ intelligently monitors for partial discharge while avoiding false positives due to noise events such as tap changer operations or breaker switching



doablePRIME iO Analog & Digital Data Module

- Collates analog and digital inputs to bring in contextual data for decisions: load (MW and MVar), temperature, humidity, tap position and more
- Context data is important to understand why a monitored parameter may have changed - the variation could be benign, rather than a fault condition



doablePRIME ANALYTICS Integration & Analysis Module

- Provides network and hub capabilities and a single point of contact for all monitoring data coming from multiple assets
- Manages alerts from multiple devices
- Provides redundant data storage and back up
- Applies analytics, and displays and overlays data from multiple devices
- Backs up data from multiple units for redundant storage

PREVENT FAILURES

On-line Monitoring Packages



We have outlined a number of package options for common monitoring arrangements. We can also help you customize your doblePRIME monitoring options. What you choose to use should be defined by your goals for condition monitoring. Doble's condition monitoring systems are flexible and can expand to meet developing or changing needs.

Packages are supplied preconfigured, in prewired enclosures.

ESSENTIAL PACKAGE

The **doblePRIME Essential Package** is recommended for smaller transformers: distribution, commercial, industrial or renewables. The Essential Package uses DGA and operational data to detect potential problems. Note: one doblePRIME i0 unit can connect multiple Calisto 2 monitors.

- Morgan Schaffer Calisto 2
- doblePRIME i0



STANDARD PACKAGES

The **doblePRIME Standard Packages** build on the essential package to give more coverage to higher risk assets across transmission and distribution. Standard Packages will detect key failure modes experienced in the industry using DGA and bushing monitoring.

- Morgan Schaffer Calisto 2 (Standard) or 5 (Standard+)
- doblePRIME IDD
- doblePRIME i0 (Standard+)



TRANSFORMER MONITORING PACKAGE OPTIONS

	ESSENTIAL	STANDARD	STANDARD+	ADVANCED	ADVANCED+
DGA	✓ Calisto 2	✓ Calisto 2	✓ Calisto 5	✓ Calisto 9	✓ Calisto 9
BUSHINGS		✓	✓	✓	✓
PARTIAL DISCHARGE				✓	✓
GIC					✓
OPERATIONAL DATA	✓		✓		✓

ADVANCED PACKAGES

The **doblePRIME Advanced Packages** are comprehensive condition monitoring packages for your most valuable assets: typically large transmission or generator transformers.

It upgrades your DGA to a full 9 gas plus moisture to detect and diagnose the widest range of main tank faults. The Advanced Package also adds in partial discharge detection.

- Morgan Schaffer Calisto 9
- doblePRIME IDD
- doblePRIME PD-Guard
- doblePRIME i0 (Advanced+)
- GIC CT (Advanced+)

The **Advanced+ Package** adds operational data, in-tank PD detection, as well as geomagnetically induced current sensors for locations with solar flare-related issues.



MANAGE RISKS

MAKING INFORMED DECISIONS

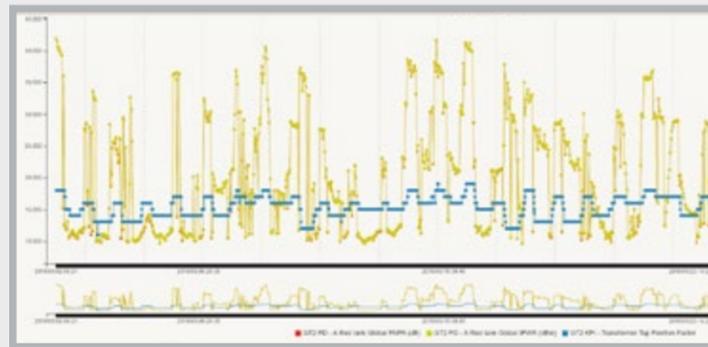
Securely access your embedded doublePRIME dashboard using a computer, tablet or even smart phone. There is no need for proprietary databases, proprietary software and cloud connections. Easy to read dashboards provide all your sensor data and can overlay relevant information to give more context to the health of each transformer.

In this example, PD from a bushing overlaid by leakage current data provides more context for analysis. The associated generator had been taken out for maintenance, and on return to service – as shown by the bushing leakage current rising, high levels of PD were measured through the bushing, and an alert generated. The source of the PD was found to be in the generator, which was immediately taken out for further maintenance and repair.



ANALYZE DATA & TRENDS

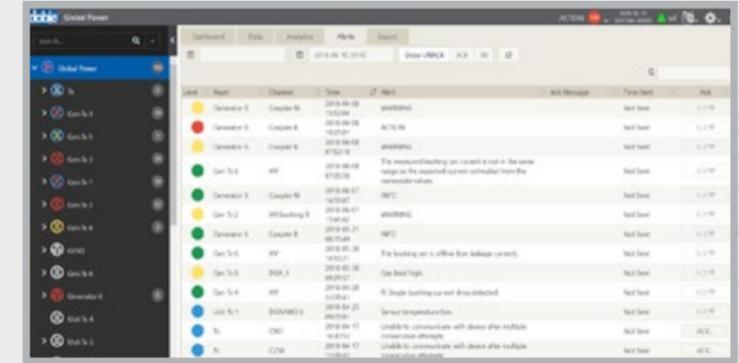
Built-in analysis tools identify trends and permit correlations to be identified and interventions planned effectively. In this doublePRIME dashboard image, we are correlating the level of partial discharge (yellow) with tap position (blue) indicating the tap changer is a likely cause. Tap changer maintenance was planned as a result.



Data & Decisions

VIEW & MANAGE ALERTS

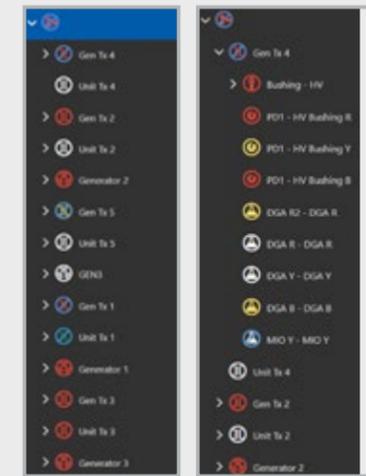
Managing alerts is key to successful condition monitoring. The doublePRIME interface shows you the latest alerts, lets you acknowledge them, and record actions taken. Analysis tools reduce false positives, track levels and trends and generate meaningful and useful alarms.



SCALE YOUR SYSTEM

Doble's condition monitoring platforms can also link to an asset risk management system such as doubleARMS® for advanced analytics, risk, and financial analysis needed to justify capital decisions and long-term strategic asset plans.

Together, doublePRIME and doubleARMS underpin smart decisions for an intelligent grid and can provide value from day one of deployment.



In doublePRIME and doubleARMS, the Asset Tree represent assets and monitors at your tracked locations.



SERVICES & SUPPORT

Doble on-line monitoring solutions have provided reliable operational performance for more than two decades. Doble provides support throughout your condition based monitoring program, from Doble Certified commissioning services, advanced user training to our new **dobleASSURANCE™** all-inclusive program and Doble Monitoring service plans. Choose the level of services to make your condition monitoring program a success.



COMMISSIONING SERVICES

Know that your on-line monitoring system has been properly implemented and is ready to start providing actionable data. Doble-certified services include:

- Pre-project planning and coordination support to mitigate project delays
- Certified factory-trained specialist to verify proper installation and perform commissioning
- Additional data analysis review upon transformer energization to verify proper condition monitoring system performance
- 2-hour user training
- Fully registered warranty benefits



SUPPORT SERVICE PROGRAMS

dobleASSURANCE™ Program

The **dobleASSURANCE™** program is an all-inclusive service package for Calisto DGA monitors covering professional installation and certified commissioning services, continuous monitoring of Calisto error codes and all troubleshooting and field service repairs for up to ten years. Carrier and calibration gases and replacement services are included. Should the Calisto need to be factory repaired, Doble will provide a replacement Calisto and all field services at no charge.

All-inclusive. Known total cost of ownership. Now that's peace of mind from one of the most respected service providers in the electric power industry. That's **dobleASSURANCE**.

Doble Monitoring Service Plan

Doble's team of experienced condition monitoring specialists can also provide expert decision support services. We act as an extension of your team, providing transformer assessments, general application consultation and alarm response policy insights so our transmission, distribution, generation or industrial customers are prepared well in advance, based on their risk profile.

- Comprehensive annual transformer assessment review
- Priority alarm & error message review
- Test data and application consultations
- Alarm response policy development
- Alarm set-point consultation



TRAINING

Committed to the education of our customers for nearly a century, we offer a comprehensive range of transformer, insulating material, substation equipment, power cable, rotating machinery and protective relay diagnostic testing and life-cycle management training. Find one of our schedule courses, attend a conference or seminar, or have Doble come to your facility. We can provide the training your staff needs to navigate today's technologies and state-of-the-art diagnostics.



Know the condition of your transformers with a Doble on-line monitoring system.

- Identify Problems
- Prevent Failures
- Manage Risk

**SEE doblePRIME AND
CALISTO IN ACTION
SCHEDULE AN ONLINE DEMO TODAY**

Call your local Doble representative or visit www.doble.com/monitoring-demo

See real world examples and view the data that supports informed decisions.

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