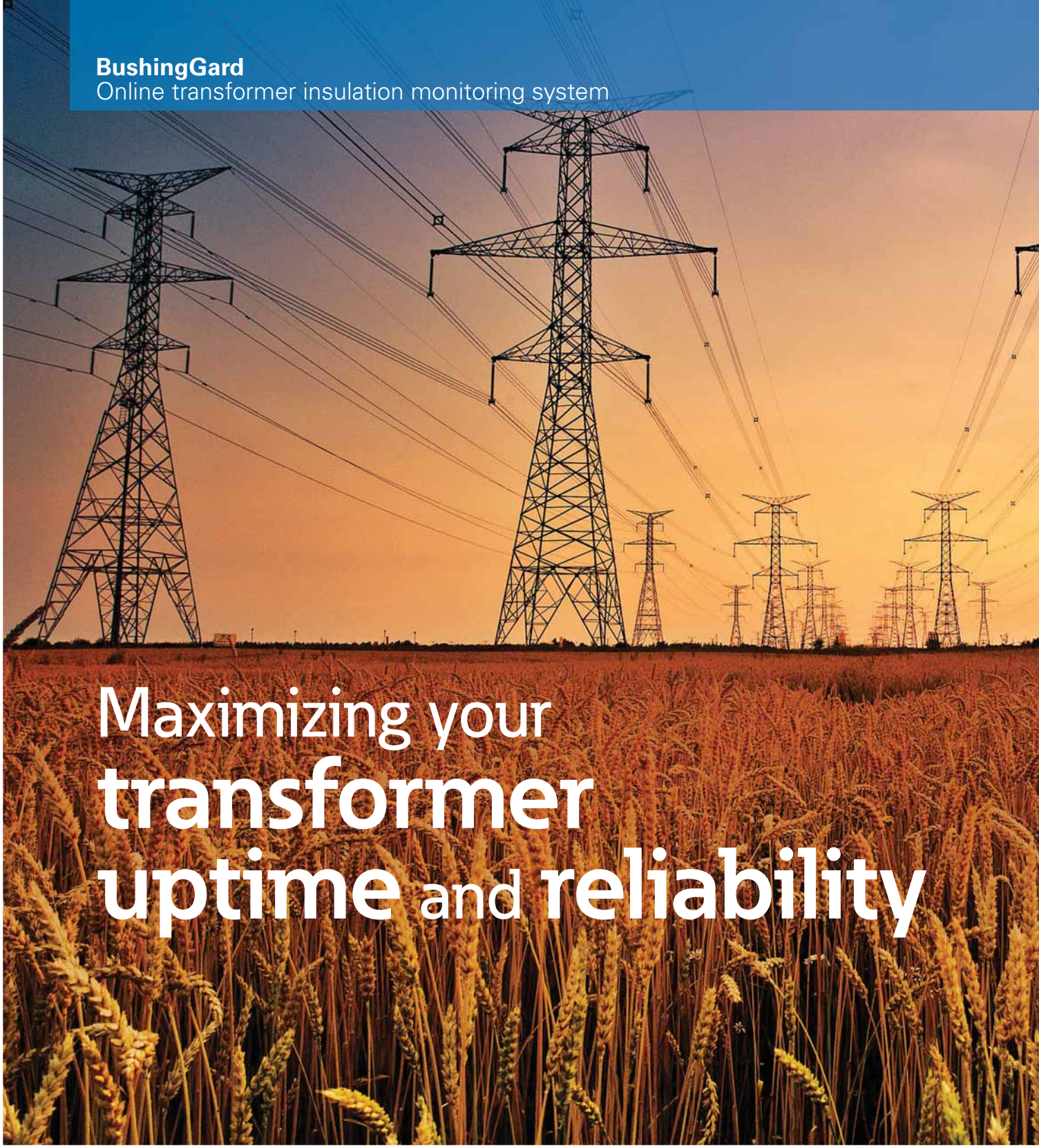
BushingGard
Online transformer insulation monitoring system



Maximizing your **transformer uptime** and **reliability**

EATON
Powering Business Worldwide

BushingGard maximizes uptime and reliability

When insulation breakdown accounts for 84 percent[1] of transformer failures and up to 92 percent of electrical failures are random[2], ensuring uptime and reliability may seem like an impossible task… but not any longer.

The BushingGard™ is an online, continuous testing tool designed to monitor bushing insulation integrity on large power transformers. It allows you to evaluate the condition of your equipment at any time, in a cost-effective manner.

Critical energy transfer

Large power transformers are found around the world at utility, industrial and commercial sites. You know their importance and their common applications.

- Generator step-up (GSU)
- Substation or switchyard
- Industrial and commercial

You trust that they will work flawlessly since you understand how critical energy transfer is.

But what if they fail? How disruptive is it?

An unexpected transformer bushing or insulation failure can disrupt an industrial process, shut down a commercial site, cripple a power plant or cause area-wide power outages. Depending on the extent of the damage caused, the disruption could last for weeks.

Eaton's Predictive Diagnostics has a worldwide reputation for online monitoring technology.

[1] IEEE® Std. 493-1997

[2] University of Tennessee—Asset Management Seminar, November 1999

How BushingGard operates

Changes in bushing capacitance and power factor are indicative of insulation deterioration. The BushingGard detects these changes by summarizing and balancing the currents of a three-phase bushing set at the time of commissioning. Then, the BushingGard continuously monitors the imbalance signal, which reflects the relative changes in both the power factor and capacitance of the bushing set. The BushingGard calculates capacitance and power factor for each bushing and calculates parameter Gamma, which reflects all these changes. The BushingGard also generates output Warning/Alarm signals if Gamma values exceed preset threshold.

Display panel

The monitor is designed to indicate bushing insulation status in several ways.

The alphanumeric display indicates:

- Measured bushing capacitance and power factor for each bushing
- Complex parameter Gamma for both monitored bushing sets
- Warning/Alarm monitored object status
- Auxiliary transformer parameters such as load current and oil temperature, as well as outside humidity

Three LEDs and three C-type relays indicate device status as well as Normal, Warning and Alarm status of monitored object.

BushingGard installed in NEMA 4 enclosure

BushingGard package contents

- Three or six transformer bushing sensors
- Oil temperature sensor
- Load current sensor
- The BushingGard monitor in NEMA® 4X enclosure
- BushingGard software

All device parameters are programmable using a front panel keypad or remotely through a computer using special software that represents all measured parameters in a convenient way for analysis.

Before each measurement, the unit performs self-diagnostics to ensure proper operation and will indicate any malfunction locally and remotely.

Sensor installed in capacitor tap of bushing

Communication

The BushingGard is also designed to communicate with a Digital Control System (DCS) or Supervisory Control and Data Acquisition (SCADA) system. Three relays (Warning, Alarm, and Error Status) will notify the operation center when a problem occurs.

The BushingGard comes standard with diagnostic software, and USB and RS-485 Modbus® RTU ports for on-site communications. Or, it is available with a commercial-grade cellular modem for remote communication.

Bushing sensors

Three or six bushing sensors are available with the BushingGard package. The sensor output current contains two components: AC current through the bushing and partial discharges originating in the bushing insulation. Also, partial discharges originating in the transformer winding and connected power lines can be measured through this sensor output. Eaton offers various transformer bushing sensors for different bushing tap designs. Customized bushing sensors are available with appropriate lead-time. Our standard sensors are designed for bushings with rated voltage of up to 800 kV.

BushingGard allows partial-discharge measurements

The BushingGard allows you to monitor partial discharge activity in both bushing sets and the transformer itself using the same sensor set. Like power factor and capacitance changes, partial discharges are also indicative of insulation breakdown.

The BushingGard houses six BNC connectors—one for each phase of each winding—which allow connection to our InsulGard for continuous monitoring, or to Partial Discharge Analyzer (PDA) used for periodic partial discharge measurements. Online monitoring of partial discharge (arcing or sparking) can help provide a root-cause analysis of discharge activity related to the bushing and winding insulation as well as various internal connections.

Keep your power flowing

Eaton's BushingGard is a continuous, online insulation integrity monitoring system for large power transformers. It offers the following benefits:

- **Maximizes uptime**
  The BushingGard conducts testing online. Therefore, unnecessary maintenance outages are eliminated. The productivity of your transformer is enhanced.
- **Eliminates inherent flaws of interval-based testing**
  Interval testing is fine if you do it regularly. Yet, too often, the interval between tests is too long to detect an impending failure. Trusting this "hit or miss" method is not ideal because you won't know when a problem started and how rapidly it is progressing. The BushingGard conducts tests continuously and notifies you of impending problems in advance.
- **Provides more accurate information—Enhances risk management**
  Offline testing methods can differ considerably from real operating conditions: the temperature is different, the voltage stresses are much lower and vibration is nonexistent. Moreover, typical power factor testing is conducted at 10 kV—usually well below real operating conditions. Consequently, it is possible to underestimate the dielectric losses (power factor) in the bushing insulation. BushingGard eliminates these issues through continuous online monitoring.
- **Reduces labor costs**
  Because the device conducts the tests, you won't have to use personnel to conduct the tests. Their time can be redirected to solving problems rather than uncovering them.
- **Prevents surprises**
  An unexpected transformer bushing failure can disrupt an industrial process, shut down a commercial site, cripple a power plant or cause area-wide power outages. Depending on the extent of the damage, the disruption could last for weeks. The BushingGard can help you avoid surprises by providing continuous information.
- **Easy to install**
  The BushingGard is easy to install and requires minimum resources and outage time. It's a self-contained unit that only requires connection to the sensors, input power and optional remote communication. Its robust construction provides reliable operation given extreme elements or electrical interference. BushingGard comes standard with a NEMA 4 enclosure.

Maximize your uptime

For more information about online diagnostic systems and sensors, please visit **Eaton.com/pd**

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