



Eaton's InsulGard mitigates unexpected motor failure risk and improves production uptime for The Linde Group's facilities

Location:

Hartford, IL

Challenge:

Development of a predictive intelligence and remote monitoring solution capable of protecting the performance and lifespan of large, mission-critical medium-voltage (MV) motors used in manufacturing industrial gases

Solution:

Eaton's InsulGard® partial discharge monitors installed on all of The Linde Group's MV motors; including remote monitoring of the units, issues reporting and response recommendations

Results:

The InsulGard solution successfully identified partial discharge activity affecting equipment valued at \$1.3M and avoided an extended downtime for The Linde Group with an estimated impact to their business of \$1 to \$3M.

Background

Founded in Germany in 1879, The Linde Group is the world's largest industrial gas company by market share as well as revenue and a leading multinational supplier of industrial, process and specialty gases. Linde products and services span nearly every industry in more than 100 countries around the world.

The Linde Group relies on large, medium-voltage (MV) motors to run the compressors that are needed for creating many of its leading industrial gases. These MV motors represent some of the largest and most mission-critical electrical assets used in The Linde Group's core business worldwide.

In 2005, the reliability engineers at The Linde Group's headquarters facility began actively looking for technologies that could more accurately predict insulation failures affecting Linde's MV motors worldwide.

The company became interested in leveraging predictive intelligence solutions that would more strategically minimize the downtime of the MV motors, while also extending their reliability and lifespan.

Challenge

Because The Linde Group is dedicated to ensuring reliability, efficiency and safety across its global facilities, it wanted to take a more proactive stance to protecting its people and its equipment.

Motor insulation failures and downtime cause huge problems for The Linde Group's operation, as many times they are providing industrial gases directly to customers on-site.

The Linde Group became interested in working with Eaton because it offered an attractive diagnostic solution coupled with remote monitoring of global sites using cell modems and FTP protocol. Eaton had created an infrastructure to collect data from each site and could provide the customer with web access to their data as well as monthly reports and recommendations.

Eaton consulted with The Linde Group through a series of extensive customer meetings and training sessions.

The team felt that its InsulGard solution could provide automated intelligence about the wellness of the electrical insulation in most of Linde's MV motors, enabling better decision-making for managing its electrical assets and increasing the safety of its personnel.

Solution

After becoming more familiar with The Linde Group's manufacturing processes, electrical equipment and reliability concerns, Eaton began the process of supplying its InsulGard partial discharge (PD) monitors on most of Linde's MV motors. Eaton also provided remote monitoring of those InsulGard units as well as issues reporting and recommendations for response to potential failures identified through the process.

Eaton's InsulGard solution mitigates risk by measuring PD activity in MV electrical equipment. The system analyzes radio frequency (RF) signals emitted by the PD pulses, measures pulse quantity and magnitude, and then correlates the data to temperature, humidity and load at the time of measurements.

Data is collected daily from the units and then screened for abnormalities. If PD levels exceed programmable set points, alerts are initiated.



Powering Business Worldwide

These alerts and alarms are triggers for Eaton's highly qualified PD staff to look more closely at the data. With the remote monitoring solution, the data is at the PD engineer's desktop without physically touching the InsulGard unit.

"In many circumstances, InsulGard can dramatically increase the lifespan of critical MV equipment by monitoring the health of the insulation system," said Joel Benzing, product manager, Eaton. "Eaton's mix of predictive diagnostics and expert analysis makes the InsulGard monitor highly effective without the costs associated with periodic on-site testing."

Detection is completed entirely online, with the complete electrical system energized so that the inaccuracies of offline tests can be eliminated.

"Linde was impressed with Eaton's PD monitoring expertise and its ability to create a remote monitoring solution specific to our global customers' needs," said Dan Reed, conditions based maintenance manager, The Linde Group. "Other competitors were not offering a monitoring solution as agile, comprehensive or user-friendly as the solution offered by Eaton."

The intuitive reporting provided with InsulGard's remote monitoring service makes it easy to determine the motor condition. Eaton's Online Viewing Portal provides clear visualizations of data trends so that The Linde Group can quickly assess the monitored equipment's health. Eaton's world-renowned PD experts provide additional support and protection.

The remote monitoring solution was implemented in September 2014 in the UK, and PD detection on Linde's MV motors soon became a normal monthly routine. The Eaton solution featured a Monthly Insulation Integrity Report.

Results

In May 2015, Eaton flagged an MV motor showing elevated activity on the InsulGard monitor during routine remote monitoring. Both the Linde regional electrical engineer and Eaton reviewed the data and together they concluded that the activity was occurring in the motor termination box.

A planned outage was scheduled for June to investigate the activity; however, it had to be postponed until December. Eaton PD engineers were continually consulted during the extended period. During the outage, the motor termination box was opened and evidence of PD as well as tracking was confirmed.

The InsulGard activity data had correctly identified evidence of a developing problem. And, because the team was alerted, the Linde regional electrical engineer was able to correct the problem proactively, before it triggered a failure in the MV motor.

Because The Linde Group took action quickly to address the PD activity discovered through the InsulGard solution, the company avoided a potential equipment failure that might have cost an estimated \$1.3 million in impact to the business.

But as each unplanned outage for The Linde Group could cost the company between \$1 and \$3 million depending on the length of downtime, additional cost savings were secured for the company in its ability to plan reliability events and other standard maintenance periods more strategically.

As a result of the successful discovery of a PD concern on one of its MV motors, The Linde Group now ensures that all CBM reports are thoroughly reviewed so that an action plan can be developed for all abnormalities:

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EXECUTIVE SUMMARY

On September 6th, 2013 data accumulated in InsulGard PD monitors was sent to Eaton from the Hartford, IL plant for data analysis.

The high magnitude sparking detected in the termination box should be investigated, although no critical pre-failure conditions were discovered at this time.



Motor CP-7079

- **PD levels and Risk of Failure** for the machine is classified as **MODERATE to ELEVATED**.
- Coupling Capacitor Phase A recorded low PD from 4/2011 through 5/2012 but following a 10 day outage the sensor has detected very high magnitude low repetition rate sparking. Phase C coupling capacitor began detecting high magnitude (~900mV) sparking on 6/1/2013. Coupling Capacitor A has detected magnitudes ~2V with low repetition rates. Coupling Capacitors B has detected low levels of PD with magnitudes <200mV and repetition rates <4400 PPS (75 PPC).
- Maintenance records from 5/2012 and 5/2013 may shed more light on why the PD spikes on Phase A and Phase C are occurring.
- The high magnitude sparking could be caused by a conductor under floating potential. This does not typically pose an immediate danger, but over time this sparking will cause a buildup of ozone which will cause surrounding material to deteriorate faster and potentially cause other, more serious problems. You should investigate the termination box (using an ultraviolet scope or ultrasound gun, if needed) to determine if the location of the sparking can be found and remedied.

A sample of the analytic report provided to the customer right after the incident occurred.

- The company has established a Perpetual Learning program around the reports so that engineers throughout its global locations can share and learn from investigations
- The company has adopted the use of Equipment Health Programs to assure its critical equipment maintains optimal uptime

"For more than five years, Eaton has been leading the way in innovating and refining its industrial remote monitoring solutions like InsulGard," said Jim Kozusko, manager, Electrical Engineering Services & Systems Division, Eaton. "A core objective of the InsulGard monitor is to provide peace of mind for our customers—ensuring the efficiency, reliability and safety of their most valued electrical equipment assets—so that they can focus more on achieving the goals of their core business."

"The partial discharge analysis data provided by Eaton's InsulGard monitoring solution allows engineers to identify potential electrical problems before they become much worse," said Reed. "By working closely with qualified equipment vendors and electrical contract partners, industrial manufacturers can prevent substantial failures that might otherwise be financially devastating."



Insulation deterioration within the terminal box motor CP11.



Findings affecting the termination compartment.

To learn more, visit
Eaton.com.