

USE OF WEB BASED PARTIAL DISCHARGE MONITORING TO EXTEND ASSET LIFE

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ABSTRACT

A web based non intrusive partial discharge alarm is used in an Innovation Funding Incentive (IFI) field trial to show a reduced failure rate of medium voltage (MV) switch gear, reduced supply disruptions and increased longevity of MV plant equipment functionality.

The benefits of using a web based non-intrusive partial discharge alarm are demonstrated by the case study of two failures that were prevented by use of the equipment.

INTRODUCTION

Partial Discharge (PD) is accepted as being one of the major causes of Medium Voltage (MV) switchgear failure [1&2]. Over recent years non-intrusive partial discharge measurements have become an effective tool for network operators to assess the condition of their switchgear without taking it out of service [3].

Utilising commercially available, small, handheld PD detection instruments, during routine maintenance visits, it is now both quick and simple to assess the condition of equipment. This results in enhanced operator safety, switchgear condition assessment and improved asset management, resulting in improved network reliability. Using permanently installed monitoring equipment would vastly increase these benefits, allowing 24/7 monitoring of potential problems, with an alert system that allowed personnel to be both reactive and proactive, resulting in a reduction in site visits.

This challenging task of getting the right information to the right people at the right time, and its practical application in reducing MV switch gear maintenance and failure is solved by the use of the new EA Technology UltraTEV Alarm.

DESCRIPTION OF THE SYSTEM

The Alarm Solution

The EA Technology UltraTEV Alarm is a semi-permanently installed partial discharge alarm system. It consists of multiple sensor devices (nodes) connected in a 'daisy-chain' to a single device that collects and interprets data from the nodes (hub). The standard node combines transient earth voltage (TEV) and ultrasonic sensors. The TEV sensor will detect internal discharges such as voids in cast resin insulation whilst the ultrasonic sensors can detect surface discharge such as in air

insulated cable boxes or tracking in circuit breaker spouts. Using these two detection methods combined the UltraTEV Alarm can be used to monitor a wide range of MV assets. Other sensor nodes can be added to provide monitoring of cables and further ultrasonic monitoring points, in order to match the requirements of the substation.

There are many benefits to using an alarm type system as opposed to a complete measuring and monitoring system. The UltraTEV Alarm system will only generate alerts when there is significant discharge activity for a period of time. This allows the system to ignore any activity caused by short transients or switching events. As the device does not require all the measurement circuits of a monitoring system the cost of monitoring an entire substation is substantially reduced. This means that it becomes cost effective to install at a larger number of sites than would be possible if purchasing monitoring equipment. This can remove the need for routine site visits with handheld PD equipment.

The UltraTEV Alarm is especially useful at high risk sites, those with a history of PD or that either have intermittent activity or insignificant activity where there is a risk it will worsen. The system will only alert when the PD activity goes above the threshold. These alarms can be sent through a wired Supervisory Control And Data Acquisition (SCADA) system to a control centre via the in-built interface on the hub. Recording this information, analysing and relaying it from the control centre to the correct field personnel can often be a problem. Migration to a web based solution allows easy application of these systems in practice.

About iHost

The Nortech iHost is a web based SCADA platform already in use within the U.K. power industry for a variety of applications including power outage detection, fault passage indication, load and temperature monitoring, distance to fault location, circuit breaker control, meter reading and cable pressure monitoring. Support for new devices and features are being added continuously.

iHost provides a unified method of collecting data for a variety of different applications it supports a wide range of device types and protocols. The web interface allows access to data direct from any desktop PC with an internet connection. iHost can also be easily and quickly integrated with control room systems as it provides a consistent interface to the control room system regardless of the type of device being used.

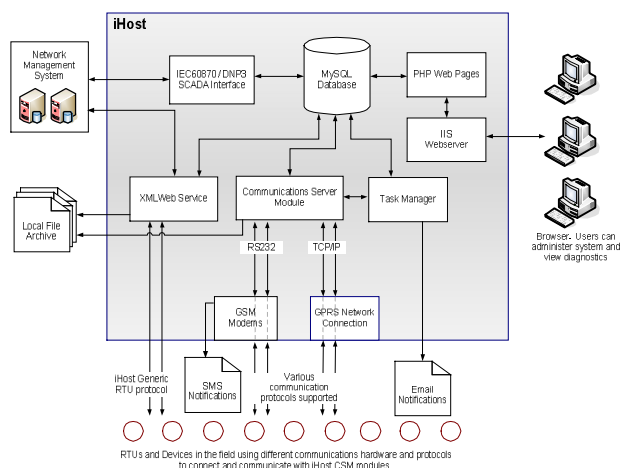


Figure 1 iHost Architecture

The benefits of an integrated web based solution

Integrating the UltraTEV Alarm with a Nortech embedded Remote Terminal Unit (RTU) allows the UltraTEV Alarm to communicate with the iHost system. This allows continuous remote monitoring anywhere in the world. The system logs alarms when partial discharge events are detected. It continuously monitors the ambient temperature and humidity of the site. It allows the remote reset of the visual/audible alarm on site.

The RTUs communicate to the server using GPRS as the primary communications channel. Using GPRS to send data to the server means that there are no international call costs to bear, this allows the UltraTEV Alarm to be deployed worldwide with minimal continuous costs.

The iHost server provides a web based user interface that can be accessed by engineers in the field, control centre staff and experts at EA Technology if required. This gets the right information to the right people when and where they want it. Users are also able to configure iHost to send SMS and e-mail notifications when a discharge has been detected. This ensures that the appropriate persons are notified when problems arise. Such a direct line of communication from substation to field engineering staff may greatly reduce response times for dealing with partial discharge before further damage takes place, consequently improving network reliability.

THE CENTRAL NETWORKS EXPERIENCE

Central Networks is one of the U.K. power distribution Networks. Central Networks brings power to 4.9 million customers across Central England. IFI is a U.K. Government incentive allowing companies to recoup a proportion of their research and development costs. As part of an IFI project Central Networks has recently installed a trial of partial discharge monitoring equipment at a number of primary substations. The insulation associated with high voltage

equipment can be prone to failure because of undesirable electrical discharge. This electrical discharge can occur due to the presence of contamination or moisture on the surface of the insulation or because of inherent faults within the insulation material.



Photograph of the system as installed on site.



Photograph showing ultrasonic sensor pointed at the circuit breaker spouts

Field Results

UltraTEV Alarm systems were installed at 11 selected sites within Central Networks where switchgear with a known history of partial discharge activity was located. Initial indications suggested significant partial discharge was occurring at several of these sites.

Figure 2 shows correlation between PD activity and humidity detected at one of the sites using the UltraTEV Alarm. The switchgear at the location shown in the graph had a known history of PD activity. The site has now been installed with dehumidification units and the switch room sealed. The UltraTEV Alarm will be used to allow the identification of a humidity threshold necessary to minimise the PD activity. This is an area where further research is currently being undertaken by Central Networks and the results will influence future substation design standards.

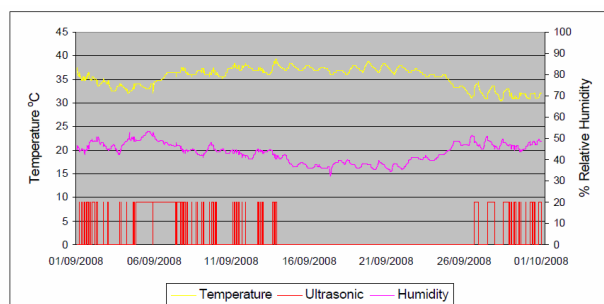
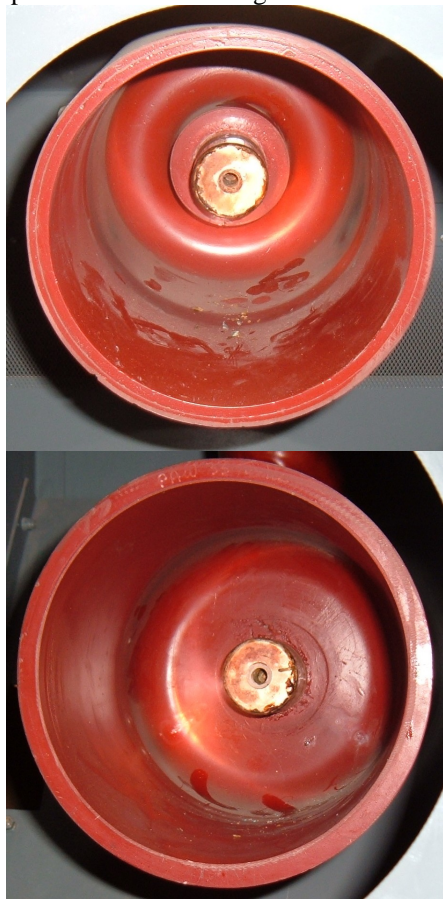


Figure 2 Ultrasonic discharge alarms as an association with humidity and temperature at one site

The switchgear at two other sites was investigated with advanced stages of deterioration of the insulation and associated equipment found due to partial discharge activity. If the partial discharge had been left to develop unchecked then it is possible that the switchgear could have failed.



Photographs of deterioration damage caused by PD detected with UltraTEV Alarm

Central Networks has yet to fully develop a Strategy regarding any permanent Partial Discharge monitoring on plant. The current units have been installed as part of an IFI trial and the main reason for choosing the particular sites for installation was that these sites had a previously identified history of partial discharge. This demonstration has the short term aims

of allowing:-

- 1) Central Networks field staff to be aware of any PD Activity at a particular site.
- 2) Central Networks maintenance staff to quantify the frequency and duration of any PD occurrence.

In the longer term this PD monitoring aims to allow Central Networks to correlate any detected PD events with external system activity or changing environmental conditions. This will allow the company to consider beneficial modifications to operational practices or substation building requirements (e.g. dehumidification levels). Once sufficient experience of the capabilities of this particular equipment has been gained, a decision will be taken on the need to retain permanent installations at specific sites.

This particular equipment was chosen because in addition to having known reliability, it is non-intrusive and does not interfere with the normal operation of the switchgear. It has the advantage that it can be easily redeployed. The Local indication provides a useful guide as to any PD activity to field staff, while the remote indication provides up to date information on PD activity at all sites, resulting in saving regular visits to download this information.

Central Networks is very interested in PD monitoring techniques and believe that these techniques have considerable potential for the early identification of faults in electrical equipment, allowing proactive investigations to be considered with consequential improvements in employee safety and equipment integrity.

CONCLUSION

This trial of the non intrusive partial discharge alarm in every day usage leads us to conclude that there will be increased life expectancy of MV switch gear, a reduction in equipment failure, resulting improved network performance and maintenance costs.

REFERENCES

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