Identification of Partial Discharge phenomena in HVDC apparatus

Take advantage of Techimp GLOBAL Monitoring System “diagnostics all in one”
Introduction

In the next 5-10 years, Ultra-High DC (UHVDC) systems with voltage levels up to 1000 kV are going to be built in some countries like China, Brazil, Russia and South Africa, where large remote power plants need to be connected with metropolitan or industrial areas. The strategic importance of these links, together with the technological challenges brought about by the development of UHVDC apparatus, have emphasized the issue of reliability of HVDC and UHVDC systems.

Partial Discharge Phenomena in HVDC Apparatus

Detecting PD in HVDC apparatus and systems can help highlighting insulation flaws. In order to improve reliability of HVDC apparatus and systems it would be important to distinguish among defects of different harmfulness. However, the key concept for PD source identifications, the phase-resolved PD pattern, loses meaning under DC voltage, so that conventional techniques for PD source identification are no longer applicable. Techniques based on the statistical correlation between subsequent PD events have been proposed to identify PD sources under DC voltage.

As a matter of fact, Techimp monitoring systems represent the ideal and ultimate solution for the CBM of electrical apparatus.
Techimp Solutions for PD Testing of HVDC links

Motivation

Partial discharges (PD) can reveal the presence of localized defects as, e.g., delaminations, cavities, polluted grading systems or trees. Fundamental information for asset managers can be gained, therefore, from PD testing of HVDC apparatus.

Important issues

In HVAC apparatus, the phase-resolved PD pattern helps operators to separate noise from PD and identify PD sources. Both steps and, in particular, identification of PD sources, are fundamental prerequisites to achieve effective condition assessment.

In HVDC apparatus the PD pattern cannot be evaluated: new solutions need be found to achieve:

(a) noise rejection
(b) source identification.

Techimp 2-step (2S) approach

1. PD pulse separation

Techimp makes extensive use of its proven technology to separate PD pulses having different shapes. Since noise pulses are generally different from PD pulses, separation allows for noise rejection.

2. PD source identification

PD source identification is based on statistical analysis and artificial intelligence tools fully developed by Techimp R&D department.

Separation Identification Diagnosis

- Noise rejection
- Source Separation
- Potential defect harmfulness (one source at a time)
- Risk assessment
- Maintenance program
- Life extension

PD inference is the prerequisite for correct diagnosis
Techimp Solutions for PD Testing of HVDC links

Techimp provides PDCheck (or PDBase II) with the most advanced software tools for PD data analysis and identification.

These tools are based upon the SID (Separation, Identification, Diagnosis) strategy and allow noise rejection, PD source separation and identification.

Techimp patented technology provides a powerful and efficient diagnostic approach able to disentangle even the most critical PD phenomena, thus improving PD identification from different overlapping PD and noise sources.
Separation of noise and interference in a HVDC test circuit

This technology is readily applicable in HVDC applications. Signals coming from PD sensors are processed through an electronic equipment which preserve information about PD pulse envelope, thus enabling Techimp technologies to be applied.

As an example, using PDBase II and PDCheck filtering map, it is possible to separate HV external corona from internal PD in HVDC apparatus.
PDCheck Acquisition unit

Accurate knowledge of the condition of electrical assets is essential for the establishment of Condition Based Maintenance (CBM) strategies. In this frame, on-line monitoring is getting more and more important since this practice can provide timely information about asset conditions.

Partial Discharge (PD) measurement is recognised as the most important test for the assessment of the condition of electrical systems.

Reliable on-line PD Monitoring provides insights into condition of an insulation system. This allows early fault detection, thus minimising costly unplanned outages and equipment failures.

Techimp provides a complete solution for HVDC, representing the utmost state of the art of the technology commercially available. Techimp Technology for HVDC consists of a global monitoring unit PDCheck and Sensors with accessories covering all the possible ranges of applications and PD measurements in HVDC.

Techimp PDCheck (patented) is the ultimate solution for industrial monitoring: it is a compact, stand alone and portable global diagnostic system for the condition assessment of medium and high voltage electrical systems based on the detection and analysis of PD.

New feature: DC - PD software for noise rejection, separation and identification of PD phenomena in DC apparatus

### Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
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<tbody>
<tr>
<td>PD Input channels</td>
<td>3 PD channel + Synchronization (phase reference) channel</td>
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<tr>
<td>Bandwidth</td>
<td>Wide Band Acquisition PD channel 16kHz÷30MHz built in (up to 2GHz with Techimp Frequency Shifter)</td>
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<tr>
<td>Acquisition rate</td>
<td>100MS/s, 3 channels</td>
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<tr>
<td>Input channels for AC signals</td>
<td>Quantity: 3 AC inputs. Bandwidth: 0.2 ÷ 5000 Hz</td>
</tr>
<tr>
<td>Input channels for DC signals</td>
<td>Quantity: 4 DC inputs. Resolution: 14 bit</td>
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<tr>
<td>Platform capability</td>
<td>DGA, Tanδ, VibroM &amp; DTS integration option</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>5 ÷ 50 °C (operating temp.)</td>
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<tr>
<td>Ambient HR</td>
<td>10 ÷ 90% (not-condensing)</td>
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<tr>
<td>Data Storage</td>
<td>Up to 3 years</td>
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<tr>
<td>Output</td>
<td>Fiber Optic; RJ45 Ethernet ; Dry contact board; Advanced Web Messaging Services</td>
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<tr>
<td>Software</td>
<td>Optional Techimp Software for CERTIFIED 60270 COMPLIANCE</td>
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<tr>
<td>Overall dimensions</td>
<td>250mm x 180mm x 55mm</td>
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<tr>
<td>Weight</td>
<td>c.a. 1 kg</td>
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<td>Power Requirements</td>
<td>5 VDC, 2A</td>
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<td>Warranty</td>
<td>One year</td>
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Take advantage of Techimp GLOBAL Monitoring Systems on line diagnostics all in one

Based on multiple on-line diagnostic advanced techniques

Our Vision:

Apparatus

✓ Multiple subsystems
✓ Multiple failure modes

Approach

✓ One apparatus where multiple sensors provide complementary information
✓ Shrink monitoring costs
✓ Exploit synergies between information provided by different diagnostic techniques
✓ Enhance diagnostic capability and apparatus reliability
✓ Reduce overall maintenance costs

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