

CASE STUDY: PARTIAL DISCHARGE TESTING FINDS FOREIGN OBJECT

Company: Major Western Canadian Utility
 Plant: Confidential
 Unit: Hydro-generator, 34MW, 14.4kV, 120rpm
 PD sensors: 80pF PDA couplers
 Date: April 2002

On-line partial discharge testing was developed to monitor specific failure mechanisms within stator windings. It also plays an important role in determining the effectiveness of maintenance. PD testing helped one organization find a rag left in their stator winding from a maintenance outage!

In early 2002 an outage was scheduled for a hydro-generator, 1962 vintage. On-Line Partial Discharge readings had been taken on this unit since 2000 using Iris's PDA technology for hydro-generators. The organization has its own portable TGA-SP™ instrument in addition to the HydroTrac™ continuous on-line PD monitor.



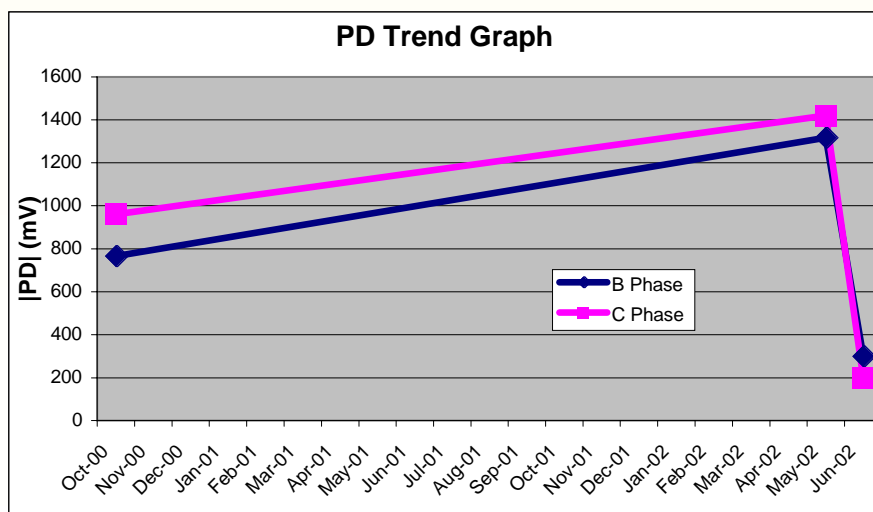
Prior to the maintenance outage in early 2002 there had been no indication of insulation problems as indicated by both the TGA-SP or HydroTrac instruments. The outage was for a simple cleaning of the endwindings. After the outage, to the owner's surprise, very large partial discharge readings were measured. This caused immediate concern as the company has faith in the Iris Partial Discharge test. They immediately consulted with Iris to have a formal data interpretation report provided. Iris concluded that the large discharges were occurring phase-to-phase originating between B and C phases.

In fact, since the PDA couplers are located within the generator tapped off the circuit ring bus, the Iris system is able to determine from which end of the circuit ring bus the high PD activity originates. In this case, it was closest to the C1 PDA couplers (indicated by graphs shown below).

After a few phone calls and receiving the report, the owner was able to schedule an outage, to search for the source of this high PD activity. Careful inspection found a rag stuck in between the end-winding left over from recent cleaning of the windings. On the left is a picture showing the rag. As can be seen, it wasn't the easiest item to locate, especially since they weren't specifically looking for a rag.

After close inspection, they found that the edges of the rag had actually started to carbonize. The rag had created an electrical path for small currents to "track" across between B and C phases in the end-winding. The rag, dirty from use, had essentially become semiconductive capable of carrying small currents. At either end of this rag, partial discharges would "spark" to the respective phase on the surface. This discharging induces small current pulses on the copper conductors, which then travel to where the PDA couplers are permanently installed on the circuit ring bus. Such discharging should not cause serious immediate concern to owners of machines. However, if not taken care of eventual machine failure will occur phase-to-phase in the endwinding. This may take 10-12 years to happen for machines in the 13.8kV range with good insulation or only a couple of years with poor insulation and a rag that conducts ever increasing currents.

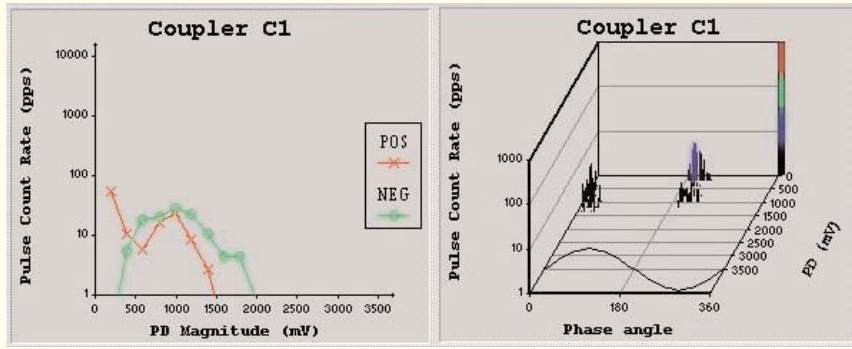
The owner put the machine back in service after removing the rag without doing any other maintenance to the machine. Follow-up PD testing indicated a significant reduction in PD activity as shown in the graphs below.



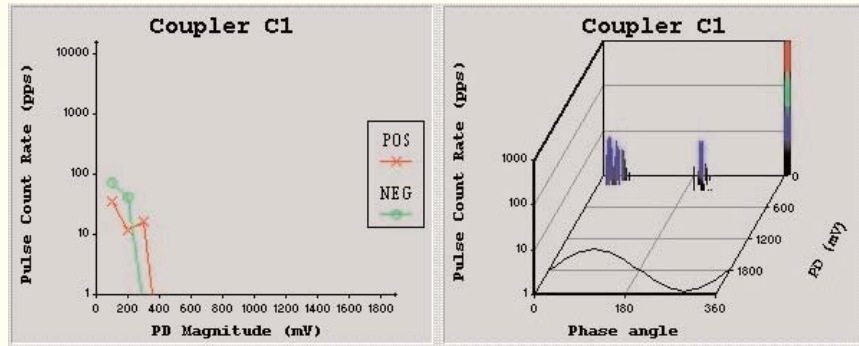
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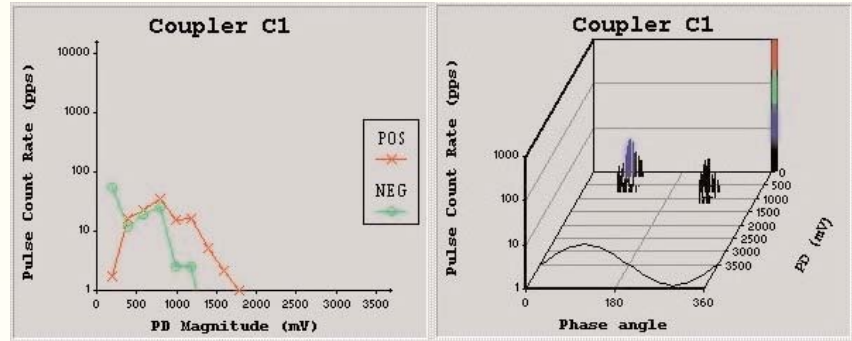
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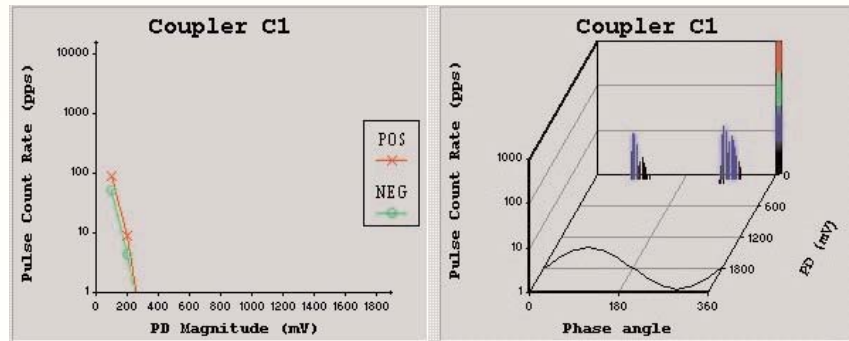
B ϕ PD before with rag in place



B ϕ PD after rag removed



C ϕ PD before with rag in place



C ϕ PD after rag removed



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