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Experience with IPB PD sensors on large turbine generators

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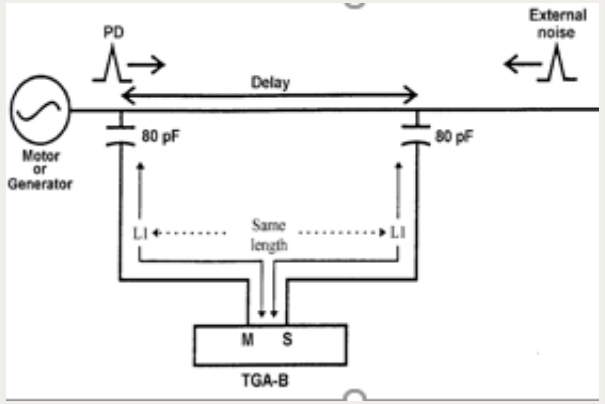
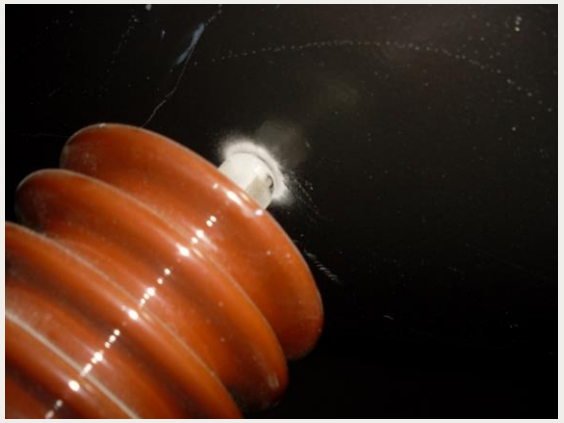
Experience with IPB PD sensors on large turbine generators

- In a large Canadian Electrical Association (CEA) project performed by Ontario Hydro (now called OPG) non-contact capacitive PD sensors such as those described in Paper 10125 were installed on the IPB in many dozens of turbine generators rated 300-1000 MVA in the 1980s [1].
- Used either isolated metal foil, insulated inspection covers and/or the isolated metal base of ceramic IPB post insulators – all with a capacitance to the HV bus of a few to several pF
- Used a pair of sensors per phase and the time of arrival method to separate stator PD from noise between the pair of sensors and noise from beyond the "system" sensor
- Discontinued such non-contact sensors since they frequently could not be installed as close to the generator bushings as conventional 80 pF sensors could be, and often there were no IPB inspection hatches in the appropriate locations
- Also, due to low capacitance, including the use of RF impedance matching transformers, the signal level was an order of magnitude less than 80 pF sensors, and varied from IPB to IPB, making sensitivity (and thus interpretation of PD magnitudes) inconsistent



Experience with Time of Arrival noise separation

- With sensors connected to oscilloscopes or instrumentation in the 0.1-350 MHz frequency range, separating stator PD from noise was effective **ONLY IF** there was no arcing sparking from the flexible leads connecting the TG bushing to the IPB, or there were no (harmless) discharges from the first IPB post insulator
- Regrettably, a survey of operating bus shows that about 30% of large TGs have such (relatively) harmless arcing/discharging sources – which makes it extremely difficult to interpret data from such installations, causing a high false positive indication rate.
- 80 pF couplers (connected to the HV bus) have since been installed (2 sensors per phase) in about 12,000 TGs
- Compared with SSC types sensors in the stator slots in large H2-cooled TGs, IPB sensors have a higher false positive indication rate due to relatively harmless arcing/sparking at the TG terminals [2]
- Of 50,000 couplers installed on TG IPB since 1994, there have been no in-service failures of 80 pF couplers, since they exceed the requirements for capacitive coupler reliability in IEC 60034-27-2 and IEEE 1434 (which is more stringent)



Questions for Paper 10125 Authors:

- What is the bandwidth of their measuring system? 2 m between the sensors is only meaningful if the bandwidth is >300 MHz
- Can endusers perform the measurements and interpret the results reliably?
- What is the false positive and false negative indication rates for stator PD?

References:

1. H.G. Sedding et al, “Evaluation of Coupling Devices for In-Service PD Detection on Thermal Alternators”, CEA Report 738 G 631, Nov 1992.
2. G. C. Stone et al, "Relative ability of UHF antenna and VHF capacitor methods to detect partial discharge in turbine generator stator windings," in IEEE Transactions on Dielectrics and Electrical Insulation, vol. 22, no. 6, pp. 3069-3078, December 2015.