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PD SIGNATURE IDENTIFICATION USING RF ANTENNA FOR CONDITION MONITORING IN POWER TRANSFORMERS

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Power transformer is a vital component in a power system. So to maintain the reliability of the power system, continuous condition monitoring of the power transformer is essential. To monitor its condition, one of the best ways is to monitor the status of partial discharges (PDs) appearing in the transformer. With aging of power transformers in the service, their insulation may get aged. As a result, PD may occur in the transformer as corona discharges in air cavities or in oil, or as surface discharges in its insulation interfaces etc. This paper deals with monitoring and analyzing of common types of PD patterns occurring in a power transformer.

In this paper, a Radio Frequency (RF) antenna was used to detect the electromagnetic signal generated due to three types of PDs i.e. corona in air, corona oil and surface discharge at interface. With preliminary investigations of different types of RF antennas by trial and error method, a loop antenna of diameter 200 mm was selected for the study. The three types of PDs were generated from laboratory set-ups. The corona set-up in air was prepared by a point plane gap with a gap setting of 20 mm whereas corona in oil was generated by dipping the same set-up in an oil container. The surface discharges were generated by keeping a transformer pressboard of thickness 5 mm between rod plane electrode system. Measured breakdown voltages for the setups used to generate corona in air, in oil and surface discharge were 25 kV, 30 kV and 10 kV respectively. The loop antenna was placed 1 m away from the setup and the captured RF signals were observed using a spectrum analyzer (anritsu-MS2661C-range 9 kHz-3 GHz) at different voltages up to 1 kV below the respective breakdown voltages. The antenna was aligned in such a way that the magnetic field generated by the PD was perpendicular to the plane of the loop.

In preliminary investigations, it was identified that the presence of the PD signal was high in 5 to 60 MHz frequency range. After analyzing the final results which were taken 1 kV below the respective breakdown voltages of each PD types, the power spectral density distributions were compared.. The highest peaks of three responses were observed at 9 MHz, 8 MHz and 8.5 MHz for corona discharge in air, corona discharge in oil and surface discharge respectively. Their magnitudes varied as 22dBm, 19 dBm and 17 dBm for corona discharge in air, corona discharge in oil and surface discharge respectively. When the HV supply was decreased the magnitudes of the spectral responses were reduced. It was found that the PD strength varied with the supplied voltage level. It can be concluded that RF antenna can effectively be used to identify different PD patterns.