ASSESSING INSULATION INTEGRITY OF CRITICAL FEEDERS AND SWITCHGEAR

The levels (magnitude and pulse rate) of partial discharge are a well known indicator of insulation quality and can provide information as to the expected life of the insulation.

Partial Discharge (PD) generally begins within voids, cracks, at conductor-dielectric interfaces within a solid insulation system, or in bubbles within liquid dielectrics. Since discharges are limited to only a portion of the insulation, the discharges only partially bridge the distance between electrodes. PD can also occur along the boundary between different insulating materials.

Partial discharges within an insulating material are usually initiated within gas-filled voids within the dielectric. Because the dielectric constant of the void is considerably less than the surrounding dielectric, the electric field (and the voltage stress) appearing across the void is significantly higher than across an equivalent distance of dielectric. If the voltage stress across the void is increased above the corona inception voltage (CIV) for the gas within the void, then PD activity will start within the void.

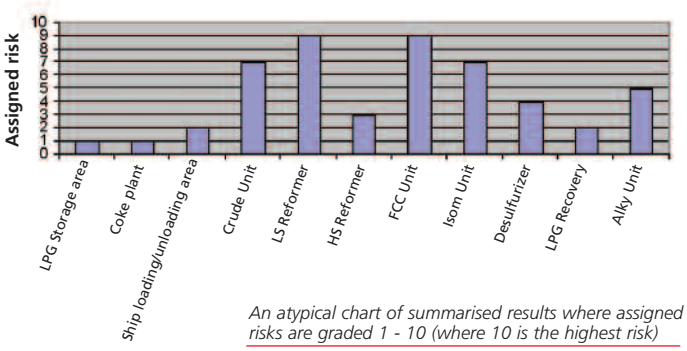
Once begun, PD causes progressive deterioration of insulating materials, ultimately leading to electrical breakdown. PD can be prevented through careful design and material selection. In critical high voltage equipment, the integrity of the insulation is confirmed using PD detection equipment during the manufacturing stage as well as periodically through the equipment's useful life using On-Line Partial Discharge surveys.

CASE STUDY

One of South America's largest refineries was experiencing random, insulation-based, cable termination and joint failures and required an independent report on the state of their High Voltage Cables and Switchgear. The problem was how to ascertain (while on-line and without loss of productivity) the insulation integrity of critical feeders and to prioritize which high voltage switchboard required maintenance in order to avoid a potential source of ignition and a forced outage.

In addition to reducing the potential risk of an ignition source in a zone 2 classification area, their production engineers needed advance notice to enable stockpiling of product to feed other sections of the refinery during the planned shutdown. The problem was exacerbated by the varying age of assets and different levels of maintenance across the entire site. Also, better financial management of assets and forecasts to suit capital funding requirements were critically needed.

Being able to target the exact area of high voltage Plant switchgear cables and motors is critical as it allows only the suspect area to be repaired or worked upon without affecting the rest of the refinery. It takes the guess work out of locating potential problems. By using On-Line Partial Discharge it is possible to determine which cable and where within the feeder a potential fault is developing. Once located repairs can be planned at the next outage thus ensuring increased reliability.



An atypical chart of summarised results where assigned risks are graded 1 - 10 (where 10 is the highest risk)

SOLUTION

The customer used On-Line Partial Discharge surveys conducted by High Voltage Solution Ltd (HVS) to monitor all cables / switchgear and cables (13 / 22 / 50kV). This will also be conducted on a regular 2 yearly cycle. The detailed report is graded, refer above diagram, providing the client with a condition of each high voltage asset. The client was provided with the following information.

- Identified problems within a switchboard / circuit breaker that allowed maintenance staff to look more closely in the areas identified.
- Report on each cable concerned showing levels of discharge where present. A rating was applied to allow the client to prioritise the order of repairs.
- Report on each HV termination concerned showing levels of discharge where present and a rating applied.

By re-visiting the refinery substations every 2 years, HVS will also be able to revisit the substations and cable circuits that had maintenance work carried out to ensure the work that was done did in fact correct the discharge problem. It is important that the report giving recommendations on how to carry out repairs gets to the appropriate field staff.

SUMMARY

Using On-Line Partial Discharge surveys allows critical information about the condition of the high voltage assets to be obtained without any outages occurring and the asset owner will always know the status of his equipment's insulation without having an outage. It also provides more effective financial management for capital funding requirements.

Levels (magnitude and pulse rate) of partial discharge are a well known indicator of insulation quality and can provide information as to the expected life of the insulation The measurements will also allow the customer to plan an outage; he can order spare parts and allocate manpower in advance.