

Thermal Securing of Electrical Contacts inside Oil Power Transformers

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Abstract : In the operation of power transformers of 110 kV/MV from substations, these are traveled by fault current resulting from MV line damage. Defect electrical contacts are heated when they are travelled from fault currents. In the case of high temperatures when 135 °C is reached, the electrical insulating oil in the vicinity of the electrical faults comes into contact with these contacts releases gases, and activates the electrical protection. To avoid auto-flammability of electro-insulating oil, we designed a security system thermal of electrical contact defects by pouring fire-resistant polyurethane foam, mastic or mortar fire inside a cardboard electro-insulating cylinder. From practical experience, in the exploitation of power transformers of 110 kV/MT in oil electro-insulating were recorded some passing disconnecting commanded by the gas protection at internal defects. In normal operation and in the optimal load, nominal currents do not require thermal secure contacts inside electrical transformers, contacts are made at the fabrication according to the projects or to repair by solder. In the case of external short circuits close to the substation, the contacts inside electrical transformers, even if they are well made in sizes of $R_{\text{contact}} = 10^{-6} \Omega$, are subjected to short-circuit currents of the order of 10 kA-20 kA which lead to the dissipation of some significant second-order electric powers, 100 W-400 W, on contact. At some internal or external factors which action on electrical contacts, including electrodynamic efforts at short-circuits, these factors could be degraded over time to values in the range of $10^{-4} \Omega$ to $10^{-5} \Omega$; and if the action time of protection is great, on the order of seconds, power dissipation on electrical contacts achieve high values of 1,0 kW to 40,0 kW. This power leads to strong local heating, hundreds of degrees Celsius and can initiate self-ignition and burning oil in the vicinity of electro-insulating contacts with action the gas relay. Degradation of electrical contacts inside power transformers may not be limited for the duration of their operation. In order to avoid oil burn with gas release near electrical contacts, at short-circuit currents 10 kA-20 kA, we have outlined the following solutions: covering electrical contacts in fireproof materials that would avoid direct burn oil at short circuit and transmission of heat from electrical contact along the conductors with heat dissipation gradually over time, in a large volume of cooling. Flame retardant materials are: polyurethane foam, mastic, cement (concrete). In the normal condition of operation of transformer, insulating of conductors coils is with paper and insulating oil. Ignition points of its two components respectively are approximated: 135 °C heat for oil and 200 °C for paper. In the case of a faulty electrical contact, about $10^{-3} \Omega$, at short-circuit; the temperature can reach for a short time, a value of 300 °C-400 °C, which ignite the paper and also the oil. By burning oil, there are local gases that disconnect the power transformer. Securing thermal electrical contacts inside the transformer, in cardboard tube with polyurethane foams, mastik or cement, ensures avoiding gas release and also gas protection working.

Keywords : power transformer, oil insulatation, electric contacts, Bucholtz relay

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