

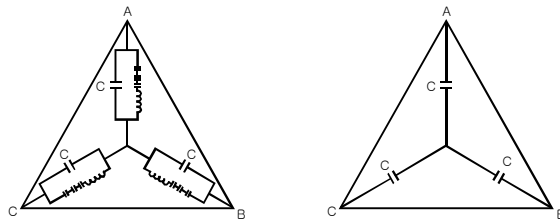
# Shifting of the Neutral Point on Ungrounded Systems

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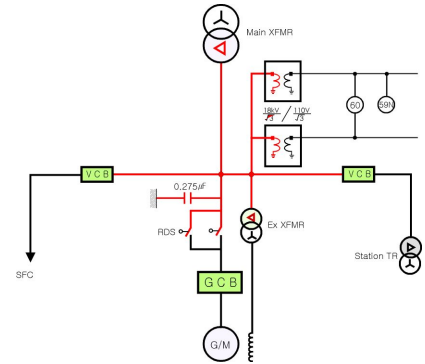
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This paper gives a brief explanation of four case studies particularly dealing with neutral point shift at power plant sites.

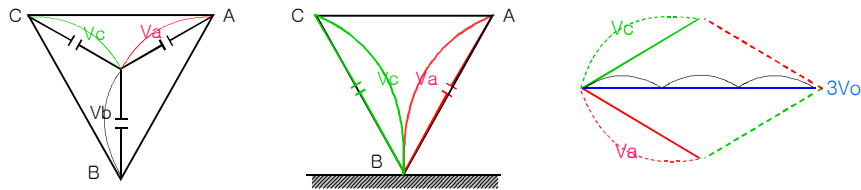


**Fig1. Neutral point of the capacitor**



■ **Case 1 : A Single Ground Fault**

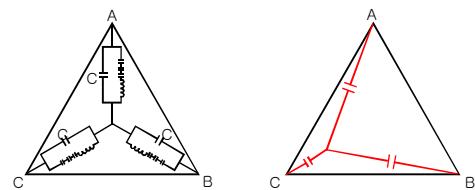
A single ground fault will raise the potential to ground of the remaining two ungrounded phases to their full line to line value (i.e can increase up to 1.73 per unit on the two phases) due to neutral point shift. If this fault is not found and corrected, a second ground fault might occur, which will possibly causing damage. An earth fault usually occurs in the IPB Polymeric High Voltage insulators, high humidity might be a problem.



**Fig 2 B-phase to Ground Fault**

■ **Case 2 : Unbalance of Capacitance to Ground**

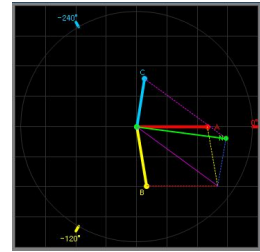
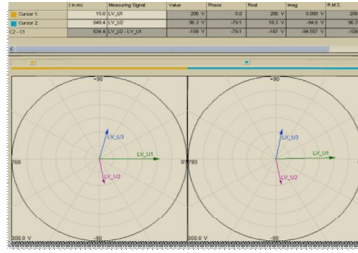
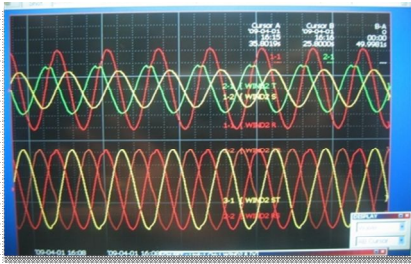
The unbalance of capacitance to ground between phases will result in neutral point shift. A small capacitance value connected from phase-to-ground can cause a large unbalance in phase-to-ground voltage. This will likely to occur if the surge capacitors have poor characteristics or improper capacitance.



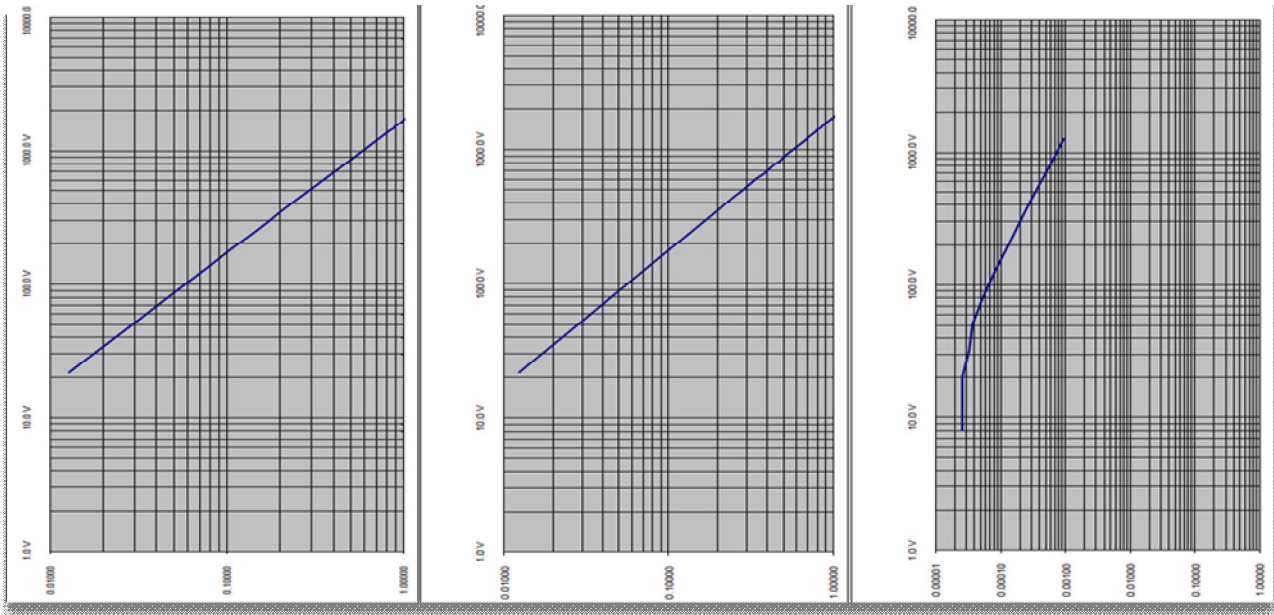
C = S.C + Capacitance of IPB + Capacitance of TR WDG

■ **Case 3: Variation of Excitation Characteristics of PT**

The variation of excitation characteristics of PT means the impedance variation in the primary winding and this eventually leads to the shifting of neutral point. Moreover, the increase of excitation current has a direct effect on the primary/secondary phase-to-phase voltages' characteristics. When analyzing such waveforms, note that the neutral point has shifted out of triangle as represented in the figures.



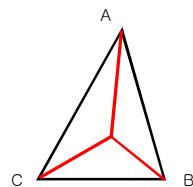
### Case 3 Waveforms



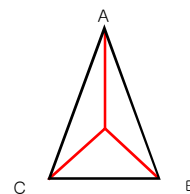
Case 3 Exhibition : Variation of Excitation Current of PT

#### ■ Case 4: Variation of PT ratio

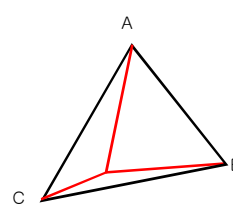
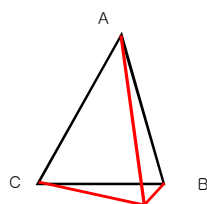
Even if the PT ratio changes, there will be no shift of the neutral point. However, the measured secondary voltage of PT on each phase will be varied with the time, and in consequence, the zero sequence over voltage protection relay is operated by the zero-sequence-voltage from an open-delta-connected PT or by a numerical relay. As shown in the case1 through case 3 where the neutral point is moved with respect to the phases, the secondary voltage of PT's line-to-line does not change where as phase-to-phase voltage changes. Except for case 4, there is significant variation both in phase-to-phase & line-to-line voltage. This would make it possible to easily identify one another.



Change of Two Phase Turn Ratio



Change of One Phase Turn Ratio



Composite Case of Turn Ratio & Exciting char.