SYSTEM NEUTRAL GROUNDING

Objective:

To study the effect of system neutral grounding on single line to ground faults

Introduction:

Neutral grounding has been in practice in many systems all over the world, but there are some systems, which still operate with ungrounded neutrals.
An ungrounded system is one in which there is no intentional connection between the system conductors and earth. When the neutral of the system is not grounded, it is possible for high voltages to appear from line to ground during normal switching of a circuit having a line to ground fault. These voltages may cause failure of insulation at other locations on the system and result to damage to equipment. A ground fault on one phase causes full line to line voltage to appear between ground and the two unfaulted phases. Line to ground fault on ungrounded neutral systems causes a small amount of ground fault current to flow which may not be enough to actuate protective relays.

The neutral of a system may be grounded through a resistance, reactance or directly. Generally, the neutrals of source transformers or generators with star connected windings are grounded. Grounding the neutral reduces the magnitude of transient voltages, improves protection against lightning, protection for line to ground fault becomes reliable, and improves reliability & safety. Also the potential of the neutral gets fixed, whereas in the ungrounded system, the neural remains floating.

The value of the reactance used to ground the neutral is chosen to either neutralise the capacitive current or to limit the line to ground fault current to that of a three phase fault current.

Procedure:

Part I:

Ungrounded neutral

- Connect as in FIG.1
- Keep S1 open, thus isolating the neutral of the transformer from the ground. Close S3. This is now equivalent to a line to ground fault on phase B.
- Vary the line to line voltage V1, starting at zero, and in steps of 50 V. For each value of V1 9L-L voltage at the sending end), note, Vo, I_R, $I_{Y,}$ I_B and V_{BY}. *Make sure that current in the line and the transformer is within the rated values.*

Part II:

a. Neutral grounded through a reactor

- Close S2 connecting the reactor Xo between the neutral & the ground. Keep S1 open as before.

- Keep the line to line voltage V1 constant at 230 V.
- Vary Xo from a large value to a minimum possible, keeping I_B within the rated current of the line. For each value of Xo, note Vo, I_F, I_R, I_Y, I_B, I_Xo and V_{BY}. Note *that I_F reaches a minimum.*

b. Neutral grounded through a resistor

- Open S2 and close S1. The neutral of the transformer is now connected to the ground through the resistor Ro.
- Keep V1 constant 230 V. vary Ro from a large value to a minimum possible, keeping I_B within the rated value. For each value of Ro, note Vo, I_F, I_R, I_Y, I_B, I_Ro and V_{BY}. Note *that I_F passes through a minimum.*

Report:

1. From the readings of Part I, plot each variable versus V1.
2. From the readings of Part II, plot each variable versus I_{xo} and I_{Ro} respectively.
3. Calculate the value of Xo and therefrom Lo for minimum value of I_F. Also calculate the value of Lo from $L0 = 1/(3\ \omega^2\ C)$ where C is the line to ground capacitance. Compare the two values of Lo and comment.
4. Calculate the value of Ro from the minimum value of I_F. Comment.

FIG.1