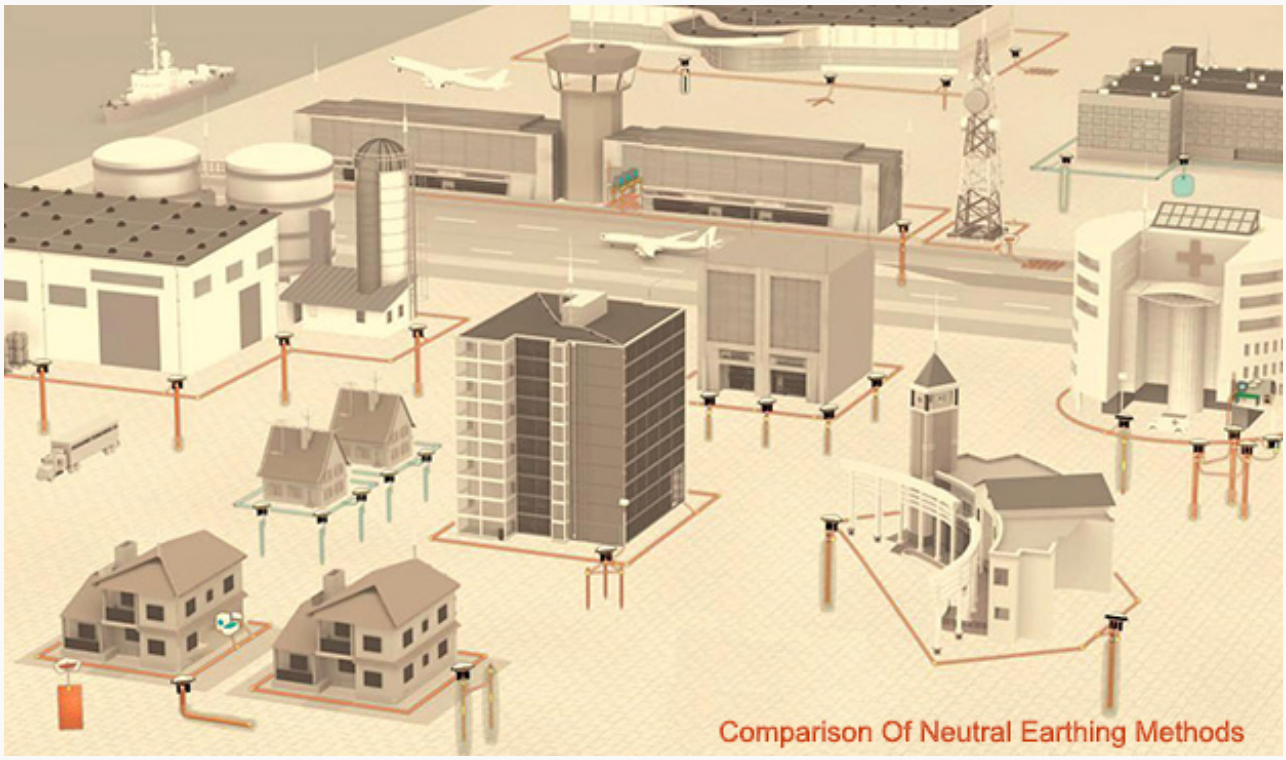
Comparison Of Neutral Earthing Methods

Edvard



Comparison Of Neutral Earthing Methods (photo credit to ISSCO GROUP)

Methods Of Neutral Earthing (Index)

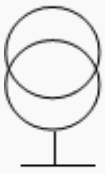
There are several methods for system earthing which can be generally divided into:

INSULATED NEUTRAL SYSTEM (No Intentional Earthing)

The neutral is not earthed directly. In reality,the electrical system is earthed ***through the system capacity to earth***.

The earth fault causes a few amperes fault current due to the cable capacitance current, and the voltage of healthy phases will not rise above the line to line voltage. So, the system can operate with present earth fault improving the system continuity and supply.

The detection of fault location is ***very difficult***. The main detection components is a ***voltmeter***. This method is typically used for ***LV networks***.



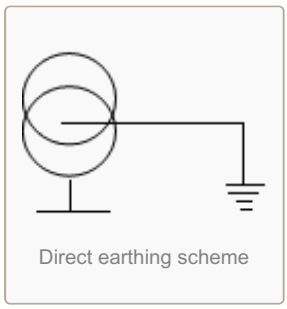
Insulated neutral system scheme

SOLIDLY EARTHED OR DIRECT EARTHING

The neutral of power transformers or generator is ***directly connected to station ground***.

The Fault current = the three phase symmetrical short-circuit current and can rise from 20 to 30 times the nominal current. The over-voltage in the healthy phase will not exceed the line to earth voltage.

No limitation of fault current when the system is solidly earthing.



Direct earthing scheme

IMPEDANCE EARTHING

The purpose of this method is ***to limit the fault current for greater safety***. There are three type of impedance earthing through:

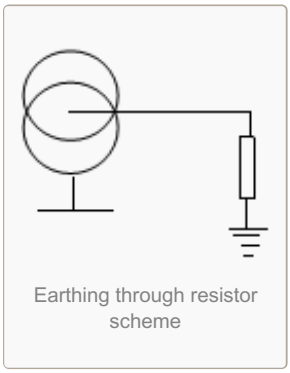
1. Resistor,
2. Reactance or
3. Arc suppression coil (petersen coil).

1. EARTHING THROUGH RESISTOR

The neutral is connected to earth through one resistors. The fault current is limited to chosen value: $I_f = V/R$

R = resistance value of resistor (W)
V = line to earth voltage (kV)

A system properly earthed by resistor is not subject to destructive transient over voltages.



Earthing through resistor scheme

The reasons for limiting the current by resistor may be one or more of the following:

- To reduce burning and melting effects in faulted electric equipment,
- To reduce mechanical stresses in circuits and apparatus carrying fault currents,
- To reduce electric shocks hazards are blast to personnel caused by stray ground fault currents in the ground return path.

There are two classes, ***High resistance value*** or ***low resistance value***, distinguished by the ***level of ground fault permitted to flow*** (No recognized standards for the level of earth fault current that defines these two classes).

In practice there is a clear difference.

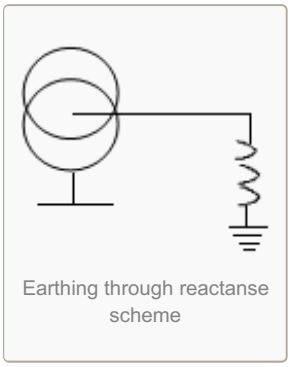
- High resistance value typically uses ***earth fault current levels of 10 A or less*** .
- Low resistance value typically uses ***ground fault current levels above 10 A and up to 3000 A*** .

Both classes are designed to limit the earth fault current and ***to keep the system free from transient over voltages*** (*maintained to a safe level*). However, the high resistance method usually does not require immediate clearing of a earth fault since the fault current is limited to a very low level, the protective scheme associated with high resistance value is usually detection and alarm.

The low resistance method has the advantage of immediate and selective clearing of the earthed circuit, but requires that the minimum earth fault current be large enough to positively actuate the applied earth fault relay.

2. EARTHING THROUGH REACTANCE

The neutral is connected to earth through reactor .



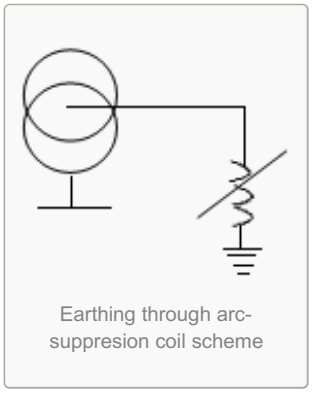
Earthing through reactanse scheme

The ground fault that may flow is a function of the neutral reactance, the level of the fault current is often used as a criteria for describing the degree of grounding.

In this method the ***ground fault current should be at least 60% of the three phase fault current*** to prevent ***serious transient overvoltages***. This is considerably higher than the level of fault current desirable in the system using resistor, and therefore reactance grounding is usually not considered as an alternative to the system using resistor.

This system is used when the system neutral transformer is not available (*DELTA connected system*) in such case the reactor is used as transformer grounding to obtain the neutral .

3. EARTHING THROUGH ARC-SUPPRESSION COIL (Petersen Coil)



Earthing through arc-suppresion coil scheme

An earthing reactor connected between the neutral of a system and earth and having a specially selected, relatively high value of reactance in such that the reactive current to earth under fault conditions balances the capacitance current to earth flowing from lines so that the earth current at the fault is limited to practically zero

If the ground fault is in air, such as an insulator flash-over, it may be self extinguishing. This method of grounding is used primarily on ***110 kV systems***, consisting largely of overhead transmission or distribution lines.

Since systems of such construction are ***rarely used in industrial or commercial power systems***.

Comparison Table

X0: Zero-Sequence reactance of the system
X1: Positive-Sequence reactance of the system
R0: Per phase zero-sequence resistance of the system

XC0: Distributed per phase capacitive of reactance to ground the system
V: Line to ground voltage

	Insulated	*Solidly Earthed*	*Low Resistance Grounding*	*High Resistance Grounding*	*Earthing Reactance*	*Arc Suppression Coil*
Fault Current	Few Amps 3cwv	20 To 30 Times The Value Of Nominal Current	From 100 To 3000A	Less Than 10A	At Least 25 To 60 % Three Phase Fault Current	0
Over voltage	Yes Line To Line Voltage	No Line To Ground Voltage	No Line To Ground Voltage	No Line To Ground Voltage	No Line To Ground Voltage	0
Double Earth Fault ***Earth Fault Arc***	Yes Self Quenching	No Sustained	Slight Partly Self Quenching Sustained	Slight Partly Self Quenching Sustained	Slight Partly Self Quenching Sustained	Yes Self Quenching
Interference With Telecommunication	No	Overhead Line = Yes Cable = No	Overhead Line = Yes Cable = No	Overhead Line = Yes Cable = No	Overhead Line = Yes Cable = No	No
		X0/X1=Positive & < Than 3 R0/X1= Positive & <1	R0<Xc0 R0>2x0	R0<Xc0 R0>2x0	X0/X1<10	

Methods Of Neutral Earthing

Reference: *Microelettrica Scientifica – M.S. Resistances*

Source: http://electrical-engineering-portal.com/comparison-of-neutral-earthing-methods