# Earthing – college essay

In the early power systems were mainly Neutral ungrounded due to the fact that the first ground fault did not require the tripping of the system. An unscheduled shutdown on the first ground fault was particularly undesirable for continuous process industries. These power systems required ground detection systems, but locating the fault often proved difficult. Although achieving the initial goal, the ungrounded system provided no control of transient over-voltages. A capacitive coupling exists between the system conductors and ground in a typical distribution system.

As a result, this series resonant L-C circuit can create over-voltages well in excess of line-to-line voltage when subjected to repetitive re-strikes of one phase to ground. This in turn, reduces insulation life resulting in possible equipment failure. Neutral grounding systems are similar to fuses in that they do nothing until something in the system goes wrong. Then, like fuses, they protect personnel and equipment from damage. Damage comes from two factors, how long the fault lasts and how large the fault current is.

Ground relays trip breakers and limit how long a fault lasts and Neutral grounding resistors limit how large the fault current is. Top Importance of Neutral Grounding There are many neutral grounding options available for both Low and Medium voltage power systems. The neutral points of transformers, generators and rotating machinery to the earth ground network provides a reference point of zero volts. This protective measure offers many advantages over an ungrounded system, like: 1.

Reduced magnitude of transient over voltages 2. Simplified ground fault location 3. Improved system and equipment fault protection 4. Reduced maintenance time and expense 5. Greater safety for personnel 6. Improved lightning protection 7. Reduction in frequency of faults. Top Methods of Neutral Earthing There are five methods for Neutral earthing: 1. Unearthed Neutral System 2. Solid Neutral Earthed System 3. Resistance Neutral Earthing System * Low Resistance Earthing * High Resistance Earthing 4.

Resonant Neutral Earthing System 5. Earthing Transformer Earthing Top 1. Ungrounded Neutral Systems In ungrounded system there is no internal connection between the conductors and earth. However, as system, a capacitive coupling exists between the system conductors and the adjacent grounded surfaces. Consequently, the " ungrounded system" is, in reality, a " capacitive grounded system" by virtue of the distributed capacitance. Under normal operating conditions, this distributed capacitance causes no problems.

In fact, it is beneficial because it establishes, in effect, a neutral point for the system; As a result, the phase conductors are stressed at only line-to-neutral voltage above ground. But problems can rise in ground fault conditions. A ground fault on one line results in full line-to-line voltage appearing throughout the system. Thus, a voltage 1. 73 times the normal voltage is present on all insulation in the system. This situation can often cause failures in older motors and transformers, due to insulation breakdown. Ungrounded neutral system

Advantages After the first ground fault, assuming it remains as a single fault, the circuit may continue in operation, permitting continued production until a convenient shut down for maintenance can be scheduled. Disadvantages 1.

The interaction between the faulted system and its distributed capacitance may cause transient over-voltages (several times normal) to appear from line to ground during normal switching of a circuit having a line-to ground fault (short). These over voltages may cause insulation failures at points other than the original fault. . A second fault on another phase may occur before the first fault can be cleared. This can result in very high line-to-line fault currents, equipment damage and disruption of both circuits. 3. The cost of equipment damage. 4. Complicate for locating fault(s), involving a tedious process of trial and error: first isolating the correct feeder, then the branch, and finally, the equipment at fault. The result is unnecessarily lengthy and expensive down downtime. Top 2. Solidly Neutral Grounded Systems

Solidly grounded systems are usually used in low voltage applications at 600 volts or less. In solidly grounded system, the neutral point is connected to earth. Solidly Neutral Grounding slightly reduces the problem of transient over voltages found on the ungrounded system and provided path for the ground fault current is in the range of 25 to 100% of the system three phase fault current.. However, if the reactance of the generator or transformer is too great, the problem of transient over voltages will not be solved.

While solidly grounded systems are an improvement over ungrounded systems, and speed up the location of faults, they lack the current limiting ability of resistance grounding and the extra protection this provides. To maintain systems health and safe, Transformer neutral is grounded and grounding conductor must be extend from the source to the furthest point of the system within the same raceway or conduit. Its purpose is to maintain very low impedance to ground faults so that a relatively high fault current will flow thus insuring that circuit breakers or fuses will clear the fault quickly and therefore minimize damage.

Solidly Neutral Grounded Systems It also greatly reduces the shock hazard to personnel! If the system is not solidly grounded, the neutral point of the system would “ float” with respect to ground as a function of load subjecting the line-to-neutral loads to voltage unbalances and instability. The single-phase earth fault current in a solidly earthed system may exceed the three phase fault current. The magnitude of the current depends on the fault location and the fault resistance. One way to reduce the earth fault current s to leave some of the transformer neutrals unearthed. Advantages The main advantage of solidly earthed systems is low over voltages, which makes the earthing design common at high voltage levels (HV). Disadvantages 1. This system involves all the drawbacks and hazards of high earth fault current: maximum damage and disturbances. 2. There is no service continuity on the faulty feeder. 3. The danger for personnel is high during the fault since the touch voltages created are high. Applications 1. Distributed neutral conductor . 3-phase + neutral distribution 3. Use of the neutral conductor as a protective conductor with systematic earthing at each transmission pole 4. Used when the short-circuit power of the source is low To be continued in Types of neutral earthing in power distribution (part 2) References: * By Michael D. Seal, P. E. , GE Senior Specification Engineer. * IEEE Standard 141-1993, “ Recommended Practice for Electrical Power Distribution for Industrial Plants” * Don Selkirk, P. Eng, Saskatoon, Saskatchewan Canada