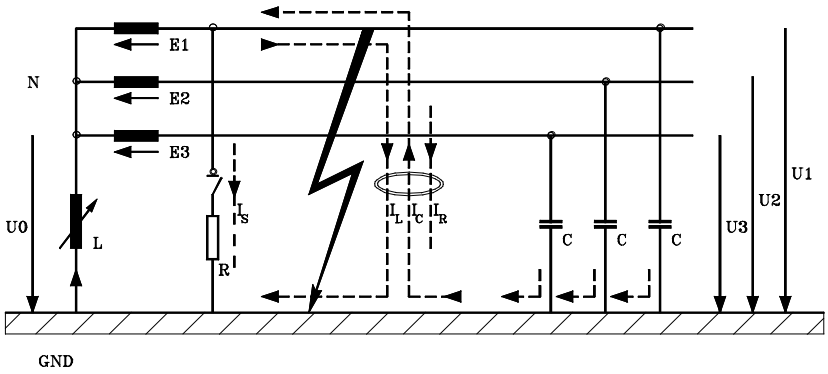
Ground fault in medium voltage networks

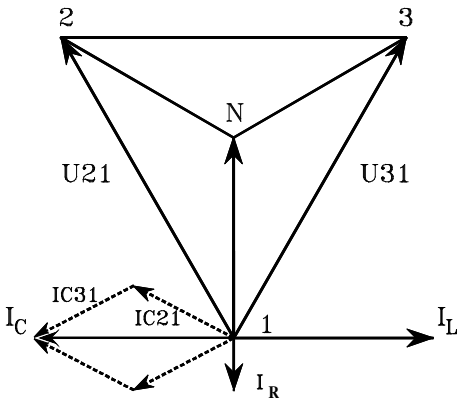
Relief of fault location by Phase Grounding and Earth Fault Detection

The phase grounding is useful applicated in inductive grounded medium voltage networks by arc suppression coils. The use in isolated systems is also possible. During a single-pole ground fault due to the earth capacitance of the cables or overhead lines a capacitive charging current is flowing through the fault place. Through the use of arc suppression coils, which is connected in the neutral point of the power transformer or is switched to the neutral point of a grounding transformer, inductive compensation current (180 ° phase) flows in the event of a ground fault on the fault place.
Through accurate compensation by means of an adjustable plunger core arc suppression coil and a qualified compensation controller, the capacitive charging current can be brought to zero (in case of resonance tuning). At the fault



At the fault location only the "Watt residual current" remains, which however in large cable networks can have quite a couple of amps. In case of over- or under-compensation (detuning), an additional reactive current flows over the fault location according to the detuning degree. Generally, in Electrical Authority Networks the resistive residual current amounts for about 2-4% of the resonant current (capacitive charging current or inductive compensation current at resonance tuning) but 6 – 8 % in Industrial Networks.

With the appropriate amount of the resulting residual current (apparent current) at the fault location significant thermal damage can cause ($I^2 R$). Therefore it is purposeful in selected applications to minimize this current. In addition to ground fault of the 50 Hz component a 250 Hz component flows. As experiences shows, the 250 Hz component can reach approximately 70-150% of the 50 Hz component. So it is obvious that the fault place is stressed by the 50 Hz current and additionally by harmonic currents.



Demonstration of currents and voltages during a ground fault.

Darstellung der Ströme und Spannungen im Erdfehlerfall eines gelöschten Netzes

Basically, there are two possibilities residual currents at the fault location to compensate:

a) The Residual Current Compensator by electronic converter

b) The low resistant shunt by grounding the faulty phase at the substation (Phase Grounding)

The Residual Current Compensator has sometimes considerable disadvantages:

1. Because of the complexity of the electronic converter up to now only the 50 Hz component will be deleted. The almost equal 250 Hz component is not compensated.
2. In the already complex zero sequence system during ground fault a converter can produce unavoidable network perturbations.
3. The compensation current is driven through may well branched lines through the fault site and thus possibly in sensitive areas such as pits, underground mining operation or sensitive chemical plants.
4. The cost of control electronics and power electronics are high, and the operational safety even depends much on power disturbances (transient voltages).5.Reliability, durability and cost of maintenance are taken into account.

The phase grounding on the other hand provides a long-known and simple, robust and reliable technology. There the faulty phase is grounded at the substation. Disadvantages were previously that 3-pole switching devices and thus 3 switching cubicles had to be used. This also resulted in significant hardware cost and because of the three switching cubicles to a significant space requirement (also an extra charge). In addition in the solid phase grounding depending on the load current at the fault location, a certain voltage drop occurs.

Due to new technological possibilities, we have made the phase grounding for practical use highly interesting. By using 3 or 4 single-pole circuit breakers, which very small magnetic drives include, the cost can be reduced to one switching cubicle.

Additionally required is a selection circuit to identify the faulty phase with interlocking and a defined switch-on command. The disturbing voltage drop across the fault location is widely compensated by the use of a power resistor.
Thus today we present a low-cost system, which the fault location relieves of residual current largely, both of the active and the reactive component, and indeed in the entire frequency spectrum so fundamental and harmonic currents.

Based on our many years of experiences in the area of ground fault treatment and the design of power resistors, we were able to develop a wide variety of configurations. Typical is a type tested interior switchgear cubicle with a built-on or separately standing control cabinet. Herewith is an affordable, flexible and highly efficient system for relief of the fault location available, which in particular, the interests of sensitive and safety-related networks considered.

Control cabinet and switchgear panels 10.5 kV (25kA)

The newly development by our technique is forward-looking, as costs, technology and effort are an optimal relation to each other. Calibration of the system

With the same facility and without additional effort, by inserting a defined short-time double- earth-fault (KUDE) an effective earth fault detection can be obtained (duty cycle 100 msec.). Both for isolated and compensated networks we possess corresponding patents.