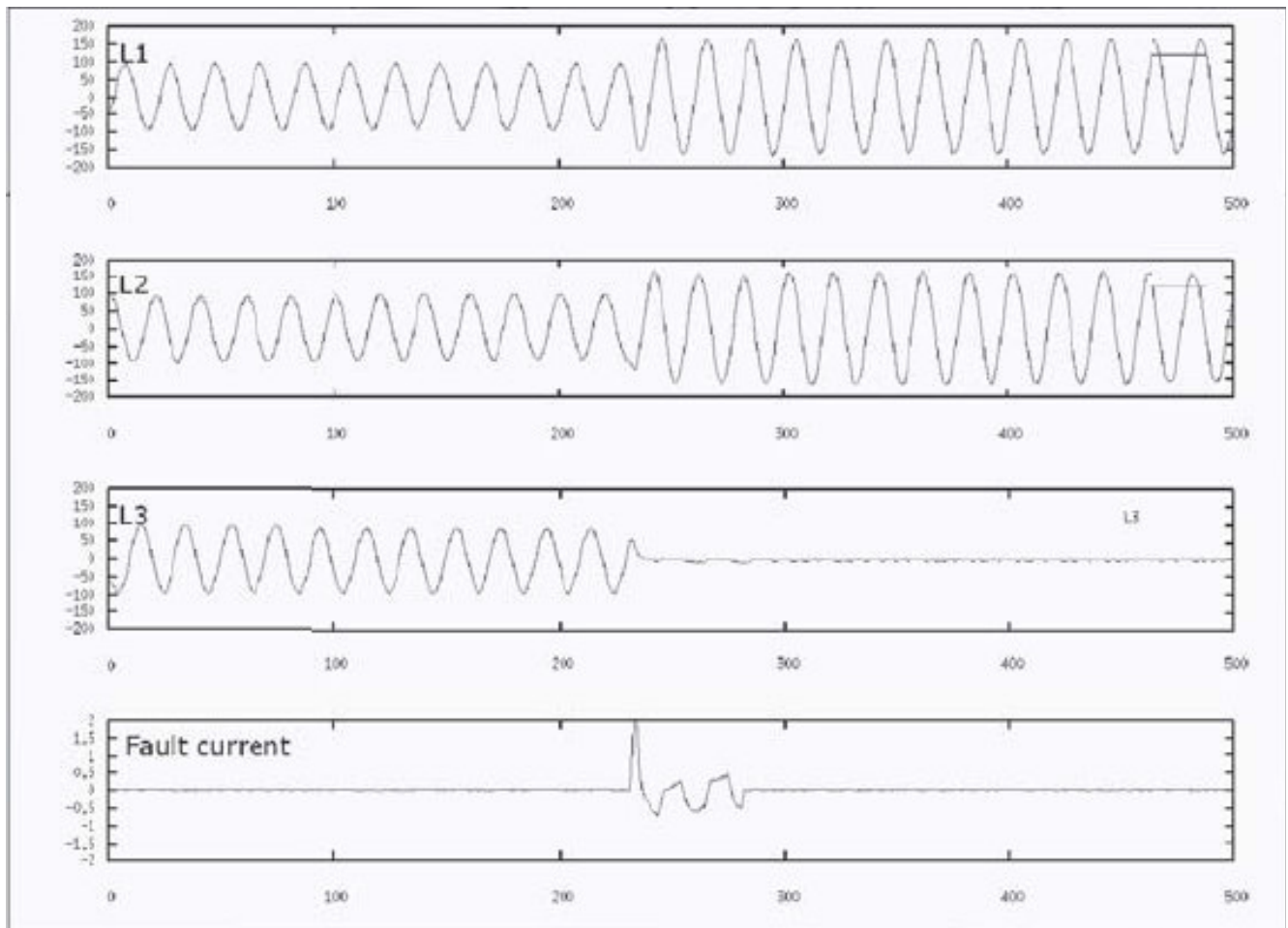


GROUND FAULT NEUTRALISER FAQ's

- Q1. **If there are simultaneous earth faults on the same phase, will the GFN try to neutralize the total fault current into the earth?**
- A. As long as the faults are on the same phase, they can be on different feeders, the GFN will compensate for the total fault current that would flow, as it is tuning to match the system capacitance of the two sound phases to earth. The system capacitance is the total capacitance of the network connected to the substation.
- Q2. **What will happen if an 11kV conductor drops onto the 400V line and earth?**
- A. With the ground fault neutraliser operational and assuming any insulation between HV and LV breaks down, there will be an initial discharge of the HV network capacitance into the LV system followed by approximately 3 cycles of residual current, i.e. The remaining current not compensated by the Petersen Coil, typically less than 5 amps. The RCC will then operate to neutralise the residual current to a very small level (refer Q8). Arcing and hazardous voltage impressed onto the LV system is thus greatly reduced c.f. a conventional earth fault protection system which will either cause major damage to the LV network or perhaps not trip at all due to the possible high fault impedance of the system – thus leaving a public safety hazard unchecked. There is the possibility that the GFN may see a high impedance fault with insufficiently low fault impedance to earth i.e. greater than about 20, 000 ohms—but this is a rare occurrence –and in may still be possible to see some neutral displacement which gives some warning of impending high impedance faults which could develop further into “real faults “. Most broken wire faults result in one end of the broken conductor contacting earth as well as other network components e.g. poles .cross arms and other circuit conductors—and this would be detected by the GFN.
- Q3. **In the event of a broken 11kV conductor lying on the ground, the 11kV system would continue to operate. What would happen if a person lifted the conductor from ground (say to clear a roadway, curious kids, or whatever other reason), would the conductor be live at a lethal phase voltage?**
- A. In this case the Ground Fault Neutraliser will compensate for the faulty phase. It will carry out a “confirmation” 30 seconds after the fault is detected, to determine whether the fault is transient or permanent. If the fault is still present, then the Ground Fault Neutraliser will stay on, compensating for the fault. If the line is lifted or the fault is removed, the voltage to ground of that line will remain at its compensated value until an operator instructs the system to stop compensating.
- Q4. **What happens when a broken conductor does not contact earth?**
- A. Further testing and answers to be provided.
- Q5. **What is the likely mode of failure associated with the system?**
- A. That the inverter will not operate when required or there is a fault in the arc suppression coil. Both of these have alarms that indicate the failure to the operator, and feeder tripping can be carried out as a backup. These are not failures we have experienced. Failure of the GFN system to indicate an earth fault can be covered by independent monitoring of the system neutral voltage (refer Q9).

GROUND FAULT NEUTRALISER FAQ's

- Q6. **How long will the fault location process take?**
A. The distance to fault method employed by the Ground Fault Neutraliser takes about 1 minute, once a loop is made in the network. This distance to fault involves removing the residual current compensation momentarily to allow calculations to be made. The 5th Harmonic method employs a portable tester and requires a line patrol and is therefore limited by how long it takes to physically take to drive to the fault point.
- Q7. **How much of the electrical arcing is reduced by the Ground Fault Neutraliser at the point a fault occurs on the network?**
A. The network capacitive discharges into the fault which is of a transient nature and then the electrical arcing at the point of fault should be reduced completely.
- Q8. **How much time is required for the reduction of electrical arcing to take place?**
A. Within 3 cycles or 60ms all arcing current is reduced to zero. See the graph below that shows a fault on L3 with the voltage to ground being shown and the last image showing the capacitive fault current in L3 discharging and then the residual reducing to zero.



GROUND FAULT NEUTRALISER FAQ's

- Q9. **The report on the Ground Fault Neutraliser states that “the existing earth fault protection can be used as backup”. Do existing protection settings need to be modified?**
- A. Depending on the existing settings, you may need to increase your pickup to prevent spurious tripping from increased levels of residual capacitive currents flowing in the un-faulted feeders connected to the same bus as the faulted feeder. Leaving the existing protection in situ enables the Ground Fault Neutraliser system to be taken out of service if required and revert to direct earthing of the transformer. We also recommend that an independent (SCADA) measurement of the system neutral voltage (U_{en}) be provided to the network controller. This will provide an indication of the presence of an earth fault if for some reason the GFN Alarms are not operative.
- Q10. **With the introduction of an RCC Ground Fault Neutraliser, do the system over voltages increase, particularly when downstream devices are operated?**
- A. Once in operation the RCC acts as a perfect surge arrester in the neutral. Transformer and line X_r/X_o ratios are not affected. Of course neutral-to-ground (source) impedance will change - that's the idea of resonance grounding. The initial fault current discharge transient comes along with a transient over voltage in the neutral. Theoretically $2xU_o$ - but much less in real life due to saturation and losses in the coil. After all, on MV distribution levels insulation coordination is determined by external rather than internal over voltages.
- Q11. **Why would an arrester on the transformer neutral be recommended?**
- A. In the case of a primary voltage earth fault at the substation, there is the possibility of causing over voltages on the secondary network (due to the series resonance of the coil and system capacitance). A suitably rated arrester will prevent any damage to transformer or coil.