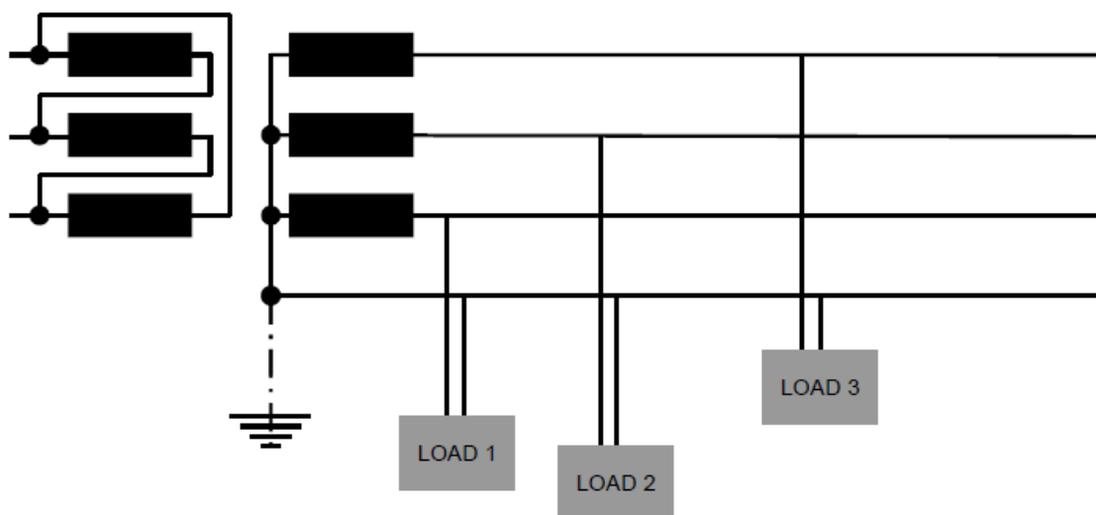


Effect of neutral loss in 3-Phase LV networks

When we analyze the low voltage distribution system be it in industrial environment or infrastructure projects or even in commercial or residential projects, you will always come across both 3-phase loads as well 1-phase loads. When 1-phase loads are more, proper planning of load sharing across all 3-phase is very much important.

We will analyze in this document the effects of neutral disconnection/neutral breakage in asymmetrically loaded phases which means neutral is loaded. One need to take note that the solution offered in this document may not be suitable for application where there is symmetrical loading of 3-phases take place. In symmetrically loaded network the device proposed may not detect neutral breakage.

The figure below provides typical distribution system which is followed in LV network. Here it can be observed that each 1-phase load is connected between different phases and neutral. As long as neutral is healthy, system will function normally even though loading is asymmetrical loading of 3-phases.



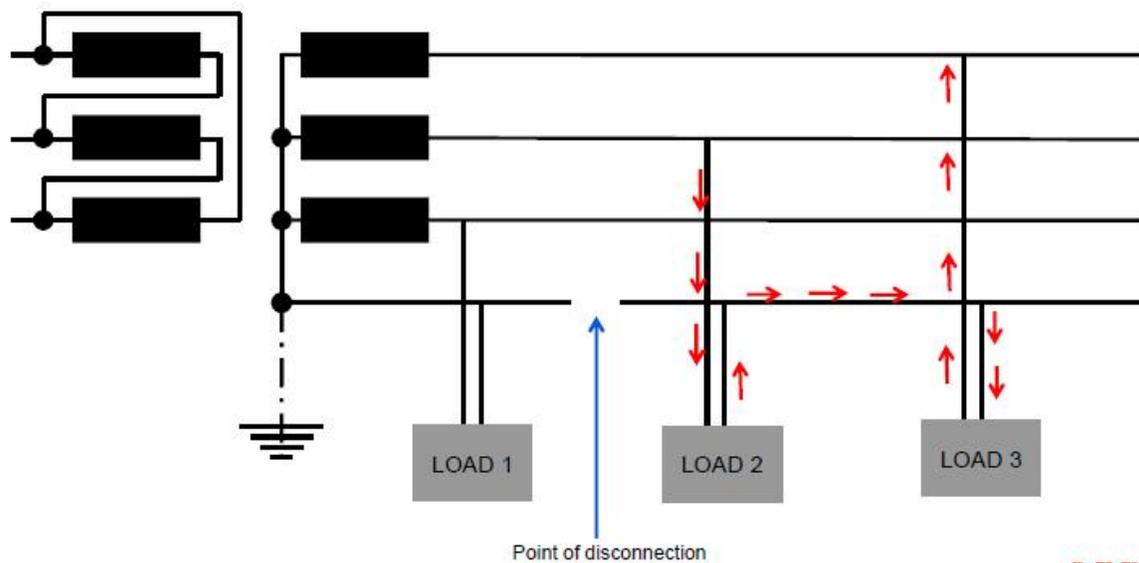
Effect of neutral loss in 3-Phase LV networks

As long as project is with 3-phase loads like motors, there will not be any issue in load symmetry. When a project has large number 1-phase loads, ensuring symmetrical loading is extremely difficult. Even though connection of loads are distributed equally among all 3-phases, there will be instances where some loads are not connected which leads to asymmetry in loading. This leads to neutral loading.

Further when we analyze the effect of neutral disconnection/ breakage, it is observed that all those loads which are connected downstream from the point of neutral disconnection experience over voltage conditions. These over voltage can be to the level of line voltage.

For e.g. if phase voltage between line neutral is 230V AC, Over voltage could reach as high as 415V AC. One can imagine the damage which could be caused to the connected loads which are rated for 230V and experiences voltage of 415V. All loads which experiences over voltage will get damaged.

The below figure will provide clear indication of how the loads experiences over voltage.



Effect of neutral loss in 3-Phase LV networks

Load 1 will continue to operate normally and no over voltage is experienced. Whereas load 2 and load 3 will experience over voltage and the over voltage contribution 2-phases with these loads are connected as shown in the figure.

There are many reasons for disconnection/breakage of neutral in an electrical network. Some of the reasons are

- Poor connection due to bad termination.
- Poor connection due to incorrect piercing insulation of neutral conductors.
- Stolen neutral bus conductors.
- Neutral loss due poor connection at electric poles.
- Poor maintenance

The above phenomena can happen in any type of installation be it process industry or Information Technology Park or may be a data center.

Improper installation is one main cause of breakage of neutral. One of the important remedy is to ensure correct installation and regular preventive maintenance. Another method of protection is to ensure proper segregation loads connected to phases which means grouping loads and connect them to same phase instead of connecting alternate loads to different phases; however it is difficult to achieve.

Another method is to incorporate the phase and neutral sensing relay at least in every incomer of sub distribution boards or final distribution boards.

These relays monitor the interruption of neutral by means of phase unbalance evaluation. The relay should detect neutral missing when a star point is displaced.

ABB offers technically suitable solution in protecting connected critical equipment from over voltages.



Effect of neutral loss in 3-Phase LV networks

ABB offers Phase monitoring relays which can be used in conjunction with MCB's or MCCB's or even ACB's. Circuit breakers are tripped using shunt trip coil in the event of neutral interruption. This will protect all your expensive 1-phase equipment from over voltage and neutral interruption.



Note – Neutral interruption may not be detected by this relay incase network is symmetrically loaded.

Contact us for further information

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