

ELECTRICAL INSTALLATION GUIDE-2

A PAPER PRESENTED
FOR
**NIGERIAN INSTITUTE OF ELECTRICAL AND ELECTRONICS
ENGINEERS ABUJA CHAPTER**

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TABLE OF CONTENT:

1. LOW VOLTAGE DISTRIBUTION
2. QUALITY OF SUPPLY VOLTAGE

1.0 LOW VOLTAGE DISTRIBUTION

In many countries that have adopted the IEC standards, the transition period on the voltage tolerance to “230V/400V was + 10% / - 10%” and this ended in 2008. Low-voltage consumers are those consumers whose loads can be satisfactorily supplied from the low-voltage system in their locality. The voltage of the local LV network may be 230/400 V.

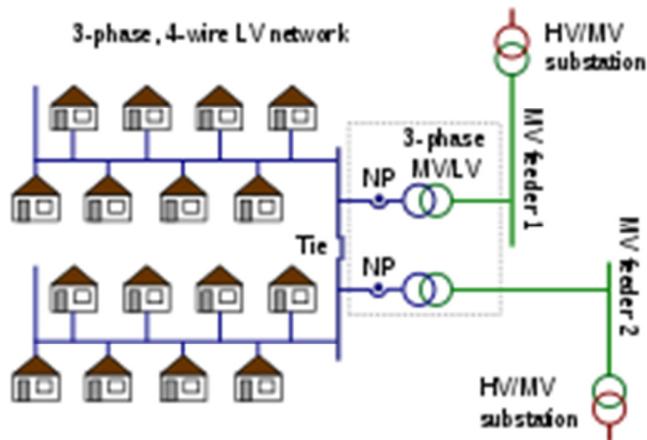
An international voltage standard for 3-phase 4-wire LV systems is recommended by the IEC 60038 to be 230/400 V and this applies to Nigeria. Loads as high as 250 kVA can be supplied at LV, but power-supply agencies/utility generally propose a MV service at load levels for which their LV networks are marginally adequate. This however guarantees a stable power supply to the load.

Many countries are currently converting their LV systems to the latest IEC standard of 230/400 V nominal (IEC 60038). Medium to large-sized towns and cities have underground cable distribution systems. MV/LV distribution substations, mutually spaced at approximately 500-600 metres, are typically equipped with:

A 3-or 4-way MV switchboard, often made up of incoming and outgoing loadbreak switches forming part of a ring main, and one or two MV circuit-breakers or combined fuse/ load-break switches for the transformer circuits

The output from a transformer is connected to the LV busbars via a load-break switch, or simply through isolating links. In densely-loaded areas, a standard size of distributor is laid to form a network, with one cable along each pavement and 4-way link boxes located in manholes at street corners, where two cables cross. Recent trends are towards weather-proof cabinets above ground level, either against a wall, or where possible, flush-mounted in the wall.

SEE FIGURE BELOW



This arrangement provides a very flexible system in which a complete substation can be taken out of service, while the area normally supplied from it is fed from link boxes of the surrounding substations.

The other forms of urban LV network, based on free-standing LV distribution pillars, placed above ground at strategic points in the network, are widely used in areas of lower load density. This scheme exploits the principle of tapered radial distributors in which the distribution cable conductor size is reduced as the number of consumers downstream diminishes with distance from the substation.

In this scheme a number of large-sectioned LV radial feeders from the distribution board in the substation supply the busbars of a distribution pillar, from which smaller distributors supply consumers immediately surrounding the pillar.

EARTHING SYSTEM FOR MV/LV DISTRIBUTION NETWORK

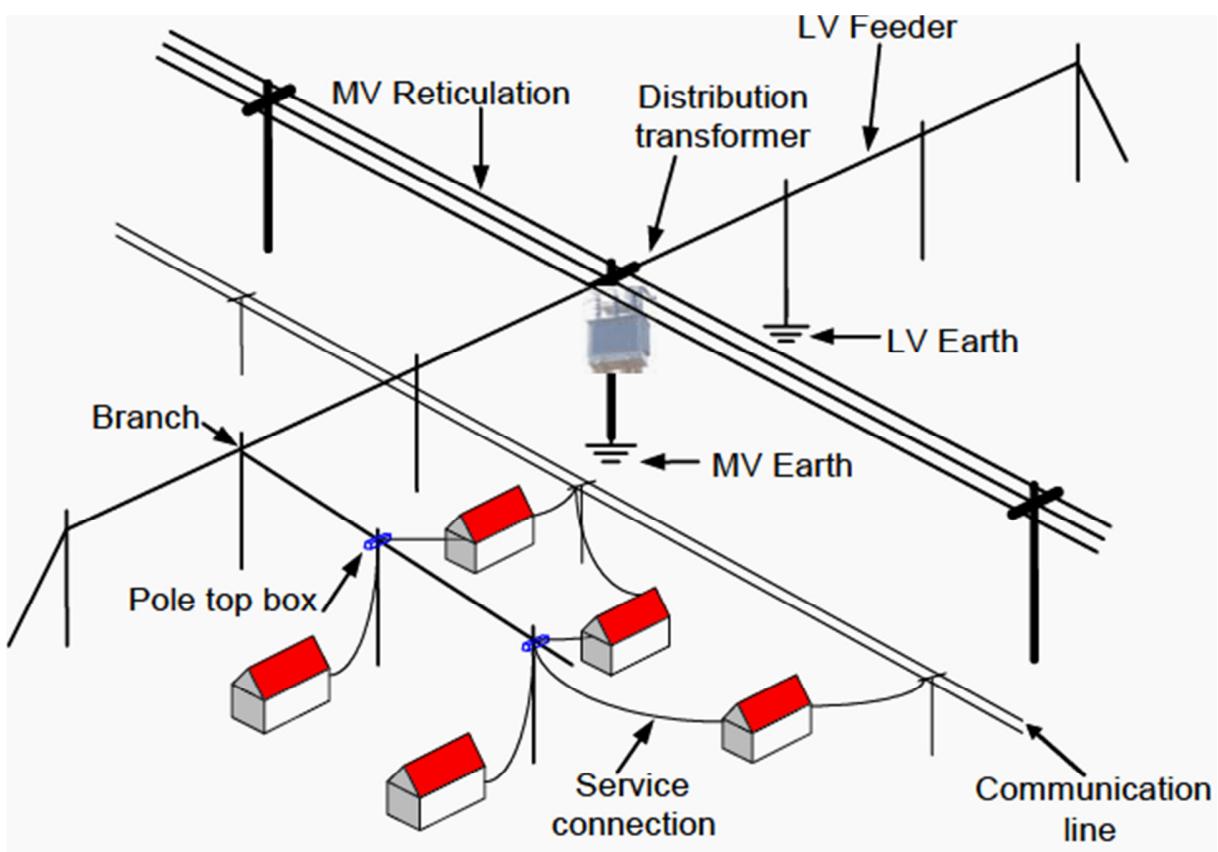
In a medium or low voltage three-phase system, three single-phase voltages are usually measured which is measured between each phase and a common point neutral. The earthing system plays a very important role in a network. On occurrence of an insulation fault or a phase being accidentally earthed, the values taken by the fault currents, touch voltages and overvoltage are closely related to the type of neutral earthing connection.

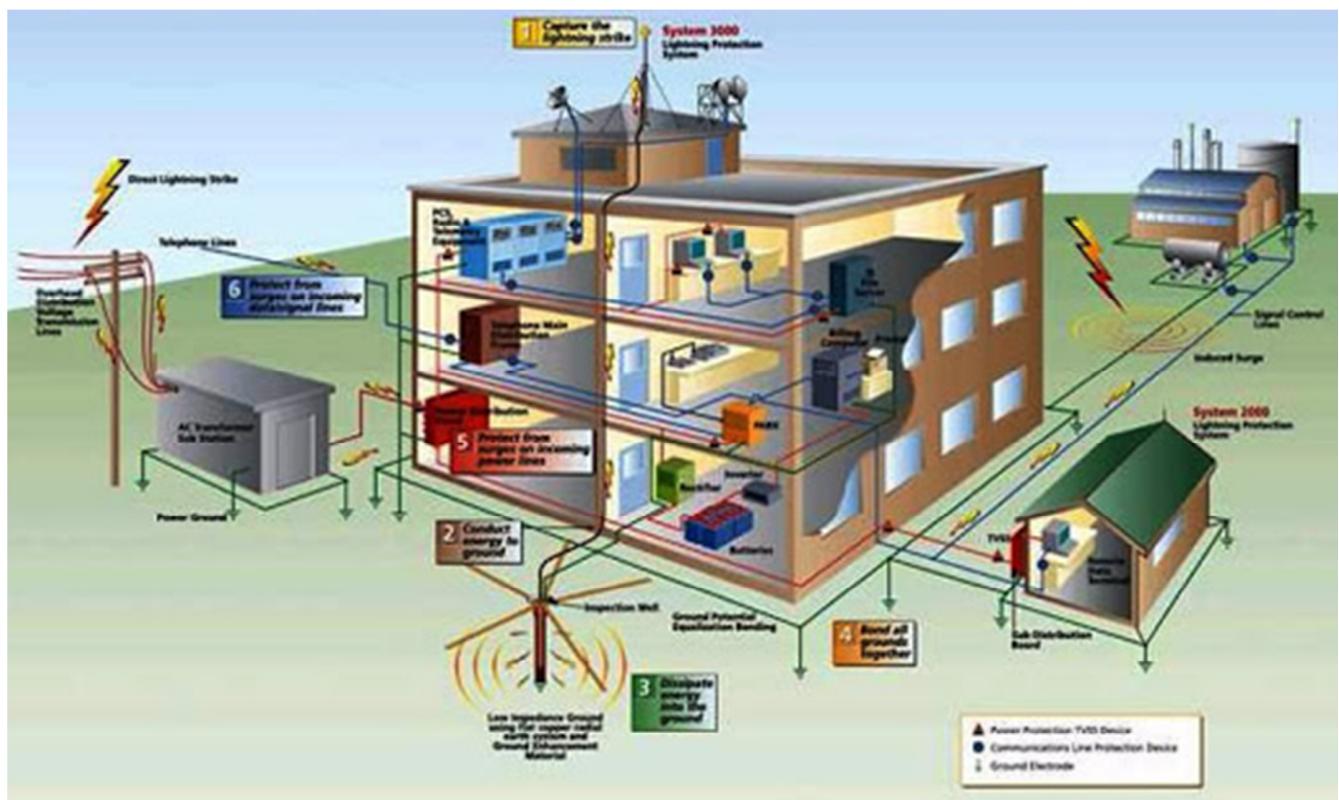
The earthing or grounding of a Neutral can be done directly or via a resistor (impedance-earth). The unearthing Neutral is the neutral point that has no connection to the earth.

Benefits of earthing the Neutral:

- Overvoltage are limited; this means that voltages do not exceed the line to ground voltages
- Arcing from high voltages are eliminated
- Protective relays are easily deployed to protect against earth fault.

In electrical installation, service continuity in the presence of an insulation fault also depends on the earthing system. The severity of the damage to some equipment, such as motors and generators having an internal insulation fault, also depends on the earthing system







2.0 QUALITY OF SUPPLY VOLTAGE

An adequate level of voltage at the consumer's supply-service terminals is essential for satisfactory operation of equipment and appliances. Practical values of current, and resulting voltage drops in a typical LV system, show the importance of maintaining a high Power Factor as a means of reducing voltage drop.

It is very important to discuss the quality of the electrical energy for various applications. The quality may be affected either by events that occur on the distribution systems (switching, lightning, etc.) or by the use made of the electricity when for example certain load create significant variations in the current consumption (switching on) or alter the waveform (harmonics).

The EN50160 stipulates the permissible limits of certain values or phenomena characterizing or affecting the 50/60 Hz sinusoidal signal. Based on a

statistical approach, it is designed to ensure a certain level of quality during normal operation.

1. **Signal Frequency:** The nominal frequency for normal operations is 50Hz with a tolerance value of **±1%** (ie 49.5 or 50.5).
2. **Slow Voltage Variation:** Under normal operating conditions, the following slow voltage fluctuations are permitted over a period of one week: ±10% of the reference value (230 or 400 V). The supply voltage of the system can fluctuate daily, weekly or seasonally as a result of significant variations in load in the system. Voltage regulation devices installed in transformer substations can limit these variations. In addition, high power equipment such as welding stations, large motors, furnaces and other energy-intensive installations may cause local voltage drops while they are in operation.
3. **Fast Supply Voltage Variations:** These variations, which come mainly from currents drawn by high loads, should not exceed 5 to 10% of the nominal voltage. The reduction in the variations is possible to about 30% when heavy duty loads such as electric motors and transformers are switched ON.
4. **Voltage Dips:** These are due to faults occurring at consumer's installations, but they often result from troubles on the public distribution system. The numbers of these vary considerably according to local conditions, and they generally only last up to one second. Most voltage dips last less than 1 second with a depth of less than 60%. In this situation, the residual voltage remains greater than 40%. There is a voltage dip as soon as the rms value of one of the voltages, measured separately on each phase, falls below a set threshold.
5. **Temporary Voltage:** This type of fault can occur both on the distribution system and on the user's installation. It can be devastating as the voltage supplied may reach a level that is dangerous for equipment. The main risk is the presence of a phase-to-phase instead of a phase-neutral voltage should there be loss of the neutral. Faults on the high voltage system (fallen line) can also generate overvoltage at the low voltage end.

6. **Unbalanced system voltage:** Voltage unbalance is caused by **high power single phase loads**. It causes negative current components which can trigger braking torques and temperature rises in rotating machines. It is advisable to divide the loads over the three phases as much as possible and to protect installations using appropriate detectors.

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