INTERNATIONAL JOURNAL OF NATURAL AND APPLIED SCIENCES (IJNAS), VOL. 3, NOS.1& 2 (2008); P. 112 – 118, 1 TABLE, 6 FIGS

Information technology (IT) projects and power source: a critical parameter in Nigeria

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ABSTRACT

In this paper we give a systematic analysis of the power supply problems which may cause damages to IT equipment and projects. The problems come from several sources. Earthing facilitates the interconnection of several equipment, plays a regulatory role in setting base voltages, and is to connect parts of the electrical system to provide a path for fault currents. If the earthing has problems, the whole system may break up. The problem of lightening seems to be solved by the installation of lightening arrestor. The problem however is much more complex since the surge from lightening can come into a building through supply cables and telephone cables. The possible solutions are analysed. When loose contacts originating from personnel or material problems (like use of aluminium cables, loose switches unstable sockets etc) these may negatively affect the whole power supply causing over- and under-voltages and ghost signals in computers. In many installations minor equipment can be used without much danger but with IT equipment it is a different story. The paper will therefore discuss protective short-circuit current (PSC) allowable in a given installation. A comprehensive analysis of these problems will be performed with view to finding solutions to the problems.

INTRODUCTION

When a building is put up many people forget the most important aspect of electrifying the house which is earthing. In many cases they simply install a small rod on top of the roof as lighting arrestor, which sometimes does not do any arrest. Most cases the electrician forgets to earth the electrical wiring simply because he believes that the thunder arrestor is installed (Jeff 1991) as a result of this many fault currents occur. IT equipment are very sensitive to fault currents which emanate from the transformers used in the supply (Whitfield 2004). These transformers which are made up of wire-wounding create some impedance which is used in calculating the earth-fault current. Because of this there is need for the use of earth electrodes in creating a path for the fault current. In many cases we forget the basic advantage of earthing until we have a nasty experience which will result in shock if not loss of equipment. One of the major advantages of earthing is that the whole electrical system is tied to the potential of the general mass of earth and cannot 'float' at another potential (Ikeji 1997). For example, we can be fairly certain that the neutral of our supply is at, or near, zero volts (earth potential) and that the phase conductors of our standard supply differ from earth by 240 volts (George 1999). Loose contacts in switches and plugs also results in spikes which are dangerous to IT equipment. Many people are ignorant of this simply because sometimes they are not experiencing the effect immediately. Maintenance personnel should be educated in this regard in order to avoid this ugly situation.

In many respects this comes in form of neglect on the part of the people concerned. As a result of this ghost signals are at times gotten in computer systems particularly (Ken 1992). The main issue here now is how do we come over this, it is very important to think of this as much IT equipment are very sensitive to this. To overcome this not only that the personnel will have to be educated but that many precautions should be taken in order to prevent this since it is deadly to these equipment. In a computer centre many IT equipment are used and the need for proper earthing cannot be over emphasized simply because any mistake in connections, a flash of systems can occur if not shock. In 1997 many systems and devices were lost in computer centre University of Calabar due to lack of proper earthing. In many cases the devices got destroyed during connections when the devices are on. A printer port got blown as it is been connected to a computer system that was on, this results in a big loss to the establishment. Many times the personnel ignore the fact that their body contains some charges and forget to discharge same before touching the computer system whose supply is not properly earthed. It is obvious that many of IT equipment users neglect this phenomenon for lack of knowledge.

The standard method of tying the electrical supply system to earth is to make a direct connection between the two as shown in figure 3.

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This is usually carried out at the supply transformer, where the neutral conductor (often the star point of a three-phase supply) is connected to earth using an earth electrode or the metal sheath and armouring of a buried cable. Fig.1. shows such a connection. Lightning conductor systems must be bonded to the installation earth with a conductor no larger in cross-sectional area than that of the earthing conductor. It is clear that the total lack of earth or introduction of a current limiting into the earth path means that the usual methods of protection will not be effective. Because of this IT equipment are not allowed to be installed in an unearthed supply.

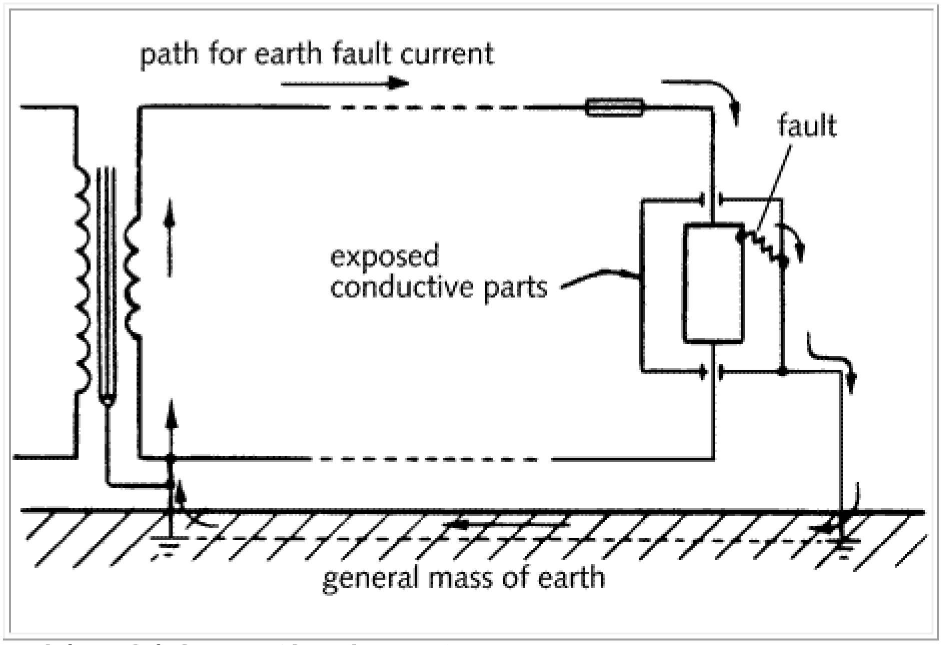

Fig.1. Path for earth fault current (shown by arrows)

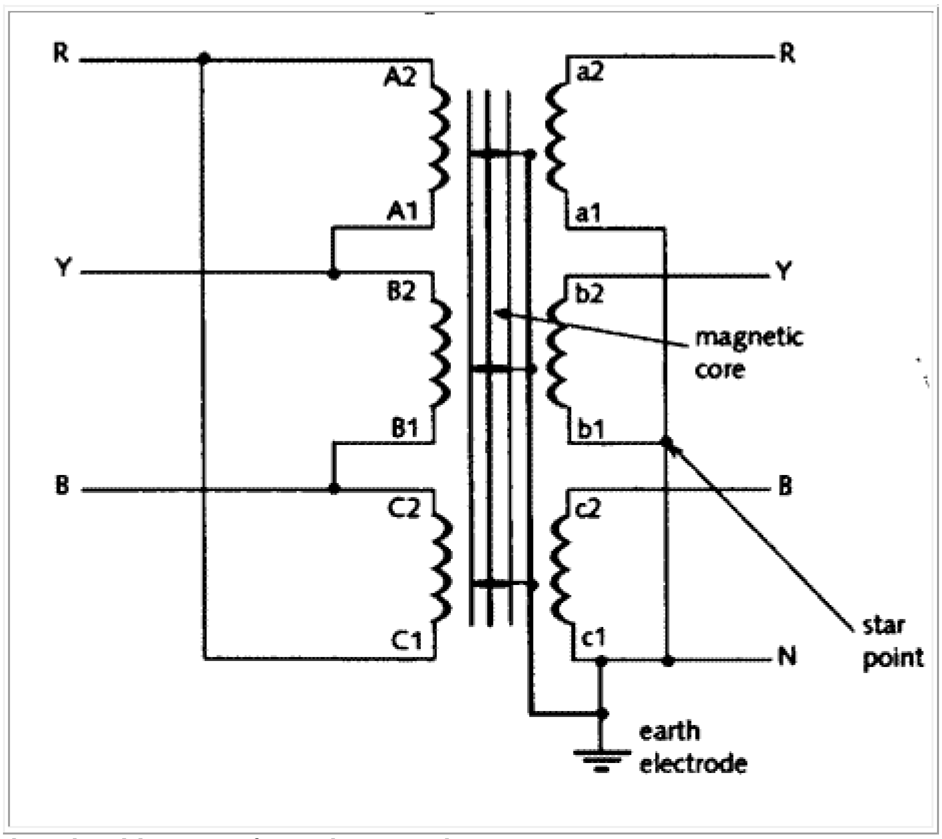

Fig.2.Three-phasedelta/startransformer showing earthing arrangements.

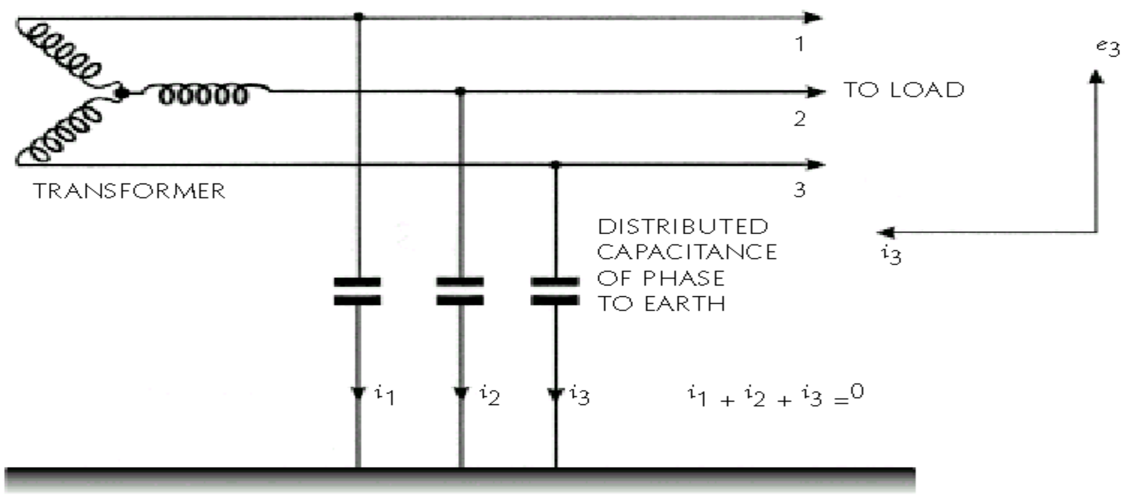

Fig. 3. Capacitance Phase earthing for a three phase system

Seasonal earthing

It was observed that during rainy season we never had earthing problems. However, during dry season the transformer supplying us (Computer Centre) started to behave in a strange way. A lot of arguments went on until an electric fire incident triggered out a detailed investigation where the following came out: The earthing of the transformer was constituted from a copper rod of about 50 cm, which was just pushed into the soil. When there was rainy season, there was no problem. When dry season came and the soil dried out up till the level of the copper rod (as shown in fig 2) in the soil, all of a sudden the earthing has vanished. This caused a problem up to the event of a fire incident. Similar cases have been observed of this nature.

Lightening protection

Most organisations consider their problems over by installing a powerful thunder arrestor. Unfortunately this is not so. The buildings are supplied power by “flying” wires, the communication lines are “flying” wires also. When the lightening strikes a flying wire far away from the building of consideration, the surge coming from the lightening will “march” into the building without any question and destroy all electronics it reaches. The result is mostly fatal.

I saw my video recorder to be damaged like this when there was no power supply, many landlines got damaged like this and in Computer Centre UNICAL we got 6 modems burned per session even when it was agreed that the communication supply cable should be disconnected when lightening was observed (shown in table 1). In a bad day most of the electronics in some houses went useless as a result of lightening developed far away elsewhere.

What can be done? The recent aerial lines solve most of the telephone problems. These are not affected.

Possible solutions:

- Bushman’s solution: disconnect all electrical connections when you hear any lightening; Simple and comparatively powerful;
- Use of a powerful surge protector at input: It may solve the problem however it is very costly;
- There are varistors which trip off to 0 resistance when the input voltage goes beyond an set voltage of 230V-250V. Varistors connect the incoming phase to the earth. When the input phase goes beyond 230V-250V, the varistor trips off, the surge goes down to the earth. This is very sensitive however, the top of the surge is not known hence the varistor will be most probably burned and it can protect the installations once only.
- Postal services have a carbon-based protector, operating similarly to the varistor. However, it will have to be replaced after each lightening.

The problem with lightening protection is that its speed is fast and there is no room for any electro-mechanical solution.

Instability of power supply

It is an old problem in power supply the materials used in the system. One of the problems come from the use of aluminium cables, which were very popular years ago however, today they are banned in most of the developed countries and in Nigeria also.

To understand the problem we should consider figure 1.

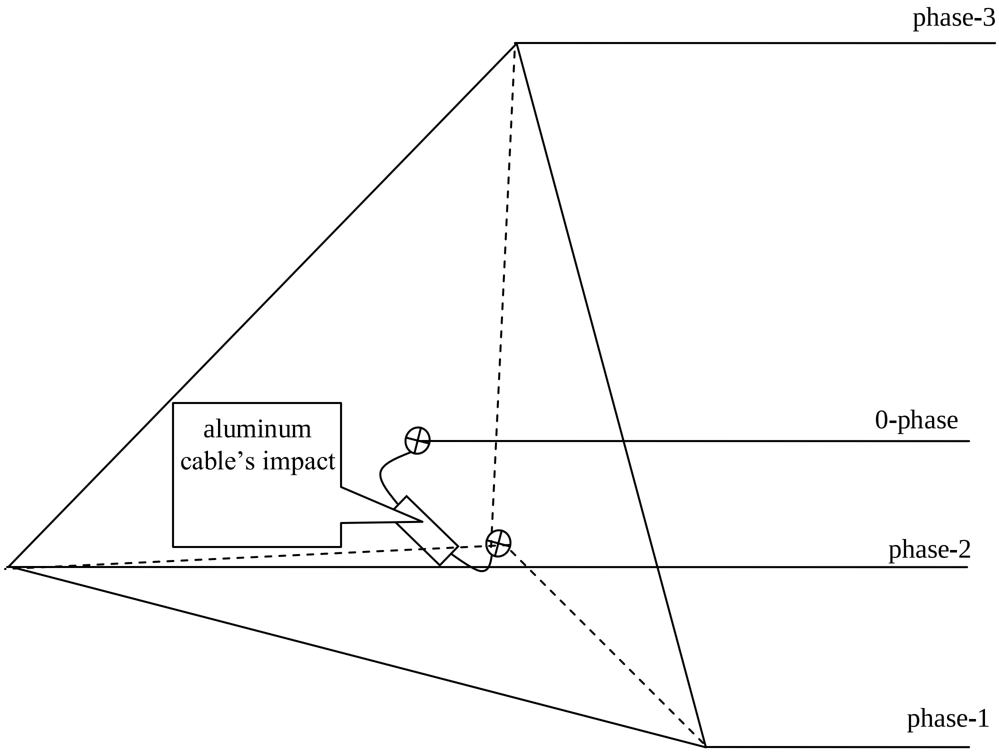

Fig. 4. Earth and phase connections.
The dotted lines show the client's voltage. The resistance shows the impact of the conductivity problem of the aluminium cable. The impact of the aluminium cable may not be permanent. It may change and then the flats connected to the power supply may have variable power supply.

The result of the corroded aluminium cable will be a resistance on the zero phase (as in fig 4) which will move the supply point and gives uneven voltages to the clients. This however is not as innocent as it seems. The corroded cable normally will spark and burn. This is a source of fire incident as it happened in several cases. The corroded aluminium cables should be replaced as fast as possible. They are a permanent source of danger – fire, destruction.

Escaped free energy

One can hear that in some houses, office walls, floor, and bathroom shocks. This electric shock normally is low, but definite. Fig. 5. shows two faults: one is the effect of a broken water pipe and the other is the escape of uncontrolled electric power.

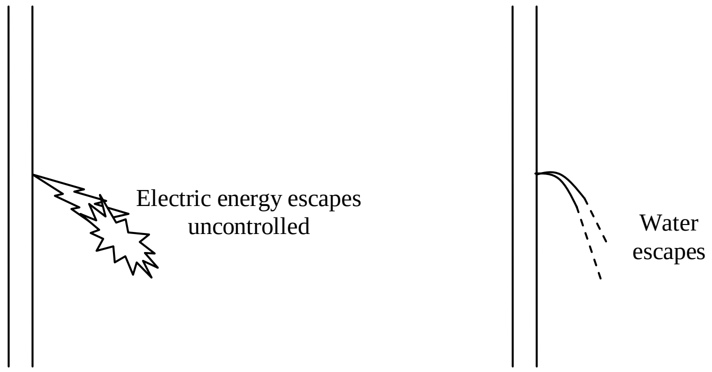

Fig. 5. Electrical energy escape and water escape.

Escape of water and electric energy look similar with one difference: When water escapes, it is repaired immediately otherwise the water visibly accumulates and create problem. The action of uncontrolled electric energy is not visible hence often left until causes fire or other fatal problems.

While water pipes are normally repaired because of the visible accumulation of the escaped water. Unfortunately the accumulation, effect of electric power is not visible.

Often the problem is not treated because of the cost of fixing new electric wiring etc. What is left out of consideration is that the uncontrolled energy will find its way to notify itself in the form of fire or other harmful way (destroying equipment). When this happens, finally the whole building will have to be reconstructed, and the whole wiring will have to be changed. Hence leaving such problems untreated is a very questionable approach. The result will be fatal.

Prospective short-circuit current (PSC)

The current which is likely to flow in a circuit if live and neutral cables are short circuited is called the prospective short circuit current (PSC). It is the largest current which can flow in the system and protective devices must be capable of breaking it safely. The breaking capacity of a fuse or of a circuit breaker is one of the factors which need to be considered in its selection. Consumer units to BS EN 60439-4 and BS 88 (HBC) fuses are capable of breaking any probable prospective short-circuit current, but before using other equipment the installer must make sure that their breaking capacity exceeds the PSC at the point at which they are to he installed. The effective breaking capacity of over-current devices varies widely with their construction. Semi-enclosed fuses are capable of breaking currents of 1 kA to 4 kA depending on their type whilst cartridge fuses to BS 1361 will safely break at 16.5 kA for type 1 or 33 kA for type II. BS 88 fuses are capable of breaking any possible short-circuit current. Miniature circuit breakers to BS EN60898 have their rated breaking capacity marked on their cases in amperes (not kA) although above 10000 A the MCB may be damaged and lower breaking currents (75% for 10000 A and 50% above that level) must be used for design purposes. Prospective short circuit current (PSC in fig. 6) is driven by the e.m.f. of the secondary winding of the supply transformer through impedance made up of the secondary winding and the cables from the transformer to the fault. The impedance of the cables will depend on their size and length, so the PSC value will vary throughout the installation, becoming smaller as the distance from the intake position increases. (313-01-01] requires the PSC to be 'assessed' by 'calculation, measurement, enquiry or inspection'. In practice, this can be difficult because it depends to some extent on impedance's which are not only outside the installation in the supply system, but are also live. If the impedance of the supply system can be found, a straightforward calculation using the formula below can be used, but this is seldom the case.

$$PSC = \frac{u}{z_1 + z_2 + z_3} \tag{1}$$

U= supply voltage

z = the impedances in the circuit.

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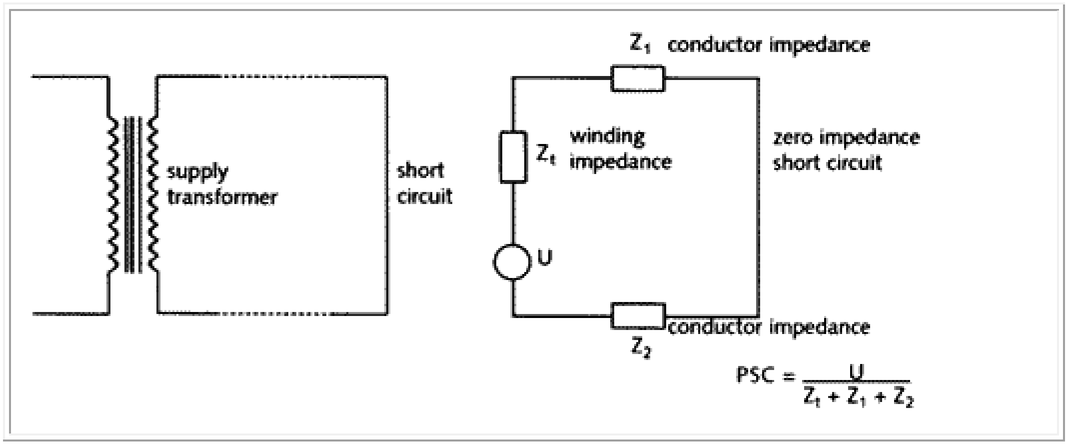

Fig.6. Prospective short circuit current (PSC)

There are two methods for measuring the value of PSC, but these can only be used when the supply has already been connected. By then, the fuses and circuit breakers would already have to be installed. The first method is to measure the impedance of the supply by determining its voltage regulation, that is, the amount by which the voltage falls with an increase in current. For example, consider an installation with a no-load terminal voltage of 240 V. If, when a current of 40 A flows, the voltage falls to 238 V, the volt drop will be due to the impedance of the supply. A second measurement method is to use a loop impedance tester connected to phase and neutral (instead of phase and earth) to measure supply impedance (Fest 1992). This can then be used with the supply voltage to calculate PSC. Some manufacturers modify their earth-loop testers so that this connection is made by selecting 'PSC' with a switch. The instrument measures supply voltage, and calculates, then displays, PSC.

Table1. Effects of unearthed system connections in a computer centre in three months

Type of equipment	**Location**	**Type of connection**	**Effect**	**Action taken**	**Amount involved**
Computer system unit	Business Centre	System to printer	Printer port Damaged	Purchase of printer port	N1500.00
Printer	Classroom	Power cable	Printer power destroyed	Replacement of power pack	N5000.00
Scanner	Business Centre	Usb port connection	System USB port destroyed	Change of motherboard	N18000.00
Network card	Cyber café room	Connection to the switch	Network card burnt	Replacement of network card	N1500.00
Printer	Business centre	Connection to the system	System printer port burnt	Purchase of multi-I/O Card	N2500.00

Source: University of Calabar computer centre workshop log book (1999) **Total** **N28500.00**

DISCUSSION

When systems are installed in a place uncertain in terms of earthing, the system stands the risk of having problems as a result of spikes. Trained personnel should be involved in the installation who should first check the earthing situation of the building. It is not enough to see a thunder arrestor on top of the building and/or a cable going into the soil to represent earthing. Proper check should be done on the sockets to ascertain the position of the neutral. In many instances we ignore the effect of not earthing our buildings and we just have to connect our equipment to the available source. This at times does not give problems but with time as explained above the problems come out. If in a computer centre the expenses on repair of systems and replacement of parts as a result of spikes emanating from either loose contacts or lack of proper earthing is this high in three months, it means that in a year the figure will be multiplied by at least 3.2. This obviously indicates that losses are incurred through avoidable source originating in lack of knowledge, or simply in bad workmanship.

CONCLUSION

Whenever a building is put-up it is usually important that there be some measure of protection. This at times is done using only thunder arrestor forgetting the electrical earthing which is very important in terms of IT equipment.

From the fore-going, it has been established that unnecessary expenses are incurred as a result of not only lack of earthing but also due to lack of knowledge and bad workmanship. This is expressed on the table below which shows the total expenses incurred in three months in a computer centre, which will deplete the income of such a centre. It is therefore important that efforts are made to arrest these situations for the interest of the equipment and for positive productivity. In doing this care must always be taken in the electrical installation in a building and the use of qualified personnel in the installations. In an establishment where losses are incurred from avoidable sources is very bad and against positive productivity. In a situation where one is in doubt one can perform PSC tests.

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