Protection of the People and Equipments in the Electric Installations

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Abstract-The electric energy, while useful, is dangerous to humans and equipments.If electric current passes through a person, there is a risk of injury and even death. It is necessary to protect persons against such dangers.

Distribution networks are characterized mainly by the number of active conductors and the earthing of the neutral.

During the defect of isolation or accidental setting of a phase to ground, the values of faults currents, touch voltage and surges are closely related to the mode of connection grounded.

Our analysis concerns some of the problems relating to the safety of persons and electric equipments.

Keywords---current ,impedance,protection,shock,installations.

I. Introduction

ELECTRICITY can kill or severely injure people and causes damage to the property. Every year many accidents at work involving electric shock or burns are reported. Most of the fatal incidents are caused by contact with overhead power lines.

Even non-fatal shocks can causes severe and permanent injury.

Those using or working with electricity may not be only ones at risk-poor electrical installation and faulty electrical appliance can lead to fire, which may also causes death or injury to others. Most these accidents can be avoided by careful planning and straight forward precautions.

II. Dangers Of Electric Current

Dangers of electricity include a variety of hazards that include electric shock, psychological damage, physical burns, neurological damage and ventricular fibrillation resulting in death [1, 2, 3]. The risk inherent with electric power can generally be divided into two categories: direct and indirect. The direct danger is the damage that the power itself can do to the human body, such as stoppage of breathing or regular heartbeat, or burns.

The indirect dangers of electricity include the damage can result as a resultat of something causes by electric shock, such as fall, an explosion, or a fire.

A.Physiological effects:

-perception current: It is the minimal current that a person can detect;

-Let- go current: sensation become unpleasant and can lead to muscle contraction. This current is definited by IEC (international commission of electrotechnic) as maximum current that can be tolered by a person;

- tetanisation :muscle contract and it is possible to let go.For above current, the trajectory of current in the body may include the respiratory muscles;

-fibrillation of the heart (cardiac arrhythmia).When cardiac contractions are anarchic, and this condition is prolonged, irreversible damage appear followed by the death.

-electrical burns: burns are the most common consequence of accidents due to electric current.

Factors involved in the physiological effects of electric current:

-current;

-voltage : the value of the voltage does not represent the danger criterion, the criterion being the current through the body and the current depends on the contact voltage and the value of the electrical impedance of the human body. Thus the means of protection do not refer to the current that is not easily mesurable, but the value of touch voltage;

-body impedance: the impedance offered by the human body to the current is not linear. Its value varies in very large proportions and the current through the body is function of the impedance;

-time of current flow: the danger is even greater than the time of passage of current through the human body is big;

-current path: the current trajectory has a great influence on the danger. These are the trajectories that can harm the hearth that induce ventricular fibrillation;

-frequency: values of frequency of 50-60Hz are the most dangerous. For frequencies above 50Hz the current becomes less dangerous.

III. Electric Impedance Of The Human Body

The human body will conduct electricity if it becomes involved in a current path or circuit. Body tissue contains a significant proportion of water, in which salt are dissolved. This solution conducts electricity relatively well [2, 4, 5].

The values of the impedance depends of very important number factors especially the current path ,the contact voltage, duration of the current flow, the moisture condition of the skin, the surface of touche,temperature ...

For voltage below 50V, the skin impedance varies widely, the total impedance varies in the same way. For higher voltage, the total impedance less depends of the impedance of the skin.

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Values of impedance human body by IEC [2, 4, 6]

Touch voltage (V)	5% of population	25% of population	95% of population
25	1750	3250	6100
100	1200	1875	3200
220	1000	1350	2125
700	750	1100	1550
2000	660	1100	1500

The current path influences the value of the impedance of human body. At the example, the impedance from a current path one hand to bath feet is 75 %, and the impedance from both hand to both feet is 50 % of the impedance hand-hand (100 %).

As far the effect of frequency is concerned. Impedance decreases hardly for frequencies of up to 500Hz, then the decrease is less pronounced and from 5 kHz essentially constant.

Other factors affecting the value of impedance: contact surface of electrodes, temperature, altitude, size, weight, psychological conditions...

IV. Protection Of Persons Against Electric Shock

To reduce the risks, various measures are taken, both in product, system design and in working practices [5, 8]:

-insulation: human contact with conductors or path of equipments carrying hazardous voltage is prevented by a covering of insulating material such as rubber or plastic.

-protective earthling: hazardous electrical paths are enclosed in a conductive housing which is then connected to earth by a separate conductor.

-separation: human contact with conductor is prevented by physical separation, enforced by physical barriers, such as in the case with overhead distribution lines, distribution switching centers.

-residual current devices: RCD operate by monitoring the current in both flow and return conductors of a circuit if a fault causes the flow.

-regulation :health and safety regulation require electrical installations and appliances used in places of work to be setup ,maintained, and used such as to prevent injury.

V. Protection Of Equipments

To protect an electrical installation, we have to detect defects (overload, short-circuit, over voltage, decreases tension) [5, 8].

-Overload:this defect from an office that call too much power to the power line.

This results in a current draw as the facility sees its temperature increase beyond its normal operating limits. Is then observed wear may lead to insulation long fault to other defects (short-circuit)

-short-circuit: this is the contacting of two conductors with different potentiels.This then causes significant degradation of the insulation which can cause other short- circuits.

-brownouts: surges is often inductive origin. It can be caused by resonance phenomena on the electric network, by lightning. A surge can cause significant strain of insulation installation which may cause short-circuit.

-overvoltage: they are often caused by imbalances in the three-phase network and they involve a malfunction receivers.

Protection devices are:

-fuses: the fuse is a connection device for opening a circuit by melting a calibrated element.

-disconnectors: a switch is a mechanical switching device to close or open a circuit.

-breathers: the circuit breather is a mechanical apparatus for establishing or breaking a current during short-circuit. In such a device, a system for manually opening and closing of the circuit elements to provide protection against overloads and short-circuit are associated.

Protection against overloads and short-circuit will be provided by thermal sensor or electromagnetic shutter.

VI. Conclusion

The study of the effect of electric current on the human body is analyzed non exhaustive part has been studied in the present work as different factors that offer way on the danger of electric current.

Electric impedance of body is analyzed and essentially action of the contact voltage and the current path.

For the protection of people, the different means of protection were studied.

For protection of the equipments different defects were mainly analyzed and ways to remedy these defects.

References

[1] Dalziel C.F - « electric shock hazard : » IEEE Spectrum,1972, vol.6 N°90

[2] « Effet du courant passant par le corps humain » commission electrotechique internationale, rapports de la CEI, publication 479-1974 et 479-1984.

[3] « The effect of electric current in the human body » PRSCenter (ICSEE 2012), Dubai 2012.

[4] « The electric impedance of the human body » PSRCenter (ICEECE 2013), Dubai 2013.

[5] Ouazani A-« theorie et pratique pour l'amelioration de la sécurité dans les installations electriques » these de doctorat, Moscou 1990.

[6] Biegelmeier G- « l'impedance electrique du corps humain » R.G.E ,N°11,1985.

[7] uazani A-« protection of persons and regime of a triphasé» PRSCenter (ICICT 2014), Dubai 2014.

[8] « Electrical installation guide » edition CITEF S.A.S, Paris 2005.