



Chemical Earthing for Lightning Arrester

Anjaly Subhash¹

M.Tech, Dept. of ECE, Rajagiri School of Engineering and Technology, Kakkanad, Ernakulum, Kerala, India

ABSTRACT: Lightning Arresters are used for protecting electrical power systems and telecommunication systems from the damaging effects caused by lightning. The lightning surge travels through the conductors and is diverted to earth. Earthing of lightning arrester is the most critical part in electrical designing and is vital for the proper operation and integrity of electrical system. Usually in Sub Stations, mat earthing connected with pipe earthing is used for protection of lightning arresters. The earthing design for the equipments is dependent upon the resistance of the soil. Chemical Earthing is a particular case of earthing preferred when earth resistance is high, usually in places with scarcity of rainfall. In Chemical earthing the four corners of mat earthing is dipped into an artificial pit with a chemical solution of bentonite. The purpose of the artificial chemical pit with bentonite is to decrease the earth resistance and to provide a safe path for penetration of lightning surge to the ground.

KEYWORDS: Earthing, Bentonite, Electrode, Mat Earthing, Lightning surge, Lightning arrester, Spark gap.

I. INTRODUCTION

Lightning is the sudden electric discharge produced by imbalance between +ve and -ve charges. Lightning bolts between cloud and ground is a phenomenon. The earth's surface receives about 100 strikes every single second and their power is extraordinary. One lightning bolt could produce one billion volt of electricity. The temperature of a single lightning flash makes the air five times hotter than sun's surface. Around 2,000 people are killed by lightning per year and many survives strikes, suffer from memory loss, dizziness and other life altering ailments. Lightning arresters are devices used to protect the insulation and conductors fro lightning surges lightning arrester has high-voltage terminal and ground terminal. The lightning surge travels through the lightning arrester and then to the ground, thereby protecting the equipments and humanbeings. Absence of lightning arrester damage transmission lines, transformers and other electrical devices by introducing lakhs of kilovolt. Lightning arrester is made of semiconductor material mostly silicon carbide or zinc oxide and consists of a spark gap in between. The solid zinc oxide discs are arranged to form a cylindrical stack. The number of zinc oxide depends upon the voltage rating of the system. The cylindrical stack is provided with cylindrical housing of porcelain and is pressed by heavy spring load attached to end cap. The spark gap consists of precision gas mixture and traces of radioactive material for ionising the gas, when gap voltage reaches specified level. Lightning arrester consists of lightning rods which is always at ground potential and never energized, diverts lightning surges to the ground. Earthing of lightning arrester is vital for the proper operation of the electrical syster. In this work mat earth is connected to bentonite filled pits thereby decreasing the resistance.

II. EARTHING

Earthing or grounding is a method of connecting non-current carrying conductor of electric installations through a conducting wire to the ground for safety purpose. Earthing may also be defined as the neutral point connection of electric power system to the ground to avoid danger during electric discharge and thereby protecting working personnel[5]. Earthing also plays a major role during neutral shift, protection from lightning, avoiding fire risks and acts as return conductor. Earthing is done for transformers, generators, stationary motors, 3 pin and 4 pin plug sockets, over head lines, iron clad switches, distribution fuse boards etc. The earth wire connects the metallic parts of the electrical installations to the ground. Properly constructed and designed electrical systems will not have any contact between the non-current carrying conducting part and the current carrying part. By accidently if any of the non current carrying conducting parts comes in contact with each other resulting in the development of the static electric charging the non current carrying conductor part results in the electric shock to the working personnel. If the metallic noncurrent carrying conductor is properly earthed, then the fault current will pass through this path to the ground, resulting in safety operation.

Earthing depends on soil resistivity which depends upon the soil moisture content and varies time to time. Earth resistance is maximum in dry season and minimum in rainy season. Some standards for maximum allowable earth resistance are:

- 1) Large Power Station=.5 ohm
- 2) Major Power Station= 1.0 ohm
- 3) Small Substations= 2.0 ohm
- 4) Other cases=5 ohm

III. COMPONENTS OF EARTHING SYSTEM

Components of earthing system include Earth wire, Earthing joint and earth electrode. Earth wire is a part of earthing system which inter connects the metallic part of electrical installations[5]. The resistance of earth wire should be less than 1 ohm. The cross sectional area of the earth wire should not be less than that of the thickest wire used in the electrical installations. Earthing joint is the conductor wire connected in between earth wire and earth electrode. Connecting point is the point where the earth wire and earth electrodes meet. Copper strips and copper wire are generally used as earthing joint. Earthing electrode is buried underground and is the last part of earthing system[5]. Metallic pipe or plate used as earth electrode has low resistance and is used to carry fault currents safely towards ground.

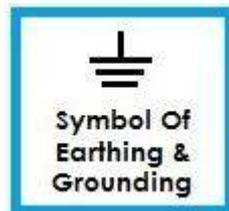


Fig 1.Symbol of earthing and groundinhg



Fig 2.Earthing

V.BENTONITE EARTHING

Earth mat is a type of earthing in which the metal mats are installed underground. The material used is copper, the higher the conductivity of the material the better. Mat Earthing is a mesh of copper material installed to protect equipments from leakage current. Ground mat is used to earth static electricity thereby protecting the working personnel and equipment. There are two types of mats: Static dissipative mats and Conductive mats. A static dissipative mat is made of 3 layers with dissipative vinyl layers surrounding conductive substrate electrically attached to earth. Conductive mats are also called “anti fatigue mats” made of carbon and used on floors for drawing static electricity to ground. Bentonite is a high performance low resistance maintenance free earthing compound, ideal for use in ground condition where conductivity is very poor. It is moisture retaining clay which is sodium activated montmorillonite, when mixed with water swells to many times its original dry volume. Bentonite is available in two forms i) Granular form ii) Powder form. Granular bentonite is preferred over powder form since it is easier to handle and the substance can be mixed in the trench. The typical expansion ratio when mixed with water is 2:1. Bentonite is natural clay which acts as copper protective i.e. it will not corrode copper. Bentonite slurry is injected into trench hole or trenches to improve the earthing up to 10 times[1]. The four corners of the mat earthing is connected to the bentonite pits dug at the four corners.



Fig 3. Bentonite Earthing

VI.RESULTS

The natural earth soil (clay) mined from areas like Wyoming proved to improve earthing up to 10 times by reducing the soil resistivity thereby providing a permanent path for excellent conduction of surge current. Bentonite when mixed with water produces an expansion ratio of 2:1.

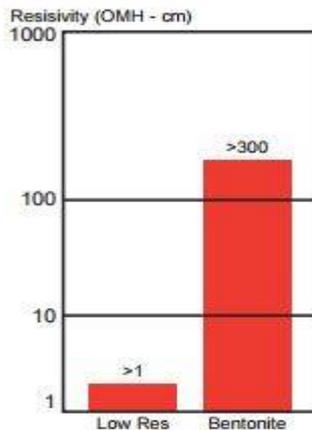


Fig 4.Result



VI.CONCLUSION

The lightning arrester made of zinc oxide semi conductor consists of spark gap in between with a mixture of precision gas and traces of radioactive material for passage of surge voltage. Lightning arrester is provided with earth electrode for protecting the equipments from the damaging lightning surge. Mat earthing is connected to bentonite slurry filled in pits to reduce soil resistance and to increase the conductivity.

REFERENCES

- [1] Siow Chun Lim, Chandima Gomes and Mohd Zainal Abidin Ab Kadir, " Characterizing of Bentonite with Chemical, Physical and Electrical Perspectives for Improvement of Electrical Grounding Systems," Int. J. Electrochem. Sci., 8 (2013) 11429 - 11447 .
- [2] Leonard J. Bohmann ,John McDaniel, E. Keith Stanek , "Lightning Arrester Failures and Ferroresonance on a Distribution System," IEEE ,Rural electric power conference, April 1991.
- [3] By Larry Pryor, P.E., GE, Sr. Specification Engineer, "Application and selection of lightning arresters," ge.industries .
- [4] Kai Steinfeld, Reinhard Göhler, Daniel Pepper Siemens AG, Berlin., "High Voltage Surge Arresters for Protection of Series Compensation and HVDC Converter Stations," The 4th International Conference on Power Transmission and Distribution Technology 2003.
- [5] N.a.Abd Rahman, N. Abdullah,M.F. Ariffin,"Influence of Earthing Resistance on the Performance of Distribution Line Lightning Arrester"2010 Asia –Pacific International Symposium on Electromagnetic Conpatibility, April 12-16,2010, Beijing,China.