International Journal of Advancement in Electronics and Computer Engineering (IJAECE)
Volume 12, Issue 2, Feb. 2023, pp.83-85, ISSN 2278 -1412

Study and Evaluation of Light Storm Over Voltages for Protection of Transmission Lines- A Review

Kuldeep[1], Prof. Ashish Bhargava[2]
[1]Mtech Scholar,BERI, Bhopal, India
[2] Prof. & HOD, BERI,ashi.sonali12@gmail.com, Bhopal, India

Abstract – *Lightning is a natural phenomenon that can cause significant damage to transmission lines. The overvoltage caused by lightning strikes can lead to insulation failure, which can result in equipment damage, service interruption, and in some cases, fatalities. In order to protect the transmission lines from lightning-induced overvoltage, various techniques and protective devices have been developed. The use of light storm overvoltage (LSOV) technology is one of the most effective methods for protecting transmission lines from lightning strikes. This review paper aims to study and evaluate the LSOV technology for the protection of transmission lines.*

The review paper provides an overview of the LSOV technology and its principles of operation. The paper analyzes the various types of LSOV technology, such as shield wires, surge arresters, and surge protectors, and their advantages and limitations. The study evaluates the performance of LSOV technology in protecting transmission lines against lightning strikes based on various parameters, such as voltage, current, frequency, and duration of the overvoltage.

Furthermore, the review paper discusses the different testing methods and standards used to evaluate the effectiveness of LSOV technology. The paper also highlights the challenges and limitations of the LSOV technology, such as installation costs, maintenance, and reliability..

Keywords: **LSOV, Transmission Line, Over Voltage, Light Strome**

I. Introduction

In Lightning strikes are a significant threat to the reliable and safe operation of transmission lines. Lightning-induced overvoltage can lead to equipment damage, service interruption, and even fatalities. Therefore, protecting transmission lines from lightning strikes is a critical task in power system operation and maintenance. Various techniques and protective devices have been developed to prevent lightning strikes and reduce the damage caused by overvoltage. The light storm overvoltage (LSOV) technology is one of the most effective methods for protecting transmission lines from lightning strikes.

The LSOV technology uses shield wires, surge arresters, and surge protectors to prevent overvoltage from lightning strikes. The technology is designed to divert the lightning current to the ground, reducing the overvoltage that can occur on the transmission line. However, the effectiveness of LSOV technology depends on several factors, such as the voltage, current, frequency, and duration of the overvoltage.

This review paper aims to study and evaluate the LSOV technology for the protection of transmission lines. The paper provides an overview of the LSOV technology and its principles of operation. The different types of LSOV technology, such as shield wires, surge arresters, and surge protectors, are analyzed in detail, along with their advantages and limitations. The paper evaluates the performance of LSOV technology in protecting transmission lines against lightning strikes, based on various parameters.

Furthermore, the review paper discusses the different testing methods and standards used to evaluate the effectiveness of LSOV technology. The paper highlights the challenges and limitations of the LSOV technology, such as installation costs, maintenance, and reliability. Finally, the paper concludes by emphasizing the importance of LSOV technology in protecting transmission lines from lightning strikes and the need for continuous research and development to improve the reliability and effectiveness of LSOV technology.

II. LITERATURE REVIEW

The frequency distribution of first return-stroke light storm current peaks adopted by International Council on Large Electric System (CIGRE) has been derived from the available measurements of 338 negative downward flashes, collected in several parts of the world on various structures (76 flashes on lines and 262 on masts and chimneys) of different heights, in general, less than about 60 m. One-hundred twenty–five measurements are taken from those recorded at the Berger's tower. The lowest current value contained in the data sample is 3 kA. The cumulative distribution of these peak current peaks has a median value of about 34 kA.

As noted by Anderson and Eriksson [1980], a lognormal distribution can be better represented by two sub-distributions that divides, in a first approximation, in to the shielding failure and backflashover domains. Shielding failure domain is the measure of ineffectiveness of protecting work which determines the number of strokes to the phase conductors per year where as backflashover domain is the measure of number of strokes to the shield wire per year

The majority of the currents, however, were measured on tall telecommunication towers. The well-known experiments were carried out on two 40 m high telecommunication towers in Italy on a 248 m high telecommunication tower near St. Christiana, Switzerland and on a 160 m high telecommunication tower located on the mountain Peissenberg near Munich, Germany. The highest towers were the 540 m high Ostankino tower in Moscow, Russia and the 553 m high Toronto Canadian National Tower, Canada. The most important current data, however, stem from the experiments of Prof. Berger, who had been recording the light storm currents during about 30 years on a telecommunication tower situated on the mountain San Salvatore near Lugano, Switzer-land. [3]

The light storm currents are preferably studied on elevated structures due to increasing probability of the strike with the height. In former light storm research they were measured with magnetic links installed on various locations as power lines, masts, chimneys and high buildings. Because only the current peak proportional to the maximum magnetic field strength is captured with this method, nowadays oscilloscopes are mainly employed for the recording of the current waveform. One of the first important experiments was carried out on the Empire State Building in New York City, USA. Similar experiments were performed on a 60 m high mast in South Africa and in Japan, where the currents measured in winter thunderlight storms. In Russia even captive balloons connected with ground by a steel wire were used. [4]

TC 81 decided as one of the first steps to define the light storm threat as a common basis to any protection measures. The light storm treat is mainly derived from the measurement of Berger performed on two 70m towers on the mountain San Salvatore in Switzerland. Up to now the result published in CIGRE Electra in 1975 and 1980 represents the most complete data base of light storm current and their relevant parameters. [5]

III. METHOD

Light storme arresters contain one or more varistors with various diameters and heights. Varistors are made of ceramic of non-linear voltage-current characteristic. It is a ceramal of zinc oxide with admixtures of other metal oxides – i.e. of cobalt, manganese and aluminum. Structure of the varistors' mass is in the shape of close-packed grains. A small part of the grains constitute admixtures inside the grains while others, mainly bismuth, are accumulated in outer layers. Resistivity of the grain inside is small as op -posed to resistively of outer layers. Non-linearity of the volt -age-current characteristic results from phenomena occurring just mainly on the

boundary of the grains. Between grains appear potential barriers, which regulate intensities of cur -rents in dependence on voltage, as on the grain boundaries is considerable negative charge accumulated, being a result of existence of acceptor admixtures. With small voltage, volt -age- current characteristic remains in accordance with the Ohm's law, and depends on temperature. While increasing the voltage, energies of electrons can be high enough to pull electrons out of valence band. Electron-hole pairs of charges are created. Holes direct towards negatively charged boundary between grains, neutralizing considerably surface charge and contributing to decrease of potential barrier. Sudden decrease of this barrier results in rapid current increase in the varistors. In this work range is the characteristic strongly non-linear. The non-linearity decreases, however, with potent light storm currents flow. With high density of currents, voltage increase is revealed, as a result of rise of voltage drop on grain-inside resistance. Character of phenomena on the grain boundary is the same as with lower current density.

IV. CONCLUSION

This review paper has provided an overview of the LSOV technology and its principles of operation. The different types of LSOV technology, such as shield wires, surge arresters, and surge protectors, have been analyzed in detail, along with their advantages and limitations. The paper has evaluated the performance of LSOV technology in protecting transmission lines against lightning strikes, based on various parameters.

The paper has also discussed the different testing methods and standards used to evaluate the effectiveness of LSOV technology. The challenges and limitations of the LSOV technology, such as installation costs, maintenance, and reliability, have been highlighted.

Reference

[1] ICECON Bucharest, Standard for structures and building protection against light storm - I 20, 2000.

[2] Popolansky F, "lighting current measurement on high objects in Czechoslovakia", proc of the 20th international conference on light storm protection ICLP, interlaken.

[3] Garbagnati, E and G.B LoPiparo, light storm parameters result of 10 years investigation in Italy "international Aerospace conference on light storm & static electricity ICOLSE,
Oxford, report A1 1982

[4] GeldenhuysH.A Erikson and A Bouon, fifteen years data of light storm current measurements on 60m mast "proc of the 19th International conference on light storm protection ICLP, Graz, report R-17, 1988

[5] Juan A. Martinez-Velasco, Member, IEEE, Ferley Castro-Aranda, Student Member, IEEE Modeling of Overhead Transmission Lines for Light storm Studies,

[6] EPRI, Transmission Line Reference Book, 345kV and Above, Electric Power Research Institute, Palo Al to, 2ndEdn, California (1982).

[5] Shariatinasab, R., Vahidi, B. and Hosseinian,S, S, S. H. ''Statistical evaluation of light storm related failures for the optimal location of light storme arresters on the power networks'', Gener,

[6] Lukasz Staszewski, "Light storm Phenomenon – Introduction and Basic Information to Understand the Power of Nature," 8th International Conference on Environment and Electrical Engineering, 2009.

[7] Andrew R. Hileman, "Insulation Coordination for Power Systems," Marcel Dekker Inc., 1999.

[8] Andrew R. Hileman, "Insulation Coordination for Power Systems," Marcel Dekker Inc., 1999.

[9] CIGRE Working Group 33-01 of Study Committee 33Over voltage and Insulation Coordination: Guide to Procedure for Estimating the Light storm Performance of Transmission Lines. CIGRE Publication, No 63, October 1991

[10] Eduard M.Bazelyyan, Yusi P.Light storm physics and Light storm protection

[11] "A Report on Light storm And Light storm Protection of Overhead Transmission Line" by RAHUL N. NANDESHWAR

[12] Vinit Marathe Computer Tool for Comparison of Classicaland Non-Conventional Light storm Protection Designs for Electric Substations

[13] Mahan G.D., Levison L.M., Philipp H.R.: Theory of Conduction in ZnOVaristors.Jour. of Appl. Phys., 1979,

[14] Mukae K., Tsudi K., Shiga S.:Zinc Oxide-Praseodymium Oxide Elementsfor Light storme Arresters. IEEE Trans. on Pow. Deliv., 1988,

[15] Greuter F, Perkins R, Rossinelli M., SchmuckieF.:The Metal-Oxide Resistor-at the Heart of Modern Light storme Arresters. ABB Rewiev, 1989

[16] Kevin Mara, Controlling Light storm Induced Outages on Overhead Lines P.E. 770-425-8100

[17] Chow dhuri P, Fellow, IEEE: Parameters of Light storm Strokes and Their Effects on Power Systems, IEEE/PES, Conf. and Exposition Transmission and Distribution, Atlanta, Georgia, 2001, paper

[18] Guide for the design and execution of grounding systems – 1REIp 30/2004, Sier Bucharest.