Corona Effect on Transmission Line

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***Abstract*—: Corona effect on high-voltage transmission lines is one of the leading causes of power loss in the power system, which is both inefficient and undesired. Corona and the factors that cause loss are studied using example calculations based on Peek's formula and Peterson, the distance between the generating station, frequency, and load centre, as well as the amount of power to be handled. Our research will be beneficial to those interested in corona loss and prevention.**

I. Introduction

System planners opt for EHV/UHV AC and HV DC transmission because of the increased demand for bulk power transmission across long distances.The influence of corona discharges at the conductors is a critical design consideration at voltages above 400 kV. Corona loss, radio interference, audible noise, and television interference are the most common impacts of corona. Conductor geometry, line geometry, conductor surface condition, atmospheric and weather conditions are all factors that affect corona performance for a given system voltage.Because these variables have a direct impact on line and tower design, it's critical to predict corona impacts early in the process. Therefore data collection techniques have been created from relatively short section of conductor, either on a single phase overhead test line or in a corona cage

[1]The corona cage is a useful tool for evaluating several types of conductor layouts quickly. The usage of a corona cage is one of the most effective, quick, and relatively inexpensive methods for measuring bundle conductor corona performance.

[2].As artificial rain can be easily created for cage research, preliminary conductor selection is usually done based on the cage data.If further research is required, the specified conductor configuration can be strung in the experimental line.

[3]A voltage of 765 kV Transmission lines have been established throughout the country, and more will be added. In the upcoming years, the next transmission line voltage is envisaged to be 1200 kV, in the nation. Considering corona performance is a key factor in selecting the conductor, evaluation of the corona effects is important at the design stage.

II. Calculation

The power dissipated in the system due to corona discharges is called corona loss.The fluctuating nature of corona loss serves to make accurate estimation difficult. It has been discovered that the corona loss under fair weather condition is less than under foul weather conditions. The corona loss under appropriate weather conditions is given below by the Peek's formula

$$\mathrm{P}_C = \frac{241}{\delta}(f+25)(E_n-E_0)^2\frac{\sqrt{r}}{\sqrt{D}}10^-5kW/km/phase$$

Where Pc – corona power loss
f – frequency of supply in Hz
$\delta - airdensityfactor$
En – r.m.s phase voltage in kV
Eo – disruptive critical voltage per phase in kV
r – radius of the conductor in meters
D – spacing between conductors in meters
It is also to be noticed that for a single –phase line,
En=1/2×line voltage and for a three phase line,
En = 1/(3)×line voltage

Peek's formula is applicable for determined visual corona. This formula the gives the inaccurate result when the losses are low, and En/Eo is less than 1.8. It is superseded by Peterson's formula given below;

$$\mathrm{P}_C = 2.1fF\frac{E_n^2}{(\log_1 0\frac{D}{r})^2}10^-5$$

Pc – corona power loss
f – frequency of supply in Hz
En – voltage per phase
r – radius of the conductor
D – spacing between conductors in meters
Factor F is called the corona loss function.
It varies with the ratio (En/Eo).
Eo is calculated by the formula given below,

$$\mathrm{E}_O = G_O m_O r\delta^{\frac{2}{3}}\ln_e\frac{Deq}{r}V/phase$$

Go – maximum value of disruptive critical
voltage gradient in V/m. mo= irregularity factor

III. Prevention

Corona discharge can be reduced using a range of techniques. The following are some of them:

1) By enlarging the diameter of conducter. If the conductor diameter is relatively small, the surface field intensity of the conductor is greater, resulting in a greater corona effect.

2)By increasing conducter spacing. In order to avoid corona effect, spacing between conductors should be more so that there is less electrostatic stress between them.

3) Using a bundled conductor improves the effective diameter of conductor. As a result, the corona discharge is reduced.

4) Using corona rings. Where the conductor curvature is sharp, the electric field is greater. Corona discharge occurs first at sharp points, edges, and corners as a result to lessen the impact corona rings are used at the terminals of very high voltage lines. To achieve this, high-voltage equipment such as the bushings of a very high-voltage transformer. A corona ring is electrically connected to ththe high-voltage conductor that encircles the corona point where the possibility of discharge happening is high. This drastically minimises the risk. As the ring distributes, there is a gradient at the conductor's surface. Its smooth round form disperses the charge over a larger region.

IV. Conclusion

Corona, like any other transmission line defect, has some drawbacks, but these drawbacks are dependent to weather conditions; this partial discharge is most likely to occur during stormy weather conditions and the fair weather conditions This negative effect analysis was carried out in order to put a preventative technique to reduce the influence of these effects in the transmission line. This partial discharge has several engineering benefits and applications. We determined the value of power loss due to corona using the Matlab programl for sample analysis.

V. References

[1]Gupta J. B. A. Course in Power system. New Delhi 2008.

[2] Anumaka, Nigeria 330Kv Interconnected power system

[3]V.K. Mehta, and R. Mehta, Principles of Power Systems. S. Chand Company Ltd, India 2008.