Flashover Analysis in High Voltage Insulator Using By ANN

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Abstract--- The pollution flashover, observed on insulators used in high voltage transmission is one of the most important problems for power transmission. It is very complex problem due to several factors such as the modeling difficulties of complex shapes of the insulators, different pollution different regions, non-homogeneous pollution distribution on the insulation surface and unknown effect of humidity on the pollution. In the literature, some static and dynamic models were developed by making some assumptions and omission to predict the flashover voltages of polluted insulators. In this paper, an artificial neural network (ANN) model was built with limited number of measurement for the prediction of the critical flashover voltage of polluted insulator. Multilayer fully connected feed forward neural network (FFNN) with Back propagation algorithm has proposed for the assessment of critical flash over in artificially polluted porcelain insulators The comparisons indicate the proposed ANN model gives better results compared to the analytical model suggested earlier.

Keywords---Pollution Flashover, Flashover Voltage, Artificial Neural Networks, Laboratory Measurements

I. LITERATURE REVIEW

In this dissertation work, the project will be performed on the topic "Flashover analysis in high voltage insulator using by artificial neural network". Several paper of conference, IEEE, SCIENCE DIRECT, IJSRP are read out and from each paper certain conclusion and ideas method techniques were observed.

- The flashover performance of insulators under polluted conditions is one of the guiding factors in the design and dimensioning of insulation in power transmission lines. The simplest model for the explanation and the evaluation of the flashover process of a polluted insulator consists of a partial arc spanning over a dry zone and the resistance of the pollution layer in series.

- In the literature, some static and dynamic models were developed by making some assumptions and omissions to predict the flashover voltage of polluted insulators. For this purpose, scaled shape of a concerned insulator was firstly partitioned into triangular elements, then finite element method (FEM) was implemented and finally potential distribution on the insulator surface, variation of pollution resistance and flashover voltage were determined. The computed flashover voltage values of the selected string insulator have been compared to results from other research. Moreover, after ignition of the discharges across the dry bands, the increasing leakage current causes additional variation and non uniformity in the series pollution layer. The experimental data leads to the identification of the arc constants, which are used in the polluted insulator model. The use of the derived values of the arc constants allows not only the qualitative but also the quantitative description of the dielectric behaviour of polluted insulators, providing the users of insulators with a polluted insulator model of general application.

- In this paper, A.C pollution flashover performance of disc type glass insulator and composite long rod insulators investigation under various artificial pollutions by varying Equivalent Salt Density Deposition (ESDD) levels. Here, we use different types of pollution methods like binding method, dipping method and spraying methods with different types of pollutants concentration. Based on dimensional analysis, four different Mathematical models have been developed to predict the A.C pollution Flashover Voltage (FOV) of insulators.

- A new model of V_C = f (V, $I_{initial}$, I_{em}, I_{emax} and I_{σ}) based on artificial neural network has been developed to predict flashover from the analysis of leakage current. The input variable to the artificial neural network are mean (I_{mean}), Maximum(Imax) and standard deviation(I_{σ}) of leakage current extracted along with the initial value of leakage current $I_{initial}$ and the input voltage(V).The target obtained was used to evaluate the performance of the neural network model.

  Insulators used in outdoor electric power transmission lines are exposed to outdoor environmental contaminations. Contamination on outdoor insulators enhances the chances of flashover. Depending on the nature and duration of exposure, deposits of wind-carried industrial, sea and dust contaminants build up on the insulator surface as a dry layer.

- In order to effectively assess the degree of contamination present on an insulator surface the dimensions of the insulator must taken into account. The relevant dimensions include creep age distance, diameter and height. The troublesome pollution comes in two forms. The soluble and non soluble components – e.g. salts from the sea and industrial gases that result in weak acids being formed, it produce an electrolyte when dissolved in water, this can be expressed as equivalent salt density deposition. And the non soluble materials, the non soluble part of the pollutant, can be expressed as the non soluble deposit density.

- This paper shows the results of the analysis of the dynamic behaviour of the flashover phenomenon on the high voltage polluted insulators gotten from a mathematical and an experimental model that introduce the variable thickness influence of the layer pollution deposited on the high voltage insulator surface. The analysis of flashover is done by introducing a variation in the thickness of the channel of Obenaus' model, simulating a layer pollution of variable thickness.

- The objective is to obtain a better reproduction of the real layer pollution deposited on the insulator that works in the polluted regions. Two types of thickness variation are used: a sudden variation, using a step; and a soft variation, using ramps; that are put in the way of the discharge. The mathematical model developed can simulate electrical discharges on polluted surfaces with the influence of the variations of the thickness and variations of the voltage polarity of the experimental model. This mathematical model was obtained from the equivalent electrical circuit of Obenaus' model with geometrical characteristics of this model. The introduction of the thickness variations modifies the resistance value of the pollution simulated layer and the values of the electrical variables of the analyzed phenomenon. This comparison shows that introduction of a ramp makes Obenaus' model more efficient to analyze the dynamic behavior of flashover phenomena.

- In this paper, the transition from weak inception current flow on the surface of the contaminated porcelain insulators till flashover occurs, is classified into three stages which can better be explained in terms of arc voltage gradient.. The present work describes the development of a multi layer Feed Forward Neural Network (FFNN) classifier model using back propagation algorithm for training, to discriminate the arc gradient for the three stages considered, for the given values of A, n and I as the input parameters. The model is tested and the results show that, Neural Network structure with six nodes in the hidden layer is best suited for the present classification. The percentage of correct classification is found to be 100 in all the three classes.

- Working insulators begin failing as airborne contaminants and moisture from natural wetting combine on insulator surfaces to cause a drop in surface resistivity. This enables current to conduct across the insulators, thereby changing the electrical activity exhibited by the insulators when clean. If the drop in surface resistivity is severe enough, then the leakage current may escalate into a service interrupting flashover that degrades power quality. To help improve power quality, Texas A&M University developed an experimental methodology to investigate the electrical activity of contaminated insulators exposed to natural wetting. Leakage current and weather data obtained during experimentation showed that humidity and rain cause a deviation in the electrical activity of contaminated insulators from that of clean insulators. Analysis of leakage current data showed that this electrical activity was characterized by transient arcing behavior. Further, this non steady state activity is small, intermittent, and broad band in nature. This results in a drop in surface resistivity, which enables current to conduct across the insulators. Unless natural cleaning or corrective maintenance occurs, this electrical activity may eventually escalate into an over current fault in the form of a flashover (insulator failure).

- This paper presents a new method of outdoor insulation coordination with artificial neural network (ANN). This method employs an ANN model to map the climatic condition and the flashover voltage of an insulator. After the appropriate model is established with training and validating, it can forecast the flashover voltage of an insulator in complex ambient conditions. Then, it puts forwards that using this ANN model is helpful in studying outdoor insulation coordination and analyzing the electrical performance of insulator in complex ambient climatic conditions. Performance of outdoor insulator under polluted conditions depends specially in the contamination layer configuration and conductivity, which makes important to take them into account during the conception and the design of new insulator.

- This paper presents an experimental study of the flashover voltage of polluted insulator as a function of pollution layer parameters such as; conductivity, layer length, position, number and width of dry bands. Many configurations of pollution distribution are studied using design of experiment methodology. Parameters effects and their interactions have been investigated and evaluated using ANOVA variance analysis statistical technique. The relationship between pollution parameters and the flashover voltage are modeled and analyzed using response surface methodology. Results show how much the flashover voltage of non-uniformly polluted surface is mainly influenced by length of contamination layer and conductivity. Moreover, the obtained statistical models of flashover voltage are adequate with experimentation results. Such information can be exploited to optimize the design of glass insulator used in polluted areas, by making suitable design to create much and wider dry bands in the middle of the insulator surface. Statistical analysis is a powerful tool for predicting the degree of pollution severity, dimensioning insulator, selection of the insulation levels and making decisions of washing program in polluted areas.

- High voltage insulators form an essential part of the high voltage electric power transmission systems. Any failure in the satisfactory performance of high voltage insulators will result in considerable loss of capital, as there are numerous industries that depend upon the availability of an uninterrupted power supply. The importance of the research on insulator pollution has been increased considerably with the rise of the voltage of transmission lines. In order to determine the flashover behavior of polluted high voltage insulators and to identify to physical mechanisms that govern this phenomenon, the researchers have been brought to establish a modeling. Artificial neural networks (ANN) have been used by various researches for modeling and predictions in the field of energy engineering systems. In this study, model of V"C=f (H, D, L, @s, n, d) based on ANN which compute flashover voltage of the insulators were performed. This model consider height (H), diameter (D), total leakage length (L), surface conductivity (@s) and number of shed (d) of an insulator and number of chain (n) on the insulator.

- Use of pollution monitors with a neural network to predict insulator flashover. Insulators on power distribution lines in industrial zones become contaminated from particulates in the air, causing flashovers. Insulators may be cleaned occasionally, but this is a costly process. In this paper, a neural network is trained to interpret data from two pollution-related monitoring devices to estimate the imminence of flashover on substation insulators. The monitoring devices are the UE-386 Ultrasound monitor and the CAT-ILD leakage current monitor. Data is taken from flashover tests conducted at the Electric Power Research Institute (EPRI) High Voltage Testing Research Center (HVTRC). The neural network predictions are validated with a test set of flashover experiments.

- In this paper, a new approach using ANN as a function estimator has been developed and used to model accurately the relationship between Vc for given H, D, L, r, n and d. Input–output data are normalized before the initiation of the training of the neural network for better convergence and accuracy of the learning process. The neural network is trained with the help of data obtained from the FLASHOVER computer program. In this paper multilayer feed-forward network with back-propagation learning algorithm was used for modeling. It is shown that ANN model of the insulator was prepared with a major accomplishment. It is seen that ANN model is capable for predict the flashover voltages of different type of the string insulators. Separately, the results of comparison for each insulator are satisfactory.

II. FURTURLTIC APPROACH

The paper present artificial neural network (ANN) based technique that predicts the flashover voltages of the insulator under contaminated condition energized by AC voltage. The result indicates strong between the model prediction and observed values. These results clearly indicate that salinity is an important factor in determining ESDD and FOV, and it level should be determined carefully.

III. CONCLUSION

In this paper, an ANN has been successfully applied order to solve the problem of flashover voltage modeling. The ANN is developed in order to determine the relationship between flashover voltage as function of insulator parameters and the equivalent salt deposit density. The comparisons of the estimated results with the measured data collected from experimental studies prove the validity of Artificial Intelligence for modeling phenomena in High Voltage Engineering.

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