Academic Journal of Engineering and Technology Science
ISSN 2616-5667 Vol.2, Issue 5: 84-89, DOI: 10.25236/AJETS.2019.020510

Research on grid voltage sag based on distributed power generation

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ABSTRACT. *A new method for grid voltage sag stochastic estimation considering the correlation of new energy output is proposed for new energy power systems including wind power, photovoltaic and electric vehicle charging stations. Firstly, a stochastic model of fault information and a stochastic model of new energy output are constructed. After using the Pearson correlation analysis method to determine the correlation coefficient of the same type of new energy output, a series of sag events are obtained through fault simulation, and the voltage dips of each node are calculated. Indicators, estimate the voltage sag of each node[1-4].*

KEYWORDS: *distributed; Pearson correlation analysis;*

1. Introduction

New energy sources such as wind power and photovoltaics are increasingly connected to the distribution network, optimizing the power supply structure of the power grid [5-6]. However, due to the randomness of new energy output, it will affect the power quality, power supply reliability, safety and economy related to the distribution network [7-8]. Among the effects of new energy on power quality, the assessment of voltage sag is one of the important issues of concern [9-14]. Literature [9] studied distributed electricity

The type of distributed generation (DG) and its control strategy have an impact on voltage sag; the literature [10] based on the literature [9], based on Monte Carlo method, a more comprehensive analysis of the type and control strategy of new energy The effect of output and access location on voltage sag; literature [11] studied the effects of different DG penetration power levels and different network topologies on voltage sag; the literature [12] proposed a consideration of the inherent uncertainty of wind farms. The voltage sag evaluation method uses the probability model of the wind farm output to classify the output of the wind farm into three scenarios, on the basis of which the evaluation results of the uncertainty of the output of the wind farm on the voltage sag are obtained; [13] Aiming at the distribution network with DG, a voltage sag evaluation method based on point

ISSN 2616-5667 Vol.2, Issue 5: 84-89, DOI: 10.25236/AJETS.2019.020510

estimation method is proposed. The voltage sag weak link in the active distribution network is obtained through simulation evaluation. With the vigorous implementation of electric vehicles in the country in recent years, electric vehicle charging stations have emerged [12], the connection of electric vehicle charging stations in the power grid

Incoming brings more power fluctuations and uncertainties, so it is necessary to study the impact of electric vehicle charging stations on grid voltage sag. At present, there have been related researches in the fields of distribution network reconstruction and power supply reliability [10-11], but there is no voltage sag evaluation study that can comprehensively consider new energy sources such as wind power, photovoltaic and electric vehicle charging stations. In addition, the output power of new energy sources not only has strong randomness, but also has a certain correlation between new energy output in the same geographical position, which will also have an impact on grid operation. At present, the correlation of new energy output has been studied in the fields of probabilistic power flow and power system reliability [12-13], but there is still a lack of research on voltage sag evaluation. In summary, this paper proposes a random estimation method for grid voltage sag considering the correlation of new energy output. Firstly, a stochastic model of new energy output and a random model of fault information, such as wind turbines, photovoltaic power generation systems and electric vehicle charging stations, are established. Secondly, for the stochastic model of fault information, Latin hypercubesampling (LHS) is used to obtain each fault information sample. For the stochastic model of new energy output, the correlation coefficient is determined by Pearson correlation analysis, and then the correlation is processed by Nataf transform. Sex, and then use the LHS method to obtain a sample of new energy output. Then, the fault simulation analysis is carried out, and a series of sag events are obtained. After the sag event is evaluated, the grid voltage sag is obtained. Finally, taking the IEEE 30-node system as an example, the effects of new energy output and the access of different types of new energy on the voltage sag of the grid are studied.

2. Stochastic Model

The fault line, position, type, duration, and fault resistance are the primary information for the fault.

(1) Faulty line. Generally, it is difficult to obtain the fault probability of the line from the measured short-circuit fault data of the power grid. For this reason, it can be assumed that the line fault is proportional to the line length [9].

(2) Fault location. The fault location is set to obey the uniform distribution of [0,1], and the probability of occurrence of the fault location is randomly generated [7].

(3) Fault type. This paper mainly considers four main fault types: single-phase short-circuit (LG), two-phase short-circuit (2L), two-phase short-circuit (2LG), and three-phase short-circuit (3LG).

(4) Duration. The fault duration obeys the expected normal value of 0. 06 s and

ISSN 2616-5667 Vol.2, Issue 5: 84-89, DOI: 10.25236/AJETS.2019.020510

the standard deviation is 0. 01 s of the standard normal distribution [9].

(5) Fault resistance. The fault resistance follows a standard normal distribution with an expected value of 5 Ω and a standard deviation of 1 Ω [10].

3. Voltage sag random prediction

In actual engineering, the geographical characteristics of the same area, such as geography and climate, are often similar, so that the wind speed and illuminance of the area are often similar. Therefore, the same type of new energy output in the same area is often related. For the related new energy output, the Pearson correlation analysis method is needed to obtain the correlation coefficient between the new energy sources, and then the correlation is processed by the Nataf transformation. Then, the LHS method can be used to obtain the relevant new energy output samples and establish The sample simulation scheme; then, the fault simulation analysis is carried out for each sample simulation scheme, and the sag events of each node and their characteristic values (temporary amplitude, duration, etc.) are counted. Finally, the voltage sag index is selected to evaluate and analyze each node, and each The node voltage sag is estimated.

Method Flow

In order to improve the stability and convergence of the voltage sag random prediction results, the fault information data and the new energy random output data are generated by LHS method, then the fault simulation is simulated in MATLAB, and the sag events and their characteristic values are counted. Furthermore, the sag of each node is obtained, and the influence of new energy output under the change of correlation coefficient and the access of different types of new energy on the voltage sag of the power grid is studied. The basic flow of the grid voltage sag stochastic estimation method proposed in this paper considering the correlation of new energy output is detailed below.

(1) Establish a stochastic model of fault information and a stochastic model of new energy output.

(2) For the stochastic model of fault information, the sample data is generated by LHS method; for the stochastic model of new energy output, the correlation coefficient is determined by Pearson correlation analysis, and then Nataf inverse transform and LHS are adopted.

The method generates sample data; establishes a sample simulation scheme.

(3) Perform fault simulation analysis on each sample simulation scheme in MATLAB and calculate the simulation results.

(4) Statistics of the sag events of each node and their characteristic values (temporary amplitude, duration, etc.).

(5) Select the voltage sag evaluation index to perform statistical analysis on each node, and obtain the sag evaluation results of each node.

In order to further clarify the grid voltage sag stochastic prediction method proposed in this paper, the basic flow of grid voltage sag stochastic estimation is given in this paper, as shown in Figure 1.

ISSN 2616-5667 Vol.2, Issue 5: 84-89, DOI: 10.25236/AJETS.2019.020510

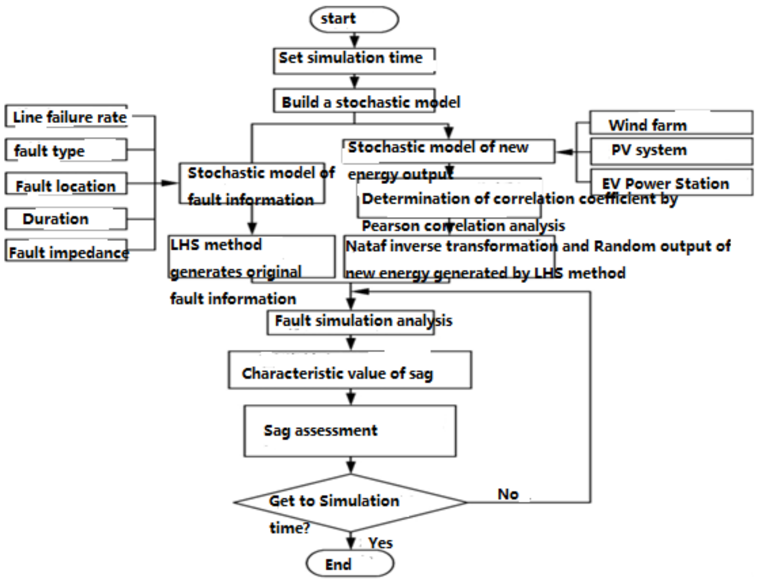

Figure 1 Basic process of sag random estimation

4. Grid Model

In this paper, the IEEE 30-node system is selected as the test system, and Figure 2 is the topology diagram of the system.

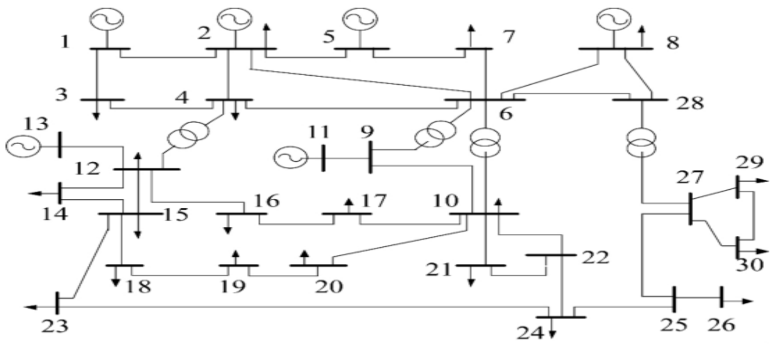

Figure 2 IEEE 30-node system topology

5. Conclusion

(1) This paper proposes a grid voltage sag stochastic prediction method that considers the correlation of new energy output. The correlation coefficient is

ISSN 2616-5667 Vol.2, Issue 5: 84-89, DOI: 10.25236/AJETS.2019.020510

determined by Pearson correlation analysis method, and then the Nataf inverse transform process is used to obtain the correlated new energy random output data. . The magnitude of the correlation coefficient will affect the sag of the system. As the correlation coefficient increases, the consistency of the new energy output is enhanced, which increases the probability of a smaller output, thus making the system voltage sag more serious. No test

There is an increase in the correlation.

(2) The change of the correlation coefficient has the most significant effect on the voltage sag at the node accessing the new energy. As the electrical distance increases, the node away from the new energy access point is little or substantially unaffected by the node. Impact; if the impact of correlation is not considered, it may lead to an overest optimistic assessment of the sag severity of new energy access nodes. Therefore, when studying the impact of new energy access on voltage sag, it is necessary to consider the correlation between their outputs. Sex to meet the actual project.

(3) For the access of different types of new energy sources, when the wind turbines and photovoltaic power generation systems are connected, the system voltage sag can be alleviated to a certain extent. The greater the output, the greater the expected value of the system sag, the voltage is temporarily increased. The lower the frequency of occurrence of the drop; because the electric vehicle charging station is equivalent to the power load, it will increase the severity of the system voltage sag when it is connected to the system.

(4) The access of new energy has a great influence on the voltage sag of the access point and its nearby nodes. Therefore, when selecting the sensitive load access point, try to choose the access point close to the wind turbine and the photovoltaic power generation system and keep away from the electric power. The location of the car charging station access point.

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