Research on Real-Time Transient Current Carrying of Overhead Transmission Lines

Chenhua Xu[1], Junwen Dong[2], Shihao Hu[3]

[1]Equipment Management Department of State Grid Jiangxi Power Co., LTD. Nanchang

[2]Human Resources Department of State Grid Jiangxi Power Co., LTD. Nanchang

[3]State Grid Jiangxi Electric Power Co., LTD. Jiujiang Chaisang District Power Supply Branch. Jiujiang

Keywords: overhead transmission line; real time; transient current carrying; load

Abstract: The static stability of power system refers to the ability of power system to automatically recover to the initial operation state without spontaneous oscillation or non-periodic out of step after small disturbance. The power system is disturbed almost all the time. For example: the small change of load in the system; the small change of the distance between lines (affecting the line reactance) caused by the swing of overhead transmission lines, etc. Therefore, the problem of power system's static stability is actually to determine whether a certain operation steady state of the system can be maintained.

1. Introduction

With the continuous expansion of the power system scale, the impact of system failures is also growing, especially in the context of large-scale regional networking, power system failures will cause significant economic losses to the economy and society, so ensuring the safe and stable operation of power system is the primary task of power production. Power system is a complex dynamic system. On the one hand, it must guarantee reliable power quality at all times; on the other hand, it is in constant disturbance. The time, place, type and severity of disturbance are random. When the disturbance occurs, once the stability problem occurs, the system may have serious consequences in a few seconds. For a specific stable operation state of the system, and for a specific disturbance, if the system can reach an acceptable stable operation state after the disturbance, the system operation is in transient stability. A lot of transient stability analysis is needed in power system planning and design. Through transient stability analysis, we can see the effect of various stability measures and the performance of stability control. Therefore, it is of great theoretical and practical significance to verify the stability of power system in a certain state through time-domain simulation.

2. Real time transient current carrying of overhead transmission line

2.1 Static stability of power system

The static stability of power system refers to the ability of power system to automatically recover to the initial operation state without spontaneous oscillation or non periodic out of step after small disturbance. The power system is disturbed almost all the time. For example: the small change of load in the system; the small change of the distance between lines (affecting the line reactance) caused by the swing of overhead transmission lines, etc. Therefore, the problem of power system's static stability is actually to determine whether a certain operation steady state of the system can be maintained.

2.2 Transient stability of power system

The transient stability of power system refers to whether the power system can reach a new stable state or return to the original state through the transient process after being suddenly disturbed in a certain operation condition. The so-called big interference here generally refers to

short circuit fault, sudden disconnection of line or reduction of generator output, etc. If the power system can achieve stable operation after large interference, then the power system is transient stable in this case. On the contrary, if the system can't establish the steady-state operation state after being greatly disturbed, but there is always relative motion between the rotors of each generating unit, and the relative angle is constantly changing, so the power, current and voltage of the system are constantly oscillating, so that the whole system can no longer continue to operate, it is called that the system can't maintain the transient stability under this operation condition. There are many reasons for the great disturbance of power system. In summary, there are mainly the following.

2.3 Control of stable operation of power system

Power system transient power angle stability control is the first line of defense for power system stable operation. Transient stability refers to the ability of power system to keep synchronous operation and transition to new or restore to the original steady-state operation mode after being greatly disturbed (such as short-circuit fault, sudden increase or decrease of generator output, large load, sudden disconnection of line, etc.), which generally refers to the ability of the first or second oscillation cycle without losing step. There are many ways to improve the transient stability of power system. In this paper, taking the single machine infinite bus system as an example, the single machine infinite bus system is mainly simulated by MATLB software. After the line is cut off in a certain period of time, the speed of the generator changes with time. The change of the speed of the generator affects the voltage, current and the Electromechanical of the power system. Change of magnetic power. The theory of power system transient stability is proved by simulation parameters.

3. Main causes of large disturbance in power system

(1) Sudden change of load. For example, users who cut off or put in large capacity will cause large disturbance.

(2) Cut off or put into operation the main components of the system. For example, large disturbance caused by cutting off or putting in large capacity generators, transformers and more important lines.

(3) Short circuit fault of power system. It is the most serious disturbance to the power system. Among the short circuit faults, three-phase short circuit is the most dangerous one, which causes the most disturbance to the power system, so the transient stability of the system is often damaged. However, the number of such serious faults is the least. According to statistics, the number of three-phase short circuit in high-voltage power system generally accounts for about 6% ~ 7% of the total number of short circuit.

Two phase to ground short circuit and two phase to ground short circuit have great disturbance to power system, and the harm degree of two-phase to ground short circuit is second only to three-phase short circuit. However, in general high-voltage system, the frequency of these two kinds of short circuit is about 23% ~ 24%, which is more than that of three-phase short circuit.

The single-phase short circuit occurs most frequently in the high-voltage system, generally accounting for about 70%. However, the disturbance of single-phase short-circuit to the system is the smallest in the short-circuit fault, and the instantaneous lightning single-phase short-circuit accounts for about 70% of the single-phase short-circuit, which has less impact on the system.

4. Measures and methods

4.1 The transient process is divided into the following three stages according to time

(1) Initial stage: refers to the time period within about 1s after the fault. During this period, the protection and automatic devices in the system have a series of actions, such as cutting off the fault line and reclosing, cutting off the generator, etc. But in this period of time, the regulation system of the generator is not enough to play an obvious role.

(2) Intermediate stage: after the initial stage, it lasts about 5S. During this period, the regulating system of the generator set has played a role.

(3) Later stage: the time after the intermediate stage. At this time, the process of power equipment affects the transient process of power system. In addition, due to the decrease of frequency and voltage, the automatic device will cut off part of the load and other operations.

4.2 Transient stability simulation process

Because the dynamic simulation of power system can not be realized in the laboratory, Therefore, when determining the feasibility of a power system design, we can first carry out dynamic simulation research on the computer. Its outstanding advantages are feasibility, simplicity and economy. Matlab power system toolbox contains modules such as electrical sources, elements, power electronics, machines, connectors, measurements, extra library, demos, powergui, graphical user interface, etc. In order to study the characteristics of power system, the built system should reproduce the actual power system to the maximum extent. The system is constructed by using the modules encapsulated in the module library, and the components of each link are idealized. The parameters of each component are also selected and simplified. With the continuous update and improvement of the module library, the system built by the existing modules can basically simulate the characteristics of the actual power system, and become a powerful tool for the analysis, design and Simulation of the power system.

4.3 Transient stability simulation

The stability of power system refers to whether the synchronous operation of generators can be maintained after the power system is disturbed. According to the nature of the steady-state problem determined by the disturbance size, it is divided into static stability and transient stability. The so-called static stability of power system generally refers to the ability of power system to recover to its original operation state independently after being disturbed in operation. The transient stability of power system refers to whether the power system can reach a new steady state or return to the original state through the transient process after being suddenly disturbed by a large amount of power system in a certain operation condition. The so-called big interference here is relative to the small interference. If the system can still achieve stable operation after a large interference, then the system is transient stable under this condition. On the contrary, if the system can not establish the steady-state operation state after being greatly disturbed, but there is relative motion between the rotors of each generating unit, and the relative angle is constantly changing, so that the power current and voltage of the system are constantly oscillating, so that the whole system can no longer continue to operate, it is called that the system can not maintain the transient stability under this operation condition.

Analysis method: different from the analysis of static stability problems, it can not be linearized. The characteristics of transient stability problems are as follows:

(1) Whether the transient stability is related to the original operation mode and interference type.

(2) The transient stability process of the system is a complex motion process which combines electromagnetic transient process and electromechanical transient process. They interact and influence each other.

5. Conclusion

With the rapid development of modern power system, the complex power control system has higher and higher requirements on power grid in technology and safety. Many situations it may encounter are testing the sustainability and stability of power operation. During this period, the progress of automation technology is making up for this huge gap. Better detection and analysis of various faults in power grid system has become a hot topic at present. The research topic of this paper is of practical significance.

References

[1] Liu Yang, Hanxin Chen, Fault diagnosis of gearbox based on RBF-PF and particle swarm

optimization wavelet neural network, Neural computing and applications,

[2] Zeng, Li; Shi, Jun; Luo, Jingli; Chen, Hanxin. Silver sulfide anchored on reduced graphene oxide as a high -performance catalyst for CO2 electroreduction, Journal of Power Sources, 2018, Vol.398, pp.83-90.

[3] Li, B. & Franzon, P. D. Machine learning in physical design. IEEE 25th Conference on Electrical Performance of Electronic Packaging and Systems (EPEPS), 2016:147-150.

[4] Li, B., Franzen, P., Choi, Y., & Cheng, C. Receiver Behavior Modeling Based on System Identification. IEEE 27th Conference on Electrical Performance of Electronic Packaging and Systems (EPEPS), 2018:299-301.

[5] Xia, Z., Kiratitanavit, W., Yu, S., Kumar, J., Mosurkal, R., & Nagarajan, R. Fire Retardants from Renewable Resources. Advanced Green Composites, 2018:275-320.

[6] Yijiu Zhao, Shuangman Xiao. Sparse Multiband Signal Acquisition Receiver with Co-prime Sampling, IEEE Access. vol.6, pp. 25261-25269, 2018.

[7] Xia, Z., Kiratitanavit, W., Facendola, P., Thota, S., Yu, S., Kumar, J., Mosurkal, R.,& Nagarajan, R. Fire resistant polyphenols based on chemical modification of bio-derived tannic acid. Polymer degradation and stability, 2018,153:227-243.