The Electromagnetic Environment Analysis of Transmission Engineering in UHVDC Converter Station Based on Computer

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Abstract. UHVDC conveyance lines and unique advantages play a very special role in the construction of UHV power grid strategy. However, people gradually found that its related electromagnetism condition has become an important factor limiting its future development. At present, the problem of electromagnetic discharge in the living room and the electromagnetic discharge in the living room have aroused the attention of the experts[1]. First, this paper briefly describes the characteristics of UHVDC conveyance technique and the support of main equipment. Then, this paper describes the electromagnetic environment analysis of the UHV DC converter station transmission project based on the computer. Finally, the conclusion is drawn.

Keywords: Computer, UHV, Power Conveyance Project

1. Introduction

With the general development of economic globalization and the increase of social electricity demand, the increase of power load speed promotes the improvement of system voltage level. In order to ensure the stable growth of economy and the stability of ecological environment, the social needs put forward higher requirements for the construction of electric power[2]. So far, UHVDC conveyance technology has become the core technology level of the strategy of power conveyance from west to East in China. The implementation of this strategy has played an important role in ensuring China's economic development and energy security.

With the gradual improvement of economic benefits of computer technology, the detection of electromagnetism condition details of DC converter station conveyance project becomes very rigorous. In this context, the conveyance project should have high conveyance capacity and efficiency. In order to achieve a safe, reliable and economic and reasonable power supply effect, we need to
integrate the computer technology into the UHVDC conveyance project. On this basis, we should also pay attention to the electromagnetism condition of the conveyance project.

2. Main features of UHVDC conveyance technology

UHVDC conveyance technology not only has all the application characteristics of HVDC technology. It can give full play to the advantages of DC conveyance technology. In fact, the advantages and disadvantages of DC and AC conveyance are similar. However, the characteristics of DC conveyance function are more intuitive.

2.1. The cost of the same power line is lower

For the use of overhead lines, AC lines usually need to be connected by three conductors. However, DC conveyance only needs one single pole conductor or two bipolar conductors to connect. When their conveyance power is the same, the consumption of DC power conveyance is only one-third or two-thirds of that of AC power conveyance. In addition, compared with AC conveyance, DC conveyance is superior in terms of line corridor and floor area. Compared with AC cable, the cost of DC cable investment is very low. This is also the main reason why power supply systems in big cities like to use underground DC cables.

2.2. The loss of the line is relatively small

Because only one or two conductors are used in overhead DC lines, the loss on the conductors is relatively small. In addition, the DC line has no inductive reactance and capacitive reactance, and there is no corresponding loss of useless power on the line[6]. DC overhead line has space charge effect, and its corona loss and radio interference are much smaller than that of AC overhead line. Moreover, DC conveyance has no skin effect.

2.3. There is no corresponding system stability problem

In AC conveyance system, all synchronous generators connected in the power system must keep synchronous operation. System stability refers to the ability of synchronous generators intercepting each other to keep synchronous operation under the condition of system disturbance. If we use DC line to connect the AC system, there is no stable problem of synchronous operation in the system (see Figure 1).
3. Main equipment of UHVDC conveyance project

3.1. Basic working principle of HVDC conveyance project

In fact, the basic working principle of UHV DC conveyance system is the process of converting alternating current into direct current and transferring direct current to broken point through converter device. In the whole process, converter is the most important electrical equipment[4]. Indeed, in order to meet the stability and security of HVDC conveyance system. We still need the support of other devices. Such as converter transformer, smoothing reactor and reactive power compensation device.

3.2. Converter

According to the above description, we can understand that the converter is the most important device in the DC conveyance project. It is composed of various power electronic devices. Thyristor is the most frequently used device in converter. Dozens or hundreds of thyristors can be connected in series to form an overall thyristor converter valve. Generally speaking, the converter is composed of several converter valves.

3.3. Converter-transformer

Converter-transformer is one of the main equipments in HVDC project. It can participate in the conversion process between AC and DC of converter. It can also change the value of AC voltage and restrain DC short circuit current. In addition, it can also weaken the overvoltage of AC system into DC system.

3.4. Power compensation device

The principle of local reactive power compensation should be adopted in DC conveyance system. In the process of DC converter station work, we need to install a sufficient capacity of useless power
compensation device.

3.5. Wave filter

According to the purpose of DC conveyance, we can divide the filter into AC filter and DC filter. They can be connected to AC bus and DC bus respectively. It can be injected into AC system or DC line all the time. According to the connection mode of the filter, the filter can also be divided into series filter and parallel filter. According to the characteristics of power supply, the filter can also be divided into active filter and passive filter.

4. Electromagnetism condition of UHVDC project

With the deepening of people's understanding of environmental problems and the enhancement of public environment awareness, the influence of electromagnetism condition of conveyance project is paid more and more attention[5]. Therefore, in the process of implementing UHVDC conveyance project, we need to pay special attention to the research of electromagnetism condition. The problem of electromagnetism condition has become one of the important factors that affect the structure and construction cost of conveyance project (see Table 1).

Table 1. Research on electromagnetism condition of UHV DC project

| Influence of electromagnetism condition | Main problems                        |
|----------------------------------------|--------------------------------------|
| Definition of electromagnetic index    | Electricity standard stipulated by the state |
| Control of audible noise               | Vibration and noise of devices        |
| Electrode access                       | The safety of current inflow          |

4.1. Definition of electromagnetism condition index

Up to now, the index of electromagnetism condition still needs to be studied deeply. At present, it is generally believed that the index of UHV electromagnetism condition can be controlled according to the level of 500kV DC conveyance. According to China's conveyance history, 500 kV DC conveyance has been operating for 15 years.

4.2. Audible noise in electromagnetism condition of converter station

In fact, the main noise sources of converter station are converter transformer, smoothing reactor and AC filter. The noise decibels of UHV DC are higher than those of 500 kV DC. In the normal operation of the converter station, each converter station needs to have 20 transformers for the stable operation of the system. In addition, we plan to install noisy devices far away from residential areas. If necessary, we also need to set up local isolation devices and noise absorption devices.

4.3. Effect of electrode insertion

When the electrode is used as a monopole to connect the return line, the earth will be connected with a large current. In this process, the current will also bring a series of problems. The introduction of a
large number of current requires people to carefully consider the safety of human and animal. Negative current will corrode the underground metal.

5. Analysis of electromagnetism condition influence of UHVDC converter station conveyance project based on computer

5.1. The effect of electric-field

The electrostatic field generated by the electric charge of wire is called electric-field. According to the computer simulation of space settings, we found that the space charge may move around the ground due to different electric field forces[6]. This will generate a new electric-field. The combination of the electric-field generated later and the electric-field generated before will form a new type of synthetic electric-field. According to the experimental study, we can find that the nominal electric field is closely related to the voltage of the conductor. The electric field effect of the synthetic electric-field also depends on the discharge degree of corona.

5.2. Radio interference

We know that the use of computers will cause radio interference to other equipment. In fact, the corona discharge process will also produce a certain degree of voltage pulse. These pulses will produce magnetic fields in different directions. According to the principle of magnetically generated electricity, corona can also produce quantitative radio interference.

5.3. Limitation of electromagnetism condition

When the 800 kV DC conveyance line is close to the residential area, the combined field strength of the ground in the residential area is limited to 25000 volts per meter. The density limit of the ion current below it is 100. When necessary, the DC converter station close to residential areas should be equipped with corresponding noise isolation devices.

6. Conclusion

According to the demand of China's energy base and the gentle development trend of technical level, in the future, China needs to further improve the rated capacity of DC conveyance. The progress of computer technology is closely related to the progress of UHVDC converter station conveyance project. Some problems of electromagnetism condition in power conveyance project can also be solved by using computer technology.

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