Research on High Voltage Transmission and Transfer Engineering and Environmental Protection of Electromagnetic Radiation Based on Large Data Mining Technology

Li Jinyang*, Yang Dan, Li Rui, Lei Yunkai, Tang Yiming, Wang Hanyu
State Grid Sichuan Economic Research Institute, Chengdu 610000, China.
*314943013@qq.com

Abstract. The definition of electromagnetic radiation is that when the source current or charge changes with time, a part of electromagnetic energy enters the surrounding space, which is the radiation of electromagnetic energy. By explaining the mechanism of electromagnetic radiation in high-voltage power transmission and transformation project and the influence and harm of electromagnetic radiation pollution in high-voltage power transmission and transformation project, the standard and management of electromagnetic radiation environmental protection in high-voltage power transmission and transformation project are explained. At the same time, the degree of electromagnetic radiation produced by high-voltage power transmission and transformation projects is also described, which is helpful to correctly understand the electromagnetic radiation problems of high-voltage power transmission and transformation projects and to promote the coordinated development of economy and environmental protection. Applying big data mining technology to predict the probability of failure of microcomputer protection equipment in substation, and developing an effective electromagnetic interference suppression strategy by analyzing the generated model to improve the electromagnetic environment in the substation. Combined with the actual work experience of environmental impact assessment of power transmission and transformation engineering, analyze the status of electromagnetic pollution and public participation, find problems and make recommendations.

1. Introduction

With the continuous development of the power system, the capacity of the power grid is gradually increasing, and the voltage level of the transmission line is also constantly improving [1]. Electromagnetic radiation can sometimes be extended, including electromagnetic induction. With the infinite dissemination of network information and the enhancement of public awareness of environmental protection and rights protection, more and more disputes and disputes have arisen in the environmental protection of power transmission and transformation projects, which have affected the construction of a harmonious socialist society to a certain extent [2]. However, in the field of environmental protection, electromagnetic radiation refers to all phenomena that energy propagates through space, whether in the form of electromagnetic wave or in the form of electromagnetic induction or electrostatic induction. It is also accompanied by a special invisible pollution - electromagnetic radiation pollution. The disputes and disputes caused by the environmental problems of electric power projects are also increasing, which has affected the construction of a harmonious socialist society to a certain extent [3]. The public's resistance to the construction of substations around the living...
environment is very serious. It is worried that the construction of the substation will affect the health of
the substation. In recent years, the problems caused by the electromagnetic environment of power
transmission and transformation projects have become more and more prominent. The public has
resisted the construction of substations in various ways, and environmental disputes have become
increasingly serious. Relevant reports on high-voltage corridors and large-scale substations
and electromagnetic radiation pollution are reported in the newspapers. Therefore, the extent and scope
of actual electromagnetic radiation pollution in the operation of high-voltage power transmission and
transformation projects have been clarified, and effective control measures have been proposed to
reduce radiation pollution. Environmental protection work in high-voltage power transmission and
transformation projects is crucial [4].

The electromagnetic radiation of high voltage transmission and transformation engineering includes
the electromagnetic radiation produced by high voltage overhead transmission lines and high voltage
transformations. The main theory is based on Maxwell's electromagnetic field theory. The current
changing with time generates magnetic field around it, and the magnetic field changing with time also
generates electric field [5]. The essence of radio interference is that in the process of corona and
discharge, some harmful electromagnetic waves appear, and the frequency band is quite wide, from low
frequency 50Hz to high frequency gigahertz range. These frequencies will interfere with the normal
operation of the surrounding radio communication facilities [6]. According to the site inspection and the
actual situation of the project, to determine the monitoring points and select sensitive targets. The
purpose of big data mining technology is to obtain an estimate of the dependencies between input and
output of a system based on a given training sample, so that it can make the most accurate prediction of
the unknown output. Apply specific big data mining technology algorithms to process the data in the
data warehouse, and generate an evaluation model for reference [7]. Electromagnetic compatibility
analysis is used to predict the electromagnetic environment in the substation and to improve the
electromagnetic interference suppression measures of the substation electromagnetic environment. All
phenomena in which energy travels in the form of electric, magnetic or electromagnetic waves. In the
field of environmental protection, electromagnetic radiation generally refers to three physical
phenomena or physical quantities of electric field strength, magnetic field strength and radio
interference. Objectively and correctly analyze and explain the electromagnetic radiation problems of
high-voltage power transmission and transformation projects, and reduce public misunderstandings and
unnecessary disputes [8].

2. Materials And Methods

The time-varying electric field can also produce an electric field. The electromagnetic wave is formed
when the electric field and magnetic field transform each other and propagate in space. Electromagnetic
radiation can be arranged into several frequency bands according to its wavelength and frequency to
form an electromagnetic spectrum. The higher the frequency, the greater the quantum energy of the
radiation. The harm of electromagnetic radiation to human body is mainly manifested in two aspects:
thermal effect and non-thermal effect. In fact, this kind of thermal effect has been encountered in daily
life, such as microwave oven is made by the principle of electromagnetic radiation thermal effect, and if
someone calls a cell phone for a long time, they will feel headache or dizziness. Since most of the
high-voltage lines entering and leaving the indoor station are buried, the shielding causes the power
frequency field at the boundary of the indoor station to become smaller. Assume that the immunity
threshold of the microcomputer protection device is the test voltage of the corresponding test level of
the electromagnetic immunity test. When the electromagnetic interference is less than the immunity
threshold, the microcomputer protection device works normally, otherwise the microcomputer
protection device is considered to be malfunctioning.

The boundary power frequency electromagnetic field of substation varies with the type of substation.
The main reason is affected by the induced electric field of the high voltage overhead line entering and
leaving the substation. Radio interference is one of the effects of corona and other discharges on the
surface of transmission lines. According to the regulations, environmental impact reports must be compiled. Units and individuals engaged in electromagnetic radiation must evaluate the possible environmental impact caused by electromagnetic radiation activities and submit them to the relevant administrative departments of environmental protection for examination and approval in accordance with the prescribed procedures. The discrete data stored in the statistical data warehouse are calculated to calculate the probability of failure of the microprocessor-based protective device and the dominant factors leading to the failure of the microprocessor-based protective device. Take appropriate electromagnetic interference suppression measures to improve the electromagnetic environment in the substation. According to the site inspection and the actual situation of the project, to determine the monitoring points and select sensitive targets, as shown in Table 1. The higher the voltage level, the greater the load and the larger the power frequency magnetic field.

| Type                  | Electric field intensity( V/m) | Magnetic induction intensity( μT) |
|-----------------------|--------------------------------|----------------------------------|
|                       | Range                          | Mean value                       | Range          | Mean value   |
| 110 kV Outdoor Station| 0.2-503.5                      | 87.3                             | 0.02-1.9       | 0.5          |
| 110 kV Indoor station | 0.1-59.3                       | 2.4                              | 0.01-1.2       | 0.1          |
| 220 kV Outdoor Station| 0.1-1543.9                     | 193.5                            | 0.05-6.4       | 1.2          |
| 220 kV Indoor station | 0.1-192.3                      | 39.8                             | 0.2-8          | 1.6          |

High-voltage transmission and transformation projects include high-voltage overhead transmission lines and high-voltage substations, high-voltage overhead transmission lines and high-voltage substations produce electromagnetic radiation. There is no obvious inductance of hemp and electric pain when contacting metal outside the wall of 220 kV substation and below the transmission line. However, in the design and construction of 220 kV transmission and transformation project, the prevention of electromagnetic radiation pollution is still a problem that can not be neglected. The electromagnetic radiation should be reduced to the lowest possible level to ensure that the public is not affected by radiation. Far away from buildings and trees, there are no other power lines and communication and broadcasting lines. The monitoring point starts near the center of the gear, away from the line intersection and corner. The probability of failure of microprocessor-based protective devices at each grid intersection is analyzed. Then the electromagnetic environment of the whole substation space is predicted by numerical fitting method. The data of sensitive targets of transmission lines are up to the standard. Because the villages are close to the lines and the power frequency electromagnetic field is stronger than other sensitive targets, we should pay attention to the protection work. The sample data belonging to the category is marked as a positive class, and the sample data that is not a category is marked as a negative class. During the test, the decision function values of each sub-classifier are respectively calculated for the test data, and the category corresponding to the maximum function value is selected as the category of the test data. As the power-frequency electric field strength of the barrier wall is less than 3m away from the surrounding wall at 0m, the power-frequency electromagnetic field outside the substation wall shows a decreasing trend with increasing distance as shown in Figure 1.
3. Result Analysis and Discussion

Making full use of the construction facilities of substations to form metal shielding network. For example, increasing the number of flat steel sections and grounding poles of grounding grid in indoor substations can reduce the electromagnetic field intensity around substations. Grounding the metal equipment frame and base of substations also has obvious shielding effect. Under the condition of a certain distance between conductors and ground, the larger the transmission current, the larger the magnetic field generated on the ground. The transmission line of the same voltage level increases with the distance between conductor and ground. It can be described by the logarithm of the number of micro-states of the system. Information entropy can also be considered as a measure of the degree of source disorder, and can also be used to characterize the uncertainty (disorder) of the physical system motion state. After receiving the message through communication, this uncertainty is eliminated and information is obtained. Furthermore, the main coupling mode of the interference source is analyzed, and then the scientific and effective electromagnetic isolation measures are taken in combination with the characteristics of the electromagnetic interference source, so that the electromagnetic environment of the substation can be improved. In line with the environmentally sustainable development plan, for urban and suburban junctions, high-voltage transmission lines should be buried as much as possible, and high-voltage substations should be built into compact indoor-type substations to reduce the impact on the environment.

In monitoring, people are most concerned about the influence of power frequency electromagnetic fields produced by substations and transmission lines on people. The masses lack knowledge of electromagnetic radiation, and for a long time fear of power transmission and transformation projects has arisen. Time-varying currents generate magnetic fields around them, time-varying magnetic fields can also generate electric fields, and time-varying electric fields can also generate magnetic fields. Electromagnetic waves are formed when electric fields and magnetic fields transform each other and propagate in space. The main statistics of substation are the measurement results of power frequency electromagnetic field outside the boundary of substation (room). The statistics of transmission and transformation lines are based on the ground projection point at the center of the line at the maximum sag of the central conductor. Considering the distance between substation (line) project and environment sensitive target and the structural characteristics of sensitive target, representative sensitive target is selected for monitoring. Data belonging to categories are marked as negative by big data mining technology. During the test, the test data is separately tested on the sub-classifier, and the scores of each category are accumulated, and the category corresponding to the highest score is selected.
as the category of the test data. For the specific equipment for generating electromagnetic radiation, active equipment is used to generate electromagnetic fields with opposite directions and substantially the same size to achieve the purpose of shielding. The substation can combine passive shielding with active shielding to achieve better shielding effect.

From design, construction to operation, high-voltage transmission and transformation projects should strictly comply with relevant norms and regulations, especially in the design stage, high-voltage transmission and transformation projects have sufficient safety margin for the safety protection distance of the environmental sensitive points passing through. In the design of substation, reasonable arrangement should be adopted, less radiation equipment should be used to reduce the generation of electromagnetic radiation, and three-phase equipment should be used as much as possible to reduce the use of phase separation equipment. If phase separation equipment is used, the distance between phases should be compressed as much as possible. In the data pre-processing stage, the collected electromagnetic environment data are compared with the immunity threshold, and then converted into discrete quantities and stored in the data warehouse. Because of the principle of superposition of electric field vectors, the electric field intensity cancels each other when the conductors are arranged in reverse phase, so the contribution of the conductors in reverse sequence to the power frequency electric field intensity of the environment is less than that of the conductors in parallel arrangement under the premise of equal height, equal voltage and the same conductor. Big data mining techniques can decompose complex signal functions into finite components. The frequency components involved are not only related to the sampling frequency but most importantly, they vary with the signal itself.

Determine the number of electromagnetic interference sources in the substation, and divide the sample space according to the possible situation of the interference source. At the same location, when the sensitive target structure is basically the same, the sensitive target closest to the substation (line) project can be monitored first. If it is not exceeded, other sensitive targets may not be monitored.

4. Conclusion
In this paper, the large data mining technology of high-voltage power transmission and transformation projects and electromagnetic radiation environmental protection were studied. It is an indisputable fact that the electromagnetic radiation of power transmission and transformation projects will have adverse effects on the environment. According to the above analysis, electromagnetic radiation is safe to the environment as long as environmental protection procedures are carried out and sensitive targets are well protected in the design of power transmission and transformation projects. It is feasible and effective to predict and analyze the electromagnetic environment in substation by using big data mining technology. The fundamental difference between this method and the traditional radial basis function method is that the center of each basic function corresponds to a vector. In engineering design, the influence of electromagnetic radiation on the environment should be fully considered, and the sensitive area should be avoided as far as possible, which is beneficial to the project itself and environmental protection. There is no condensed meaning of electromagnetic radiation in high-voltage power transmission and transformation projects, and there is no dispute about the harm of electromagnetic radiation to the human body. At present, the public has misunderstandings about the transmission and transformation of electromagnetic radiation. Many media networks also regard electromagnetic radiation as an invisible killer, guiding the public to correctly understand the impact of electromagnetic radiation, and strengthening their awareness of protection. At the same time, the environmental monitoring department should improve The power network monitoring equipment will carry out electromagnetic radiation monitoring of the power grid as soon as possible to provide a basis for environmental management of the power grid.
References

[1] Gole A M, Zhou J Z. Rationalisation and validation of dc power transfer limits for voltage sourced converter based high voltage DC transmission[J]. IET Generation Transmission & Distribution, 2016, 10(6):1327-1335.

[2] De Paulis F, Olivieri C, Orlandi A. Identification and Modeling of Intrinsic Discontinuities in High-Voltage Transmission Lines for PLC Applications[J]. IEEE Transactions on Electromagnetic Compatibility, 2017:1-8.

[3] Kuzmin D A, Bychkov I V, Shavrov V G. Electromagnetic waves reflection, transmission and absorption by graphene–magnetic semiconductor–graphene sandwich structure in magnetic field: Faraday geometry[J]. Photonics and Nanostructures - Fundamentals and Applications, 2014, 12(5):473-481.

[4] Sarajcev, Petar. Monte Carlo method for estimating backflashover rates on high voltage transmission lines[J]. Electric Power Systems Research, 2015, 119:247-257.

[5] Kim D, Eo Y. Broad frequency-band characterizations of electromagnetic energy propagation in planar thin-film transmission lines[J]. Journal of the Korean Physical Society, 2014, 64(8):1161-1168.

[6] Cui Y, Yuan H, Song X, et al. Model, Design and Testing of Field Mill Sensors for Measuring Electric Fields under High-Voltage Direct Current Power Lines[J]. IEEE Transactions on Industrial Electronics, 2017:1-1.

[7] Seikai S, Tanaka K, Shiozawa T. Reflection and transmission of obliquely incident electromagnetic waves by an inhomogeneous plasma slab moving parallel to the magnetostatic field[J]. Radio Science, 1974, 9(3):403-408.

[8] Ohkubo, Motoaki. Reflection and transmission of electromagnetic waves by a semi-infinite uniaxial plasma moving perpendicular to the plane of incidence[J]. Radio Science, 1976, 11(7):573-582.