Study on the Cost of Environmental Protection Measures in Overhead Transmission Lines

Xiaoyan Yu[1, a], Min Yu[1, b], Fuyan Liu[1, c], Xiaoyong Yang[1, d*]
[a]e-mail: yuxy1209@163.com @163.com, [b]e-mail: minyu20211209@163.com, [c]e-mail: fuyanliu2021@163.com, [*]Corresponding author's [d]e-mail: ngxy20213@163.com

[1]Economic and Technological Research Institute, State Grid Zhejiang Power Co., Ltd., Hangzhou 310000, China;

Abstract—With the rapid development of overhead transmission line engineering construction and the increasingly strict environmental supervision policy, the project environmental impact assessment work actively, has become the important content of the early decision-making management of the project construction. Based on the characteristics of overhead transmission line construction and engineering environmental protection measures, the paper systematically analyzes the main factors of environmental protection measures and the scale of environmental protection measures for environmental protection measures, and provides reference and reference.

Keywords-Overhead transmission line project, Environmental protection measures fee, Analysis of influencing factors

1 INTRODUCTION

Overhead transmission line project is an important part of the implementation of electric power foundation in China, and also the basic carrier of electric power energy transmission. Environmental impact assessment is one of the important contents of the preliminary work of the overhead transmission line project. Therefore, strengthening the reasonable level of engineering environmental protection measures can improve the project cost control level of overhead transmission lines of power grid enterprises, and improve the operating efficiency level of enterprises.

Document [1] analyzes the composition of the environmental protection expenses of the construction project, and clarifies the envelope relationship between the environmental protection expenses and the total investment composition of the current project, which is helpful to all parties involved in the ecological and environmental protection work of the construction project. Document [2] systematically analyzes the environmental impact on the construction feasibility and investment scale. In order to meet the needs of the fine management of environmental protection water protection measures in the construction of high altitude power grid projects, combined with the ± 400k V DC network project in Qinghai Tibet, study and calculate the pricing standard adapted to the cost of environmental protection water protection measures in high altitude areas, so as to fill the vacancy in the environmental protection water protection cost quota in the power industry. Document [4] analyzes the characteristics of environmental protection infrastructure, the evaluation of environmental

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protection infrastructure in China. Literature [5] proposes an environmental value measurement method based on the cost-benefit analysis method.

To sum up, the current relevant scholars have fully realized the importance of environmental protection in engineering construction, and have carried out relevant research on environmental protection fees, environmental protection problems and environmental protection value measurement, while the impact factor analysis of the investment of environmental protection measures in the early stage of the project is relatively weak.

2 PROJECT ANALYSIS OF ENVIRONMENTAL PROTECTION MEASURES FOR OVERHEAD TRANSMISSION LINE ENGINEERING

From the environmental protection functions, environmental protection facilities, environmental protection facilities include noise prevention and noise reduction facilities, water environmental protection facilities, accident oil treatment facilities, solid waste facilities; environmental protection publicity measures, noise prevention and noise reduction measures, ecological environmental protection measures, atmospheric environment protection measures, soil environmental protection measures, demolition protection measures, solid waste measures. As shown in the following figure 1:

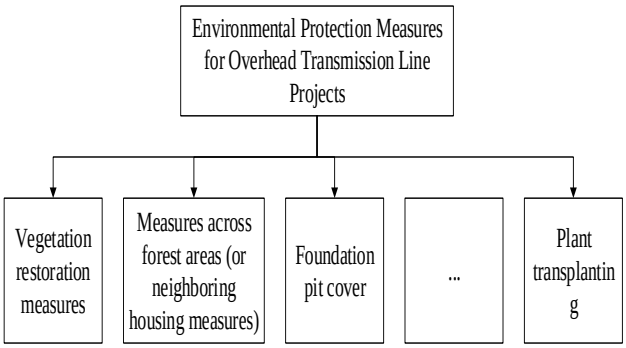

Figure 1. Environmental protection measures for overhead transmission line projects.

3 INFLUENCING FACTORS OF ENVIRONMENTAL IMPACT ASSESSMENT COSTS FOR OVERHEAD TRANSMISSION LINE PROJECTS

3.1 Basic Theory of System Dynamics

3.1.1 Basic theoretical analysis

Systems Dynamics (SD) by J a y W of MIT. Professor Forrester was founded in 1956, and is an interdisciplinary and comprehensive discipline specialized in understanding systems and solving systematic problems. Early the system dynamics theory is mainly applied in the field of

enterprise management, because in the research of complex system has great advantages, can help researchers to put forward good insights and countermeasures, the application scope of system dynamics theory is expanding, in social economy, biology, medical care, environmental protection and other fields have made great contributions. In the field of project management, system dynamics was originally applied to engineering project management in 1980, and Cooper K G used the system dynamics model to quantitatively analyze the cost beyond budget of a large military shipbuilding project, which is also regarded as one of the most successful applications of system dynamics in the field of project management.

System dynamics theory believes that the mode and characteristics of the system mainly depend on the internal structure of the system, a system must have a structure, and the system structure determines the function of the system. It defines the system as an ensemble organically combined by interacting, differentiated elements, and uses a feedback loop to depict the structure of the system. A complex system is a total feedback structure composed of the subfactors of the various subsystems, and the intersection and interaction of all the feedback loops constitute the overall function and behavior of the complex system. Based on the feedback characteristics, you can find the root cause of the problem from inside the system structure.

The basic tool for system dynamics is causal maps, connecting multiple factors with arrows labeled with causal relationships to form a causal chain. Causal has positive and negative causality, expressed as "+" and "-" on the arrows, respectively, meaning that increased cause promotes or suppresses the results. More than two causal chains are connected at the beginning to the end to constitute a causal loop. When an element in the loop strengthens, the causal relationship of the whole loop is strengthened, called a positive causal loop, or a negative causal loop. When the nature of the variable and the inflow and outflow direction of the system energy are relatively clear, the flow direction of the system energy can be identified in the figure to clarify the feedback form and control law of the system. This figure is called the flow diagram.

Power transmission and transformation project has the characteristics of large investment, long construction period and many units and departments. The factors affecting its project cost can be regarded as a complex system, suitable for the use of system dynamics model for analysis, and establish a relatively perfect influence factor system.

3.1.2 General steps for modeling the system dynamics

systems analysis:

- ◆ Clear research subjects and objectives to lay a good foundation for the construction of the system model.
- ◆ Review the literature and regulations, and determine the variable elements included in the research system through brainstorming method, Delphi law, etc.

Model construction:

- ◆ The system structure is described, and the subsystems are divided according to the overall and local structure. Clarify the intrinsic mechanism and interrelationship between the subsystems.
- ◆ The factors in each subsystem were analyzed.

◆ The above two steps are combined to construct the total influence factor diagram by considering the interaction of the factors belonging to the different subsystems.

The identification of the influencing factors has been completed, but the principle of the system dynamics can do more than that. For further analysis of the impact of energy inflow on the system, the system operation status can be simulated over a certain period of time by computer technology through specific software. It is also possible that the operation characteristics of the system can be improved by a manually controlled operation process, and by the analysis of the results of the model experiment on the computer, for the reference of the decision makers.

3.1.3 Application of the system dynamics principle

The application of system dynamics model can better reflect the close relationship between various factors, mutual restriction and moving the whole system. It is suitable for many factors and the close relationship between factors. Therefore, it is difficult to fully understand the whole system with language description. Accordingly, using the principle of system dynamics to establish the model has high requirements, the application should have a deeper understanding of the whole cost system and the influencing factors, and the graph drawing process is also more complicated.

3.2 Identification of influencing factors of environmental impact assessment fee

Combined with the construction characteristics of the overhead transmission line and the engineering environmental protection measures, the main factors influencing the input scale of the cost of the engineering environmental protection measures are shown in the figure below:

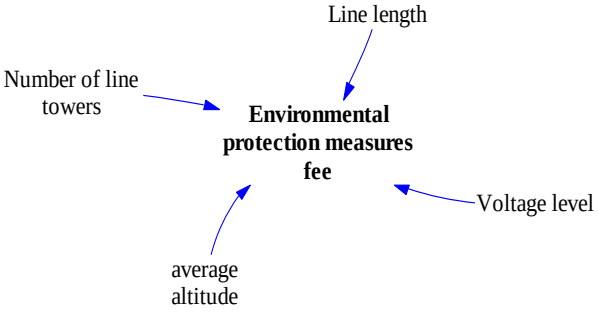

Figure 2. Analysis of the factors affecting the environmental protection measures cost.

4 FACTOR CORRELATION ANALYSIS METHOD BASED ON THE PEARSON COEFFICIENT

4.1 Principle of the correlation analysis.

The main purpose of correlation analysis (C orrelation A nalysis) is to study the degree of close relationship between variables, such as height and weight, wire material quantity and tower material quantity, main transformer capacity and power distribution device, etc. In statistical analyses, the correlation generally refers to the "linear correlation", and the degree of closeness is expressed by the correlation coefficient. The correlation coefficients are usually recorded as,

taking values between-1 and + 1, and the closer the absolute value is to 1, the closer the relationship between the variables. The absolute value is equal to 1, indicating that the two variables are completely correlated and the values of A variable can obtain the value of B variable. The correlation coefficient is positive, indicating that the B variable increases simultaneously when the variable A increases, and the two are positive correlation; otherwise, the B variable decreases and the two have negative correlation.

For different types of variables, the correlation coefficient is different. Here's simple correlation coefficient calculation below:

The Pearson simple correlation coefficients are used to measure the linear correlations of ranging variables and are most widely used in calculating the correlation coefficients. The calculation formula is:

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 (y_i - \bar{y})^2}} = \frac{1}{n}\sum_{i=1}^{n}(\frac{x_i - \bar{x}}{Sx})(\frac{y_i - \bar{y}}{Sy}) \quad (1)$$

Where n is the number of samples, and is the values of the two variables in different samples, respectively. Because the formula of Pearson simple correlation coefficient happens to be the matrix product form, it is also known as the product distance correlation coefficient. After changing the formula, the correlation coefficients can be expressed as and respectively after standardization, and then seek the average of n products.

4.2 Hypothesis test

When the correlation analysis of X variables and Y variables is conducted, the joint distribution of two variables is two-dimensional normal: when X takes any value, the conditional distribution of Y is normal, and when Y takes any value, the conditional distribution of X is normal. Due to the randomness of sampling, small sample size and other reasons, the results based on sampling can not be directly used to illustrate the population, and need to be inferred by hypothesis test. The steps are as follows.

1) Put the null hypothesis that there is no significant linear correlation between the two variables.

2) Construct the test statistics.

The test statistic for the Pearson correlation coefficient is the T statistic, T ~ t (n-2).

$$T = \frac{r\sqrt{n-2}}{\sqrt{1-r^3}} \quad (2)$$

3) Calculate the observation value of the test statistic, get the significance (Sig) corresponding to the observation value, and compare it with the significance level. If less than the significance level, the null hypothesis was rejected for a significant linear correlation between the two variables. Anyway, the null hypothesis is accepted. Note: If the correlation coefficient of the two variables is positive or negative, unilateral test can be performed, better effect.

5 EMPIRICAL ANALYSIS

This paper collects 10 engineering samples from different voltage levels in a certain region to carry out practical verification and analysis. The basic data are shown in the following table 1:

Table 1. Sample Basic Data Table.

order number	Sample name	the classification of voltage (kV)	line length (km)	Line pole and tower base (individual / base)	above mean sea level (rice)	Cost investment scale (Wan Yuan)
1	A	750	24.3	12	1000	325
2	B	500	12.5	8	800	156
3	C	220	10.6	20	500	53
4	D	330	15	15	500	68
5	E	750	20.2	10	1500	287
6	F	500	8.7	5	600	127
7	G	110	30	30	200	35
8	H	110	26	28	220	33
9	I	220	8.5	16	200	50
10	J	750	28	16	2000	384

Combined with the correlation analysis method, the influence coefficient of environmental protection measures of each factor is shown in the following table:

Table 2. Results of impact analysis.

order number	the classification of voltage	line length	above mean sea level	above mean sea level
Influence degree coefficient	.951** .000 10	.355 .314 10	-.479 .161 10	.936** .000 10

As is seen in the above table, the impact of the input scale of environmental protection measures for overhead transmission line engineering is arranged from the high to the low as: voltage level> average altitude> average altitude> average altitude.

6 CONCLUSION

Based on the analysis of the cost of the environmental protection measures, the factors include the engineering voltage grade, line length, line number and the correlation analysis to order high to low: voltage level> average altitude> average altitude. Through the analysis of the input impact factors of environmental protection measures in overhead transmission line engineering, it can enable power grid enterprises to control the cost input scale of the cost, improve the level of project cost control, and provide support.

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