

# Study on Maintenance and Retirement Decision of Substation Equipment Based on Asset Impairment

Xiyue Zhang<sup>1, a</sup>

<sup>1</sup>Department of economic management, North China electric power university, Baoding 071000, China.

<sup>a</sup>zxyupyn@163.com

## Abstract

The maintenance and decommissioning of power transformation equipment is complicated and changeable. The rationality of its decision is related to the interests of power enterprises and users, and affects the safe operation of the whole society and economy. This paper discusses the problems in the maintenance and decommissioning of substation equipment in current power enterprises, and studies the decision-making of decommissioning of substation equipment and the investment of new equipment by combining the characteristics of the impairment cost of substation equipment assets and the maintenance strategy of the equipment. Combined with the actual situation, the paper applies the life cycle cost theory and comprehensively considers the impact of asset impairment factors to analyze the cost-effectiveness of substation equipment investment, which is conducive to the quantification and scientification of the asset investment and management decision of power grid enterprises, and promotes the development of asset investment and management towards the lean direction.

## Keywords

Asset impairment, substation equipment, investment decisions.

## 1. INTRODUCTION

Substation equipment is the most important asset of electric power enterprises. Its operation reliability is not only an important guarantee for the safe supply of electric energy, but also an intuitive manifestation of enterprise benefits. Huge substation equipment put into work, equipment operation is complex, the corresponding maintenance decommissioning work is more complex and urgent. The rationality of maintenance and retirement decision will not only affect the interests of power enterprises and users, but also affect the security and economy of the whole society. For a long time, the management of power transformation equipment of the power grid emphasizes the stage and sequence and focuses on the stage objectives. There are many problems in the actual work. For example, equipment design and selection deviate from operation and maintenance. Operational safety control objectives are out of line with cost control. Lack of consideration of the overall benefits of the system. The optimization of the total cost target within the equipment life cycle was not fully considered in the design planning stage and so on. Combined with these problems, it is particularly important to consider the factors of asset impairment and to analyze the cost of the whole life cycle when making reasonable maintenance decision of substation equipment. [1]

Research approach:

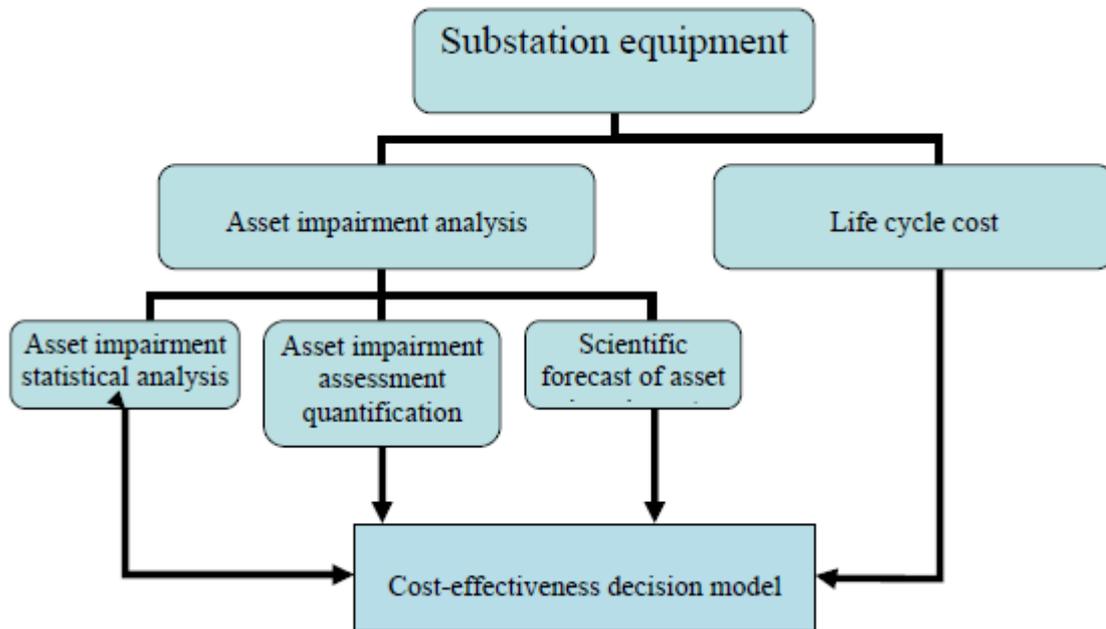


Figure 1. Research perspective

This paper takes substation equipment as the research object, combines the characteristics of substation equipment asset impairment cost and equipment maintenance strategy, and analyzes its asset impairment and life-cycle cost. Furthermore, statistical analysis, evaluation, quantification and scientific prediction are carried out on the substation equipment to study the decision-making issues of decommissioning substation equipment and investment in new equipment. Build the cost-efficiency decision model, form the optimal investment strategy, help realize the quantification and scientization of the asset investment and management decision of power grid enterprises, and promote the development of asset investment and management towards the lean direction.

## 2. ANALYSIS OF ASSET IMPAIRMENT OF SUBSTATION EQUIPMENT

### 2.1. Definition of Impairment of Assets of Substation Equipment

Impairment of substation equipment assets means that the carrying value of substation equipment is higher than the recoverable amount, and the impairment provision shall be made according to the difference between the two. The recoverable amount refers to the higher value of the fair value of the existing market minus the disposal expense compared with the present value of the future cash flow.

The transformer equipment includes single transformer equipment and transformer equipment group. The so-called transformer equipment group refers to the combination of transformer equipment that an enterprise can identify, and the cash inflow generated by it shall be independent of the cash inflow generated by other single transformer equipment or transformer equipment group. However, from the perspective of the complexity and systematization of power grid enterprise production, the identification of substation equipment group often lacks the factual support of "independent" cash inflow. Therefore, asset impairment items should be determined from the perspective of single substation equipment. Power grid enterprises should, during each financial report period, conduct impairment tests on various assets including substation equipment. If the book value is higher than the recoverable amount, the impairment provision shall be made according to the difference between the two.

## 2.2. Evidence of Impairment of Assets of Substation Equipment

It mainly includes the following situations:

(1) The production process or technical level of substation equipment has been improved through breakthrough, and the market price of existing substation equipment has dropped significantly, which is significantly higher than the expected drop due to the passage of time or normal use;

(2) The market interest rate or the rate of return on investment in other markets has been increased in the current period, thus affecting the discount rate of power grid enterprises in calculating the present value of the expected future cash flow of substation equipment, leading to a significant decrease in the recoverable amount of substation equipment;

(3) There is evidence that the substation equipment has become obsolete or its entity has been damaged or other irreversible, irreparable, performance degradation;

(4) The substation equipment has been or will be idle, terminated or disposed in advance. [4]All manuscripts must be in English, also the table and figure texts, otherwise we cannot publish your paper. Please keep a second copy of your manuscript in your office. When receiving the paper, we assume that the corresponding authors grant us the copyright to use the paper for the book or journal in question. Should authors use tables or figures from other Publications, they must ask the corresponding publishers to grant them the right to publish this material in their paper.

For power grid enterprises, situations (1) and (2) are systematic risks, which are uncontrollable and difficult to prevent. Scenario (3) and scenario (4) are non-systematic risks, which can be controlled and effectively prevented by power grid enterprises through decentralization. In practice, the reasons for impairment of production equipment in power grid enterprises are mainly the signs of situation (3) and situation (4). Once there is any sign of impairment, it is necessary to timely conduct impairment test to confirm the amount of impairment of substation equipment.

## 2.3. Influence of Assets Impairment on Maintenance and Retirement Decision of Substation Equipment in Power Enterprises

(1) Asset impairment is essentially based on a certain reality on the basis of the future economic benefits of the asset inflow of a professional judgment. Through the confirmation of asset impairment, it is not only helpful to obtain the real profitability of enterprise assets, but also helpful to improve the quality of operation and management of enterprise assets.

(2) China's power enterprises for a long time by the historical legacy and traditional accounting model and other factors, and the general withdrawal of substation equipment assets impairment unreasonable situation, will be on substation equipment maintenance and retirement decision-making misleading.

(3) The impairment of the assets of electric power enterprises will have a significant impact on enterprise profits, affect the financial situation of the enterprise, and the enterprise's capital is the key to the maintenance of large substation equipment retirement decision.

(4) The impairment of electrical equipment assets will be difficult to transformer equipment maintenance and retirement decision to bring negative effects, such as impairment of assets did not reasonable disposal of data distortion. The asset statement is reported layer by layer, which is finally reflected in the financial statistical results of power enterprises. The distortion of the corresponding statistics will mislead the management to make investment decisions, lead to the deviation of the decision-making scheme, and have a negative impact on the business operation.

[3]

### 3. EXPLORE THE TRANSFORMATION EQUIPMENT INVESTMENT DECISION

#### 3.1. An Overview

Since transformer and other power transformation equipment cannot directly generate cash inflow as fixed assets, the income cannot be considered from the situation of cash inflow. It can only be considered through the traditional cost decision method such as operation cost. If the operation cost of maintaining the old equipment is high, it is necessary to retire and replace the new equipment. If the running cost of new equipment is high, continue to use the old equipment and choose the one with lower cost. However, the traditional financial management assumes that there is no difference between old and new equipment efficiency, but it is inconsistent with the actual situation. The new equipment is more advanced and more efficient, so we should not consider it from the perspective of pure cost, but consider it from the perspective of efficiency. The investment decision of the new and old equipment is considered by running cost and efficiency. Among them, when considering the operation cost, the purchase price, time, discount and other issues should be considered when making decisions on the new and old equipment. At the same time, it is necessary to further consider the impact of asset impairment factors in the investment decision and apply the life-cycle cost management, which is a method to realize accurate decision based on the actual situation of the enterprise.

#### 3.2. Life Cycle Cost Analysis of Substation Equipment

##### 3.2.1 Lifecycle cost and lifecycle management concepts

Life cycle cost, which mainly considers all expenses related to equipment, refers to the total time spent by the equipment from planning, design, manufacturing, transportation, installation, debugging, use, maintenance, repair, transformation to scrap. On the concept of LCC proposes the concept of whole life cycle of asset management, which is based on equipment life cycle cost LCC, from equipment long-term interests, fully considering the equipment or system design, manufacturing, procurement, installation, operation, maintenance, alteration, update, until the scrap process, makes the LCC minimum a management concept.

##### 3.2.2 The application of life cycle cost in substation equipment investment decision.

In power grid enterprises, in addition to the basic characteristics of general fixed assets, substation equipment has its own particularity, which is mainly manifested in complex substation equipment types, large investment amount and high daily maintenance cost. In view of this reality, state grid corporation of China adopts the asset life-cycle management model to extend the service life of the equipment, reduce the asset life-cycle cost and improve the overall asset management level of the power grid while guaranteeing the reliability of power grid equipment.

Based on equipment maintenance of whole life cycle cost decision-making, is under the precondition of mastering the overall status of the equipment, leads into the concept of LCC, comprehensive consider monitoring costs, equipment failure probability and maintenance costs after determining the optimal maintenance plan, to choose the optimal maintenance time and maintenance method, in the future to improve grid performance, under the premise of improving power supply reliability, minimize the equipment monitoring and maintenance cost, implement equipment maintenance and repair of the economy. Compared to traditional economy analysis technology, LCC is the pursuit of the results of a single, enterprise better judgment that the smaller the LCC shows the advantages of more successful asset management mode.

The calculation formula of life-cycle cost is as follows:

Life-cycle cost = initial input cost + operation cost + maintenance cost + outage loss cost + abandonment cost (formula 1)

Alternatively,

Life cycle cost = one-time investment cost + operation and maintenance cost (formula 2)

The one-time investment cost in formula 2 includes the initial input cost; Operation and maintenance cost includes operation cost, maintenance cost, power failure loss cost and abandonment cost.

3.2.3 The relationship between the impairment of substation assets and the cost of the whole life cycle.

When the transformation equipment shows signs of asset impairment and the power grid enterprise carries out corresponding asset impairment treatment, it is necessary to analyze various influencing factors according to the requirements of the asset life-cycle management model, such as the overhaul, technical transformation, equipment renewal and so on, and determine the final investment plan of the enterprise according to the principle of the minimum cost of the life-cycle.

The calculation formula of realization value (book value) is as follows:

Realization value (book value) = original value of equipment - equipment depreciation - equipment impairment (formula 3)

In formula 3, after the asset impairment treatment, the realized value (book value) of the substation equipment is the net value after the original value minus depreciation and impairment. The realizable value (book value) is an important part of the whole life cycle cost, therefore, the accuracy of asset impairment test or not, directly affect the whole life cycle cost estimates are accurate, direct relationship between the subsequent update equipment investment decision making problems, should draw high attention and attention.

When a single substation equipment or a substation equipment group assets quality problems in use process, enterprises will be higher than the maintenance cost and power loss cost, when the maintenance cost and outage cost is increasing, based on the total life cycle cost minimization principle, from the perspective of a single substation equipment, power grid enterprises consider scrapping old equipment problems, but from the perspective of power grid enterprises investment, to ensure the safety and continuity of the original production, after the old equipment scrap, need to increase investment, buy new equipment. Therefore, whether to continue to use old equipment or buy new equipment is the most important part of the direct investment decision of power grid enterprises. Continue to use, involving technical overhaul; Purchase of new, involving investment expansion, these two issues are essentially in the existing scale of capital, how to improve the efficiency of capital use. [2]

### 3.3. Considering the Cost - Effectiveness of Investment Decisions.

#### 3.3.1 Definition of cost-effectiveness approach

Cost effectiveness refers to the unit cost benefit expressed by the ratio of the value formed by the cost consumption and the cost paid. Cost effectiveness is a relative index, which measures the effect of cost expenditure by the value of product produced by unit product cost. Cost efficiency should pay more attention to the comparative analysis of cost expenditure and its value creation. The improvement of cost efficiency is also an important reflection of market competitiveness.

#### 3.3.2 Application of cost-effectiveness method.

The cost-effectiveness method can be used to calculate the beneficial utility energy generated by the cost input when the transformation equipment is making investment decisions. It reflects the practical effects and benefits obtained by the electric power enterprises on the transformation equipment investment, and also reflects the potential ability of the enterprise's cost expenditure to obtain effects and benefits.

Calculation method:

Cost efficiency = equipment efficiency ÷ equipment cost (substituted by the calculation result of formula 1 or formula 2)

Power enterprises should take full account of the influence of substation equipment assets when making decisions with cost and efficiency methods. For older devices, the performance is relatively low. However, under normal circumstances, the maintenance expenditure of old equipment is less than the input cost of new substation equipment. In terms of the composition of equipment cost of old equipment, factors such as maintenance cost, operation cost and asset impairment loss should be considered. As for the new equipment, its equipment efficiency is higher, and the equipment cost mainly includes the input cost and operation cost of the new equipment.

Decision method: considering the investment decision of old and new equipment, compare the two investment plans which is more feasible and take the cost efficiency as the standard. Continue to use old equipment as plan 1, purchase new equipment and sell old equipment as plan 2, and compare and choose these two programs as a pair of mutually exclusive programs according to certain methods. If the cost and efficiency of plan 1 is higher than that of plan 2, the old equipment should be used instead of being updated. Otherwise, buy new equipment to update.

When analyzing equipment cost, the opportunity cost of both cannot be ignored. When making the investment decision of old and new substation equipment, it is necessary to consider the related costs of the maintenance of the old equipment and the continued use of the new equipment, that is, the opportunity cost. When the power supply company chooses to purchase new equipment, the income generated by the old equipment is the opportunity cost of purchasing new equipment. When option I, the revenue from new equipment and the revenue from selling old equipment are the opportunity costs of option I. When calculating operating cash flow, opportunity cost needs to be regarded as cash outflow. But since opportunity cost is not an expense in the usual sense, it is also a potential benefit to the company. When considering the cost of old and new equipment and cash outflow, the purchase price of new and old equipment and the time value of money should be considered.

### 3.3.3 The meaning of cost-effectiveness method.

When making investment decisions on fixed assets, it is traditionally believed that the scheme with the lowest cost is the best choice, which can increase enterprise profits and benefits. However, in fact, it is not reasonable to control and reduce costs blindly without considering the efficiency difference between old and new equipment, which can only gain short-term economic benefits and is not conducive to the long-term development and economic health of the enterprise. Based on the mechanism of the whole life cycle cost, after fully considering the cost of substation equipment asset impairment, combined with the history of the old equipment overhaul operations costs and forecasting data, set up the double cost and effectiveness of the optimal investment model, after considering the cost of asset impairment of the substation equipment retired update decision model is the improvement of research and empirical analysis in this paper, we study the foothold.

## 4. CONCLUSIONS

This article from the substation equipment management according to the actual situation of power grid enterprises in our country, the power grid equipment combined with the whole life cycle management, cost management in view of the current substation equipment investment decisions, such as lack of cost effectiveness of comprehensive benefits, investment planning stage not fully consider the project life cycle with a total investment of optimization problem, the establishment of a more comprehensive substation equipment investment decision, hope

for the electric power enterprise provide effective guidance precision substation equipment investment.

## REFERENCES

- [1] Chen fei, Yang haibo, wang yung-ching. Decision method and system development of substation equipment selection based on the whole life cycle [J]. Grid and clean energy, 2016, 32 (12): 93-99.
- [2] W. Strunk Jr., E.B. White, The Elements of Style, third ed., Macmillan, New York, 1979. Reference to a chapter in an edited book:
- [3] Chen chengsheng. Some problems on the impairment of enterprise assets [J]. China science and technology information, 2007 (03): 172-174+179.
- [4] Zhang li. Analysis of enterprise asset impairment provisions under the new accounting standards [J]. Chinese high-tech enterprises, 2008(13):35-36.