

THE ECONOMIC ANALYSIS ON POWER SUPPLY QUALITY

Cai Shimin

Nanping Electric Power Bureau, China

Abstract: The economic analysis on power supply quality is applied to guarantee the safe, reliable, economical and qualified electric energy supplying to consumers, so that the economic profit of power enterprises and that of society could be promoted. This paper is to setup a system of economic analysis indexes based on quality-cost analyses for power supplying and quality-economics analyses for the power supply enterprises and the society. The article comprises three parts: 1. Introduction; 2. Economic Analyses of power supply quality; and 3. Conclusion

1. INTRODUCTION

The economic analyses on power supply quality are a new branch of sciences, which employs an analytic method combining the electric energy quality with its economic profits. The study on the quality and profit will provide a guidance to improve and increase electricity production.

The application of these analysis aims at the safe, reliable, and economical power supplying to consumers with qualified electricity, increasing economic profits of the power supply enterprises and that of the society. For this purpose, the basic indexes must be established in order that the calculation for economic profit of the enterprises and society can be carried out. And as a result, the profits brought by supplying qualified electricity or economic losses caused by failures in incident can be evaluated. The index system is established based on the quality-cost analyses of power supplying, the quality-economics analyses for the power supply enterprises and society.

2. ECONOMIC ANALYSES ON POWER SUPPLY QUALITY

It is the major purpose in the economic analyses on power supply quality to study the relationship among power supply quality, quality-cost and economic profit, so that the quantitative analysis method on the quality, cost and profit should be employed.

2.1. The indexes for quality-cost analyses on power supply

2.1.1. The concept of quality-cost for power supplying is the sum of the costs needed to guarantee and improve the power supply quality and the losses caused by poor power

supply quality, paid both by the power supply enterprise and power consumers. The quality-cost is required in the whole process of electric energy transmission, transformation and distribution. Its result is whether or not the consumers are provided with qualified, reliable, cheap and abundant electric energy. The quality-cost should include the precaution cost, inspection cost, and the costs for interior and exterior failures.

2.1.1.1. Precaution cost: The costs are required in the activities to prevent the power supply enterprise from supplying poor quality electric energy, including the cost of the precaution measures taken for this purpose. They are: the cost of planning/scheduling for improving electric energy quality; cost of management for the reliability statistics; cost of information for power supply quality; fees for activities of power supply quality management; cost for staff training on this aspect; cost for improving the technique; cost for replacing/repairing the faulty equipment, and so on.

2.1.1.2. Inspection cost: All costs are required for inspecting and detecting the electric energy quality during electricity transmission and transformation, in order to monitor power supply quality. They include: the cost of inspection for power supply equipment; cost for monitoring voltage frequency at the customers' side; cost for inspecting pollution for electric energy quality; cost for maintaining and correcting the measuring meters; cost for inspecting the installation quality of power supply equipment; cost of running test for power supply equipment both of power supply enterprise and consumers, and so on.

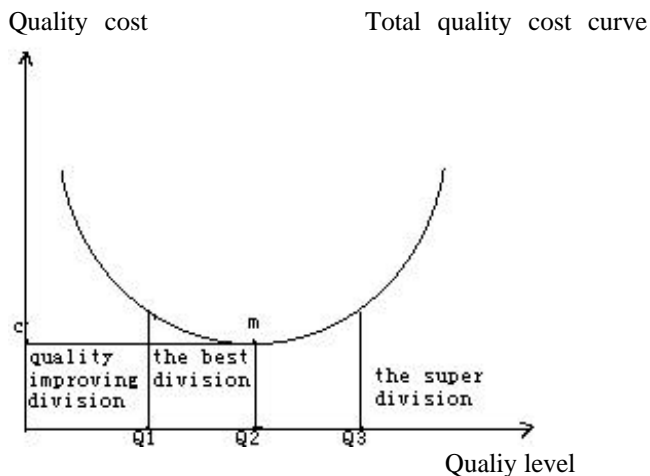
2.1.1.3. Cost for interior failures: the sum of losses caused by equipment failures and costs needed by dealing with the failures, including the losses of decreasing electricity sold due to equipment failures; cost for repairing faulty equipment; and cost for analyzing the failures.

2.1.1.4. Cost for exterior failures: the losses suffered by the consumers due to poor power supply quality, including payments for the customers' claims, etc. For example, over-voltage in lines caused by natural disasters or other reasons would burn out household electric apparatuses, such as television sets, refrigerators, audio players, recorders and so on, which should be paid by the power supply enterprise.

2.1.2. Optimum percentage in quality-cost for power supplying: It is a complicated to assign the percentages of total quality-cost individually to the precaution cost, inspection cost, and costs for interior/exterior failures. The optimum percentages will lead to the lowest total quality-cost, as well as the satisfaction to consumers for safe, economical and reliable power supply. To establish the calculating model or standard calculating formula, the information should be gathered from various sources.

By means of quality-cost analyses for power supplying, we shall be able to get the information of power supply quality in a certain city or district, to know the status of power supply quality at consumers' side, and to evaluate the effect of the quality management in power supply quality, so that the correct strategies or policies of electricity production management are made to promote the economic profit.

According to some concerned materials, the curve of total quality-cost can be divided into 3 divisions, i.e. Quality improving division, best effect division, and super division.



Quality improving division: The products are in low quality and out of control.
 Best effect division: The quality of products is satisfying, the quality-cost is the lowest, and the profit is the largest.
 Super division: The products are in relatively high quality, but the quality-cost is also relatively high, so the profit is relatively low.

2.1.3. Indexes of quality-cost for power supplying

Ratio of quality-cost in production value = (total quality-cost for power supplying/enterprise's total production value) × 100%

Ratio of quality-cost in electricity sold = (total quality-cost for power supplying/income of electricity sold × 100%

Radio of quality-cost for power supplying = (total quality-cost for power supply/total production cost) × 100%

Ratio of fault losses in power supply quality = [(cost for interior failures + cost for exterior failures) /total production cost] × 100%

Ratio of fault losses in production value = [(cost for interior failures + cost for exterior failures) /total production value] × 100%

Ratio of fault losses in electricity sold = [(cost for interior failures + cost for exterior failures)/total income of electricity sold] × 100%

Ratio of tax in cost for power supply quality = (total tax/total quality-cost for power supplying) × 100%

2.2. Indexes of quality-economic analysis for power supply enterprise

Indexes of quality-economic analysis for power supply enterprise are the criterions used to evaluate economically the improvement of power supply quality. Here are introduced 3 indexes: the profit of power supply quality, the ratio of profit in quality-cost for power supplying, and ratio of income in quality-cost for power supplying.

2.2.1. Profit of power supply quality. This profit is the remaining value of total revenues incurred with improvement of power supply quality minus all costs caused for the improvement. Calculating formula is listed as follow:

Profit of power supply quality = total revenue of power supply quality - total quality-cost

2.2.2. Ratio of profit in quality-cost for power supplying: This ratio is used to evaluate the economic profit of the enterprise with improvement of power supply quality. The following is the calculating formula:

Ratio of profit in quality-cost for power supplying = (profit of power supply quality/quality-cost for power supplying) × 100%

2.2.3. Ratio of income in quality-cost for power supplying: This ratio is relative in quantity, indicating the economic return per unit of quality-cost.

Ratio of income in quality-cost for power supplying = (profit of power supply quality/quality-cost for power supplying) × 100%

Or

Ratio of income in quality-cost for power supplying = (ratio of profit in quality-cost for power supplying + 1) × 100%

2.3. Indexes of quality-economics analysis for the society

The establishment of these indexes is to evaluate the contribution of power supply enterprise to society with improvement of power supply quality, and the satisfaction to the society in national economic construction and people life requirement. The quality-cost in these indexes means the extra cost paid by the consumers for purchasing and applying the high quality and reliable electricity. The quality profit in these indexes consists of the revenue gained both by the consumers and the state (the quality tax gain). The indexes are listed below:

2.3.1. Quality profit of power supply to consumers

This profit means the net revenue gained by the consumers with purchasing and applying high quality electricity. The calculating formula is

Quality profit of power supply to consumers = Quality revenue gained by consumer—the quality-cost paid by consumer

Or

Quality profit of power supply to consumers = Revenue from decreasing running cost + Revenue from increasing productivity—consumer's quality-cost of power supplying

Revenue from decreasing running cost includes: the revenue from decreasing electricity consumption; revenue from decreasing the fault times of equipment and maintenance cost; revenue from decreasing the loss of stop-production; revenue from prolonging the life of equipment and decreasing depreciation cost, and so on.

Revenue from increasing productivity includes revenue from improving product quality by purchasing and using high quality electricity; and revenue from upgrading the quality level of products. It is calculated by: profit per product×increased number of product

2.3.2. Ratio of profit in quality-cost for power supplying to consumers: It is relative in quantity, indicating the net revenue gained by consumer for paying per unit of quality-cost for power supplying. It can be used to know the benefits consumer gained. The calculating formula is:

Ratio of profit in quality-cost for power supplying to consumer = (Profit of power supply quality to consumer/quality-cost for power supplying to consumer) ×100%

2.3.3. Ratio of profit in quality-cost for power supplying to consumer: It is relative in quantity, too. The calculating formula is:

Ratio of profit in quality-cost for power supplying to consumer = (total revenue of power supply quality to

consumer/quality-cost for power supplying to consumer) ×100%

Or

Ratio of profit in quality-cost for power supplying to consumers = (ratio of profit in quality-cost for power supplying to consumers +1) ×100%

2.3.4. Ratio of tax gain in quality-cost for power supplying: It refers to the increased tax to the state with per unit of quality-cost for power supplying paid by the consumer, indicating the improvement of power supply quality. It should be calculated in the following way:

Ratio of tax gain in quality-cost for power supplying = (increased tax for power supply quality/total quality-cost for power supplying) ×100%

Increased tax for power supply quality = Tax paid to the state after improvement of power supply quality—tax paid to the state before improvement of supply quality promoted

2.4. Cases

A factory with power supply voltage of 10/0.4KV suffered an annual loss of RMB50,000, because of the quantity & quality of its products. The reason causing the loss was due to the problems of power supply quality. Its LV circuit breakers tripped frequently for over-loading at lower voltage because the facilities were not equipped correctly. The cross-section of conductor was smaller so the voltage drop in line was remarkable. After consultation, capacitors were installed in site costing RMB10,000. Through the electricity equilibrium research, the ratio of electric energy utility was only 60% in the factory. The improving measures for the ratio cost RMB5,000. The total consultation fee was RMB3,000. Now, in this case, the annual profit of power supply quality, the annual ratio of profit in quality-cost for power supplying and the ratio of income in quality-cost for power supplying, of the factory, may be calculated. Assuming that the annual tax gain of the factory will be RMB18,000 after improving power supply quality, the ratio of tax gain in quality-cost for power supplying of the factory can also be calculated.

It goes in the following manners:

- The profit of power supply quality = RMB50,000—(RMB10,000 + RMB5,000 + RMB3,000) = RMB32,000
- The ratio of profit in quality-cost for power supplying = (RMB32,000/RMB18,000) ×100% = 177%
- The ratio of income in quality-cost for power supplying = (RMB50,000 /RMB18,000) ×100% = 277%
- The ratio of tax gain in quality-cost for power supplying = (RMB18,000/RMB18,000) × 100% = 100%

3. CONCLUSION

3.1. In this paper, by setting up the indexes of quality-cost for power supplying, indexes of quality-economic analysis for power supply enterprise and indexes of quality-economic analysis for the society, the economic analysis for power supply quality can be carried quantitatively out.

3.2. As a kind of commodity, electricity should also be guaranteed in high quality through the whole process from its design, operation to its utilization. In the process of network planning, the electricity production quality should be guaranteed from power demand prediction, power design, and project construction to the equipment putting operation. And in the process of power utilization, great attention should be taken in "before- and after-sale" services, dealing in time with the troubles of electric energy quality and contacting more closely with the consumers.

3.3. Because of electricity characteristics, its generation, transmission and utilization are completed simultaneously in the same power network. Therefore, in order to improve the power supply quality, reliability and safety, the management for reliability and safety of power network should first be enhanced under the police of "safety is first, and precaution is major", so that the qualified, reliable and abundant electric energy may be supplied to the society and all the national economic sections.

3.4. Power supply quality depends not simply on safe and reliable operation of the power network, but like other industries, should meet the requirements of applicability, efficiency, economy, reliability, stability and remediableness. The economic analyses of power supply quality enable the quality to be in a "optimal" level. The unity of the generation and demand for power supply will be realized, meeting the requirements of applicability and economy for consumers.

Note:

Company: Nanping Electric Power Bureau, Fujian, China
Address: No.211 Bayi Road Nanping, Fujian, China
Phone: 0599-8843888 0599-8843816
Fax: 0599-8843172
Email: Cai_np@hotmail.com