Calculation of Grid Investment Quota Based on Electrical Transmission and Distribution tariff

Bingbing Yin¹, Xu Xia², *
¹Economics and Technology Research Institute, State Grid Jibei Electric Power Co., Ltd., Beijing 100038, China;
²North China Electric Power University, Beijing 102206, China

*Corresponding author e-mail: 50600463@ncepu.edu.cn

Abstract. Electrical transmission and distribution tariff reform is an important part of the new round of electric power system reform. Under the supervision of transmission and distribution tariff, the optimization of investment scale will be the focus of power grid companies’ future work. The lack of investment capacity of power grid means that the grid can't meet the load growth and the requirement for the quality of power supply, and the investment surplus is that the investment scale of grid is much ahead of the load growth and power quality demand of users, which will lead the electrical transmission and distribution tariff soar in the next supervision cycle, causing the investment contraction of power grid. Therefore, the power grid companies must determine the reasonable investment scale based on the transmission and distribution tariff.

1. Introduction

The independent verification of transmission and distribution tariff is an important issue in the new round of electric power system reform in China. In terms of the calculation method of transmission and distribution tariff, Some Opinions of the CPC Central Committee and the State Council on Further Deepening the Reform of Power System [1] pointed out that the transmission and distribution tariff should be determined according to the principle of "permitted cost plus reasonable benefits". Subsequently, the Provincial Power grid Transmission and distribution Tariff Pricing Method (Trial Implementation) was issued, which specifies in more detail the approval method of provincial power grid transmission and distribution tariff.

In order to improve the scientficity, rationality and transparency of power transmission and distribution pricing, promote the scientficity, refinement and standardization of power grid transmission and distribution cost supervision and examination, and promote power grid enterprises to strengthen cost management, the National Development and Reform Commission launched the second round of power grid transmission and distribution pricing cost supervision and examination. The notice of the National Development and Reform Commission and National Energy Administration on printing and distributing Measures for The Supervision and examination of the Pricing Costs of Power Transmission and Distribution [3] clearly defines that the transmission and distribution pricing cost is the reasonable expense of the power grid enterprises approved by the government to provide transmission and distribution services.
The regulation of transmission and distribution tariff will change the profit model of power grid, and the operating profit of power grid will be affected, which will affect the investment ability of power grid. It is of great significance for accurate investment and development of regional power grid to evaluate the investment capacity of power grid reasonably and judge whether it can adapt to the future investment planning demand [4]. This round of power grid transmission and distribution pricing cost supervision and examination puts forward more explicit and stricter regulatory requirements on the income, cost, asset investment and operation efficiency of power grid enterprises. Due to the lack of overall consideration of the impact of the existing power grid investment strategies on the future electrical transmission and distribution tariff level, total profit, asset-liability ratio and other operation target, it is necessary to make adaptive adjustments. The State Grid Corporation of China carried out the calculation of the provincial power grid investment capacity in May 2019. Its finance department took the total profit, asset-liability ratio and transmission and distribution tariff as constraints, and considered the rational allocation of the approved investment scale within three years of the regulatory cycle, and established the investment capacity prediction model to meet the requirements of transmission and distribution tariff reform, and provided reference for the preparation of investment strategy analysis report.

2. Calculation model of power grid investment capacity

Transmission and distribution tariff reform is an important part of the new round of power system reform. Under the supervision of transmission and distribution tariff, the optimization of investment scale of power grid enterprises will be the focus of their future work. The lack of investment capacity of power grid means that the grid can't meet the load growth and the requirement for the quality of power supply, and the investment surplus is that the investment scale of grid is much ahead of the load growth and power quality demand of users, which will lead the electrical transmission and distribution tariff soar in the next supervision cycle, causing the investment contraction of power grid. Therefore, the power grid companies must establish a simulation model to determine the reasonable investment scale based on the prediction results of asset status, operation status and power demand [5].

2.1. Calculation of power grid investment capacity under transmission and distribution tariff constraints

Investment capacity constrained by transmission and distribution tariff = \( \frac{\text{permitted income from new investments}}{\text{the percentage of new investment converted into permitted income}} \)

One of the core contents of this round of power system reform is to calculate the transmission and distribution tariff of the power grid, and the transmission and distribution tariff of provincial companies should verify the permitted income of power transmission and distribution business first [6]. The calculation of investment capacity under transmission and distribution tariff is the functional relationship between transmission and distribution tariff and investment capacity of power grid based on the permitted income identity of transmission and distribution tariff. The steps are as follows:

Step 1: through the average electrical transmission and distribution tariff, transmission and distribution quantity and its growth rate, the permitted income recovered through the transmission and distribution tariff is calculated, and then the allowable income that should be deducted is added to calculate the permitted income. Calculate the new permitted income in the year “i”.

Step 2: to calculate the permitted cost, firstly calculate the depreciation of the fixed assets, calculate the depreciation expenses of the new fixed assets through the original value of the assets, the original value of the aged assets, the original value of the scrapped assets, the adjustment of the special events of the asset changes and the comprehensive depreciation rate; then calculate the operation and maintenance costs, including the material costs, repair costs, labor costs and other operating expenses.

Step 3: calculate the permitted income through the effective assets (including net fixed assets, net intangible assets and working capital) and the permitted rate of return in the year “i”. The calculation of permitted rate of return refers to the rate of return on equity capital, the rate of return on debt capital and the asset-liability ratio.
Step 4: calculate the income tax, urban maintenance and construction tax, extra-charge for education and extra-charge for local education paid by the power grid in the year “i”, and calculate the tax included in price. The total investment beyond the price shall be counted by the total investment in non-regulated business and the total investment in assets sent out.

Step 5: calculate the proportion of new investment converted into permitted income through comprehensive depreciation rate of new assets, coefficient of investment conversion, ratio of maintenance and operation expenses to original value of fixed assets, accrual ratio of other expenses of new assets, permitted rate of return, asset-liability ratio, net assets returns ratio and rate of income tax.

Step 6: through the ratio of the permitted income generated by the new investment and the proportion of the new investment converted into the permitted income, the total capital investment under the transmission and distribution tariff is calculated, which is the power grid investment capacity constrained by the transmission and distribution tariff.

The permitted income I (i) is determined jointly by the transmission and distribution tariff x approved in advance, the transmission and distribution quantity y in the forecast supervision period and the allowable revenue PDI to be deducted. The transmission and distribution quantity y (i) is determined by the previous year's transmission and distribution quantity y (i-1) and the growth rate d of this year's power transmission and distribution.

\[ I(i) = x \cdot y + PDI = x(i) \cdot y(i-1) \cdot d + PDI \]

2.2. Investment capacity measurement under the constraint of business objectives

(1) The calculation process under the constraint of business objectives is as follows [7]:

Step 1: through the average electrical transmission and distribution tariff, electrical transmission and distribution quantity and their growth rate, the permitted income through the transmission and distribution tariff is calculated, and then the permitted income that should be deducted is added to calculate the permitted income. Calculate the newly increased permitted income in the year ‘i’.

Step 2: firstly, calculate the profit before interest and tax and the balance of interest-bearing liabilities in the current period through revenue and cost forecast, and then calculate the current year's expensed interest; Secondly, calculate the net profit, depreciation expense in transmission and distribution costs, net working capital change, asset impairment loss, fair value change and investment income; Finally, summarize the net cash flow generated by operating activities.

Step 3: calculate the net cash flow generated from financing activities, which is derived from the balance of interest bearing liabilities in the current period, equity cash inflow, turned in investment income and cash inflow of other financing activities.

Step 4: calculate the cash inflow of investment activities and the change of monetary fund security provision.

Step 5: add the constraint of total profit and asset-liability ratio, adjust the calculation method of the balance of interest bearing liabilities, expensed interest and net profit, and recalculate them.

Step 6: through the sum of net cash flow from operating activities, net cash flow from financing activities, cash inflow from investment activities and the change of monetary fund security provision, the investment capacity under total profit( asset-liability ratio exceeding the limit or not) and asset-liability ratio were calculated respectively.

Step 7: take the smaller value of the investment capacity under the total profit and the asset-liability ratio as the power grid investment capacity under the constraint of business objectives.

(2) Service logic constrained by business objectives

Cash flow identity:

\[ ICF = OCF + FCF + CF - \Delta YECB \]

Among them: ICF is the cash outflow of investment activities( investment capacity ) , OCF is the net cash flow generated from operating activities, FCF is the net cash flow generated from financing activities, CF is the cash inflow from investment activities, and \( \Delta YECB \) is the change of monetary fund security provision.
3. Investment capacity decision

There are two constraints on the investment capacity of power grid in the supervision period:

1. The investment capacity is less than or equal to the investment capacity under the constraints of business objectives.
2. The investment capacity is greater than or equal to the investment scale under the constraint of transmission and distribution tariff.

Therefore, there are two kinds of choices of investment capacity:

1. When the investment capacity under the constraint of transmission and distribution tariff is less than or equal to the investment capacity under the constraints of business objectives, the investment capacity is taken as the investment capacity under the constraint of transmission and distribution tariff;
2. When the investment capacity under the constraint of transmission and distribution tariff is greater than the investment capacity under the constraints of business objectives, the investment capacity is taken as the investment capacity under the constraint of operation objectives, but it can not meet the constraints of transmission and distribution tariff at this time, that is to say, there is a gap in investment scale.

If (2) occurs in the supervision cycle, the investment capacity in other years can be increased on the premise that it is less than the investment capacity constrained by business objectives, so as to reduce the investment gap of the whole supervision cycle.

To sum up, under the guidance of business objective constraints and transmission and distribution tariff constraints, the estimated investment capacity can not only meet the business objectives, but also support the approved permitted income.

References

[1] Central Committee of the Communist Party of China, State Council. Some opinions on further deepening the reform of electric power system (ZF [2015] No. 9) [Z]. 2015.
[2] National Development and Reform Commission. Provincial power grid transmission and distribution pricing measures (Trial) (fgjg [2016] No. 2711) [Z]. 2016.
[3] National Development and Reform Commission, state energy administration. Implementation opinions on promoting the reform of transmission and distribution tariff (fgjt [2015] No. 2752) [Z]. 2015.
[4] Feng Liang, Liang Rong, Lu Zhaojun, Wu Kuihua, Sun Xianzhuo, Yang Yang, Qi Lujie, Cui can. Quantitative analysis of regional distribution network investment capacity considering transmission and distribution tariff reform [J]. Guangdong electric power, 2019, 32 (02): 24-30.
[5] Zeng Ming, Huai Wenming, ye Jiawen, Chen Yunfei, Liu Yingxin, Liu Wei. Study on simulation model of investment scale of power supply company under the supervision of transmission and distribution [J]. Power engineering technology, 2019,38 (03): 1-7.
[6] Huang Chenyang, Yan Zheng, Yang Huoming, Han Dong, Fu Jingyang, Yang Jianlin. Impact of transmission and distribution tariff reform on provincial power grid investment and dynamic evaluation method [J]. Power grid technology, 2018,42 (10): 3291-3298.
[7] Zhang Pengfei, Liu Lu, Yang Weihong, Wang Xuyang, Cheng haozhong, Cai Yizhu. Calculation method of multi regional power grid investment capacity based on asset-liability ratio [J]. Journal of power system and automation, 2018,30 (06): 85-89.