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Power Plan Investment Plan Based on Simulated Annealing Algorithm

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***Abstract*—In this paper, the information provided by the annex is data support, based on matlab and Excel software, based on the simulated annealing algorithm, the mathematical model of the power planning investment plan is established. Taking the mathematical model of power planning investment plan as the leading analysis, starting from the engineering economic analysis, we can find out the influence of “time” value, and then study the single-stage power expansion planning from different angles, then extend the power expansion planning to multiple stages, and finally according to the analysis. The calculation analyzes the impact of renewable energy access to the power system and provides a new solution to the enormous challenges brought about by the numerous components of the actual power system.**

Keywords-Power planning; simulated annealing; nonlinear programming.

I. INTRODUCTION

Reasonable planning is the prerequisite and basis for safe, reliable, and economic operation of the power system. Power system planning is used to determine the time, place, and type of additional power equipment to meet the power demand within the planning period [1], and to meet the technical indicators of the power system (such as: 20% standby, N- 1 criteria, reliability, etc.) to minimize the total cost of the planned power system (including investment costs, operating costs, power outage losses, etc.) [2]. According to different planning objects, power system planning can be divided into power supply planning, transmission grid planning, and distribution network planning. Power planning is essentially a multi-stage mathematical optimization problem, which is usually solved by linear programming, nonlinear programming, heuristic optimization methods (such as genetic algorithms, simulated annealing, etc.) [3].In the related power planning process, due to the large number of components, we had to consider the establishment of a multi-objective optimal model [4]. In the multi-objective optimal solution problem, there are multiple objective functions with different constraints. According to the corresponding theorem, we can conclude that if the multi-objective optimal solution exists, it can be obtained by solving the single-objective optimization problem.

Considering the diversity of the originals, we can carry out the corresponding combination of components, that is, classification, and orderly design power supply planning. In the process of designing a power plan, we can introduce an active distribution network as a tool to help us easily calculate. The investment operation cost is used as the objective function, and the conditions are searched for restrictions, so as to construct a feasible region of the power supply optimal configuration model. Due to the many decision variables of the optimal allocation model of renewable energy sources in the active distribution network constructed, and the constraints are also many, it is appropriate to use intelligent algorithms to solve them [5]. PSO has the characteristics of fast search speed, high efficiency, and simple algorithm. PSO is the best way to solve the power planning optimization model. The particle swarm algorithm introduced by our active distribution network combines economic indicators and reliability indicators, and proposes a multi-objective optimal configuration model that considers active power distribution network power.It is more reasonable to evaluate the optimal configuration of distributed power and accurate. At the same time, the particle swarm optimization algorithm is used to solve the multi-objective optimization model, which can effectively avoid the local optimum and accelerate the search speed of the optimal solution [6].

II. CALCULATION MONETARY

The so-called time value of money refers to the value added to the currency after a certain period of investment and reinvestment. We all know in life that after one year, the value of 1 yuan is not the same. The latter is always large [1].

To the former. The reason for this is the "time" factor. For example, we deposit 100 yuan into a bank,

The reason for getting 110 yuan after 1 year (assuming the bank's annual interest rate is 10%), we do not consider the impact of inflation here.

(1) Final value of compound interest

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The final value of compound interest, as the saying goes, "profit rolling," refers to the final value of a particular fund calculated as compound interest over a period of time. The formula is: $F = P \cdot (1+r)^t$

(2)Present value of compound interest

The present value of compound interest refers to the principal and interest at a certain point in the future, and the principal required now, that is, the present value of a specific fund at a certain time in the future calculated by compound interest, is actually an inverse calculation of the final value of compound interest.

(3) Ordinary annuity

An annuity is an equal, regular series of income or expenses.Ordinary annuities are annuities that are earned or paid at the end of each period,So it is called postpaid annuity.

1）Ordinary annuity calculatioh

the first year :F=A

the second year： $F = A + A \cdot (1 + r)$

The third year： $F = A + A \cdot (1 + r) \cdot (1 + r)^2$

……

Year n： $$F = A \cdot \frac{(1+r)^t - 1}{r}$$

2 ） Calculation of present value of ordinary annuity

Similarly, the present value of the ordinary annuity is the inverse operation of the final value of the ordinary annuity, so the nth year:

$$\mathrm{P} = \mathrm{A} \cdot \frac{1-(1+r)^{-t}}{r} \tag{1}$$

III. Planning the Type and Number

This year's peak load = previous year's peak load * (1 + 3%);The total installed capacity meets the generation capacity reserve ratio = 20%;The increased capacity this year = the total installed capacity of the year-up Annual total installed capacity [2]

It can be seen from the table that the annual increased capacity is between 109MW and 134MW. Although the probability of failure will decrease with the increase in the number of investment units, the operating cost and investment cost will increase accordingly. The sum of the costs is minimal [3], and the balance of the three should be found.

In order to minimize the sum of costs, the number of investment units per year can be as small as possible under the premise of increasing capacity. According to the classification and combination, find the following combination [4]:

Table 1 Combination

Combination	Number of units	Provided capacity	Cost of investment （× 106$）
Combination one	1	250MW	220
Combination two	2	200MW	180
Combination three	1 1	165MW	150
Combination four	1 1	150MW	140
Combination five	2	130MW	120
Combination six	1 2	165MW	160

the final investment plan is [5]

Table 2 Investment plans for the next ten years

year	2025	2026	2027	2028	2029	2030
Portfolio	Incerase 1 set Machine group Type 2 and 1 machine	Incerase 1 set Machine group Type 2 and 1 machine Group Type 4	Incerase 1 set Machine group Type 2 and 1 machine Group Type 4	Incerase 1 set Machine group Type 2 and 1 machine Group Type 4	Incerase 1 set Machine group Type 2 and 1 machine Group Type 4	Incerase 1 set Machine group Type 2 and 1 machine Group Type 4

	Group Type 4					

Analysis of the rationality of the method:

(1)Accuracy

According to the annual peak load growth rate in the planning period, and under the constraint of 20% reserve, and under the premise of ensuring the minimum cost, the annual added value of the total installed capacity can be accurately calculated, that is, the minimum sum of the unit capacity that should be added each year value.

By comparing the relative sizes of the three costs in the total cost, each part can be given a certain weight, that is, its ability to influence the total cost. On the basis of deriving their respective weights, the most important part is considered, which increases the reliability and accuracy of the final result to a certain extent.

On the basis of clarifying the weight of each part, a problem analysis is carried out on the absolute influencing factors of the total cost. The addition of units based on minimum investment costs can be the optimal solution to minimize total costs.

(2)Calculation efficiency

First of all, the annual unit capacity that must be increased in accordance with the growth requirements and 20% reserve requirements is calculated directly, which establishes a good basis for determining the type and number of additional units to be installed and reduces the calculation time.

Secondly, the comparison method used directly analyzes and deals with the investment costs that are dominant and dominate, which greatly reduces the scope of the optimal installation plan. The feasible solution is narrowed down to the better feasible solution, and the optimal feasible solution is directly found in the better feasible solution [6].

Finally, on the premise of meeting the annual increase in unit capacity, from the most economical point of view, the options that can meet the growth demand but have unnecessary investment costs are eliminated, which greatly reduces the workload. Starting from the investment cost with absolute influence, analyze the optimal installation plan with the lowest overall cost.

IV. CONCLUSION

In the planning process, a multi-objective optimal configuration model was established with the maximum investment benefits of distributed power sources, the smallest active network loss, and the largest voltage stability factor. The multi-objective ant lion algorithm is used to optimize the configuration of renewable distributed power, and the gray compromise projection method is used to find the optimal compromise solution in Pareto solution set. In order to deal with the output uncertainty of distributed power, consider 20% of the energy storage device as a rotating reserve, and use the Monte Carlo method Beam theory gives the standby output of the energy storage device.

Finally, the distributed power planning in the active power distribution network is combined with the operation of 20% energy storage. The planning of renewable distributed power takes into account the optimal scheduling of the energy storage device by the active power distribution network, and Scheduling can reduce the planning error caused by the uncertainty of the distributed power output, so that the planning is more effective and realistic, and has advantages over traditional planning. The improved mathematical model of TPPBIC commercial profit has focused on the characteristics of the indicators and the characteristics of the evaluation system. The considerations are also more complex and close to the objective reality. Therefore, it has more practical application value and more important guiding significance for power planning.

Because this paper cannot consider all the influencing factors, the possible results cannot be well adapted to more complicated situations. In fact, there are many system components and they are more diversified. This article only identifies the types that are more important for analysis, and the model accurately reflects the reality. Some types are selected in the simulation process, and there may be errors. Due to the diversity of society, the model established in this article cannot fully apply to all cities, but the model has certain reference significance and provides a good idea: in-depth analysis will make the model reflect the main aspects and major contradictions of the problem. It also ignores the factors that have a small impact on the problem, in case the model established is too complex to be solved.

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