Improved Newton's Method for Calculation of Power Distribution Network Theory Energy Loss

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***Abstract*—At present commonly used distribution network loss calculation theory method, the not fully consider load curve changes. Thus, the theory energy loss too small, and the management energy loss too large. On this issue, the article puts forward an improved Newton's method for distribution network theory energy loss calculation. According to the current transformer substation of 24h a distribution network power records, the trend of the model results show that the total distribution network energy loss. The experimental results show that, compared with traditional methods, improved Newton's method to calculate the result more close to the energy loss calculation theory statistical energy loss.**

Keywords-distribution network; energy loss; power flow calculation; improved Newton's method

I. INTRODUCTION

With the continuous development of social productivity, the human daily life and production process using energy quantity also more and more big. Electrical energy because of its economic, environmental protection, transportation is convenient wait for a characteristic, has become the industry, agriculture, transportation, aerospace, defense, and many other areas of the national economy indispensable power [1].

Electrical energy as a secondary energy, is through the power plant will all kinds of primary energy conversion get. According to use a different energy, power plants have many types.

At present the world power structure, thermal power the proportion of the maximum, the main power generation mode is still mainly coal-fired power. Thermal power consumed coal and oil to wait for a large number of nonrenewable resources. As into the 21st century, human beings are facing increasingly exhausted energy crisis, energy conservation and environmental protection has become the theme of sustainable development. As into the 21st century, human beings are facing increasingly exhausted energy crisis, energy conservation and environmental protection has become the theme of sustainable development. Therefore, we should not only actively develop wind, water, solar energy and so on new type of power generation mode, but should notice more electricity from production to the transmission process of loss problem.

II. SUMMARIZE

Network power loss is electricity from power plant transmission to the power customer in the process, in the transmission, substation, power distribution and sales of various links produced in power loss and loss overview. Power system attrition rate hereinafter referred to as is in the same time, power grid loss power share this time the percentage of supply.

Electrical energy loss is certain time active power loss of time integral [2].

$$\Delta A = \int_0^T \Delta P(t)dt$$

For resistance heating loss, formula rewritten into:

$$\Delta A = \int_0^T I^2(t)R(t)dt$$

A. Statistical Energy Loss

Network in the actual operation, with meter measurement statistical out of the electricity supply and the poor get power. Statistical energy loss includes theory energy loss and management energy loss.

B. Theory Energy Loss

Electrical energy in lose, variable, distribution in the process of the produce inevitable loss. It numerical can through the electrical component itself parameters and establish rational mathematical model for calculation.

C. Management Energy Loss

Due to the lack of management work, illegal electricity situation occurs, resulting in the loss of power.

III. TRADITIONAL METHOD

At present, in energy loss calculation, and on the basis of collection of different data, using the common calculation methods are mainly electricity method, the RMS current method and so on[3][4].

A. Electricity Method

Through the electric energy meter measuring circuit of the active supply and reactive power supply. Electricity method characteristic is: value and calculation are very simple. Line variable energy loss is:

$$\Delta A_{kb} = \frac{\left(A_{Pg}^2 + A_{Qg}^2\right)}{U_{pj}^2 t} K^2 R_{d,\Sigma}$$

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A_{Pg} 、 A_{Qg} is average energy supply and reactive power supply; K is coefficient of load curve.

Fixed loss of energy is:

$$\Delta A_{gd} = \left(\sum_{i=1}^{n} \Delta P_{0,i} \right) t$$

$\Delta P_{0,i}$ is energy loss of transformer.

Circuit total energy loss is

$$\Delta A_{\Sigma} = \Delta A_{kb} + \Delta A_{gd}$$

B. RMS Current Method

RMS current method physical concept is circuit through the RMS current produced by the electrical energy loss is equivalent to the actual load at the same time in the consumption of electrical energy. This method is mainly used in load characteristic close cut power factor similar power grid. Formula is:

$$\Delta A = 3 \times 24 I_{\mathrm{jf}}^2 R_{\mathrm{d},\ \Sigma}$$

I_{jf} is day RMS current.

IV. Improve Newton's Method Calculation Energy Loss

Power system operation and planning, need to study power system steady state operating condition. According to the given power system operation parameters and the network structure of power system steady state operation parameters to determine the commonly used method is power flow calculation. Power flow calculation, the commonly used method is Gauss's method and Newton's method and so on[5].

A. Gauss's Method

Gauss's method for calculation of the power system flow calculation principle is simple, of each iteration computation, to calculate the initial value no special requirements. However, it slow convergence speed and so on characteristics, but also for morbid system is often difficult to convergence.

B. Newton's Method

Newton's method for calculation of the power system trend a fast calculation speed, convergence performance is good. But Newton's method for initial value demand is higher, in the calculation of the process, the initial value to choose in the actual operation value nearby. If the initial value choice improper, its operation result may appear not convergence or convergence to the power system actual delivery done solution[6].

Flow-chart of improved Newton's method to calculate energy loss as is shown in Fig.1.

Improved Newton's method calculation theory the basic energy loss calculation steps roughly as follows.

Firstly, draw calculation network loss region of the circuit structure and its equivalent circuit diagram. Secondly, through each substation every 24h a record of the active power and reactive power, by use of the Gauss's method to calculate each node voltage. After three iterative, will be its operation results as Newton's method of calculating initial value. Through the iterative operation, so that the final result meet the convergence conditions. Thirdly, with each node voltage value calculated unit time energy loss.

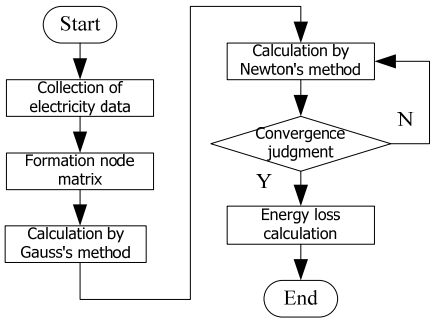
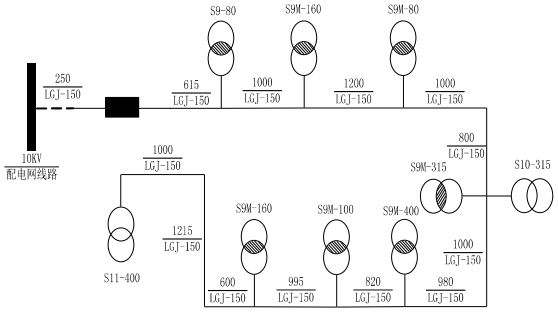


Fig1. Flow-chart of improved Newton's method to calculate energy loss

V. Example Analysis

Selection of a certain area in a certain period of 10 kV distribution network circuit as shown in figure 2 shows as an example. The grid basic data acquisition, including power grid line the first paragraph supply, reactive power and representative day 24h current, voltage 24h voltage. At the same time, record traverse model and each transformer model and its quantity sold. Basic statistical data as is shown in tab 1.



Conductor long/m

Fig2. 10 kV distribution network diagram

Tab1. 10 kV power distribution networkbasic statistical date

Voltage/(kV)		10.1
K coefficient		1.12
Active power/(kWh)		11183
Reactive power/(kVarh)		8387
Power factor/(kWh)		0.8
Sale energy/(kWh)		10570
Statistical energy loss	Total loss/(kWh)	613
	Loss rate	5.18%

It is proposed to distribution network of traditional method and improved Newton method, energy loss calculation. Calculation function program is as follows.

```
void CTideDlg::amend()//
{int n=2*Nodenum;y[1]=B[1];
```

```
for(int i=2;i<n;i++)
{double a=0;
for(int k=1;k<i;k++)
{a+=Lower[i][k]*y[k];}
y[i]=B[i]-a;}
x[n]=y[n]/Upside[n][n];
for(int j=n-1;j>=1;j--)
{double b=0;
for(int k=j+1;k<=n;k++)
{b+=Upside[j][k]*x[k];}
x[j]=(y[j]-b)/Upside[j][j];}}
```

Calculating results such as shown in tab.2.

Tab.2 can be concluded that the use of electricity method and root mean square current method to calculate the energy loss short were 4.45% and 4.69% respectively. With the traditional calculation method compared with the calculation results, improved Newton's method calculation energy loss calculation results obtained more close to the statistical energy loss rate.

Tab.2 Different methods of calculationenergy loss results

Calculation method		Electricity	RMS current	Improved Newton
Energy loss	Total loss/(kWh)	497.6	524.5	551.3
	Loss rate	4.45%	4.69%	4.93%
Management energy loss/(kWh)		115.4	88.5	61.7
Management loss rate		1.03%	0.79%	0.55%

VI. CONCLUSIONS

The traditional methods, such as electricity method, the RMS current method and so on, in the calculation in the process of line loss is very dependent on load output curve of stationary condition. But power grid operation process load curve are changing. Therefore, use common method to calculate the line loss there is greater error. However, use improved Newton's method for grid loss calculation, because the data collection process of fully considering load change. The method to calculate the power loss results more close to the statistical energy loss, so that can effectively control the size of management energy loss. Therefore, this method can be used as a new method of distribution energy loss calculation.

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