

Key Analysis on Energy Saving Technology of 10kV Distribution Transformer

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Abstract: China has taken the green development path and has attached great importance to energy conservation and consumption reduction. All industries have started to develop in the direction of low carbon, and have greatly established the green concept, and have implemented low consumption and low pollution in the process of industrial development. This is also an important development direction of the power industry. 10kV distribution transformer applies widely and has great energy-saving potential, which needs to be further explored to improve its power conversion efficiency, while it requires ensuring the safe and stable operation, so as to realize economy in the process of efficient operation. This paper focuses on the main energy-saving technologies of 10kV distribution transformer.

Keywords: 10kV Distribution Transformer; Energy Consumption; Capacity; Loss Reduction; Energy Saving Technology

Introduction

In the power system, the transformer is the very important equipment, and its main role is to convert electric energy with different voltage levels. In the power system, the energy consumption of transformer is very large. Distribution transformers are installed in the 10kV distribution network. If they have been used for many years, they are likely to have the problem such as low operation efficiency and large energy consumption, accounting for more than 10% of the operation consumption of the entire distribution network system. The operation efficiency of the distribution transformer is low, and the waste of electric energy is serious. In addition, the parameters of the distribution transformer are not high, and the energy consumption is large. Therefore, there are many defects, and there is no high level of automation, which makes the operation of the distribution network lack stability, reliability and economy. Therefore, in order to achieve good energy-saving effect during the operation of 10kV distribution transformer, it is necessary to identify the causes of loss, and it is encouraged to use technologically advanced equipment, so as to control the loss of equipment to the minimum, while ensuring the reliable supply of power in the distribution network and maintaining the low-cost operation, so as to achieve the effect of energy saving, which ensures that the power supply meets the needs of users.

1. Reasonable load distribution among transformers

From the current situation of energy saving and consumption reduction of distribution transformers, remarkable results have been achieved through the efforts of technical experts. Basic technical measures have been widely applied in distribution network systems, such as S12 transformer and S11 transformer. The operation efficiency is very high and the energy consumption maintains a low level. In the process of actual dispatching, the characteristics of system load change shall be fully taken into account. For the reasonable selection of transformer, the number and capacity of equipment shall be considered and the dispatching operation mode shall be specified. The application of dynamic reactive power compensation device can improve the power factor of the distribution transformer, which can save energy and reduce consumption. The distribution transformer is fully utilized and all functions are brought into play, thus improving the operation efficiency.

In the actual application of 10kV distribution transformer in the project, multiple transformers need to be operated at the same time to ensure the power supply. In other words, during the operation of the power supply system in the distribution network, the transformer loss is the sum of the active power loss and reactive power loss of the distribution transformer. The research shows that during the operation of the power supply system, the total power load remains constant,

the transformer adopts a fixed operation mode, and different loads are distributed among each other. The active loss and reactive loss of the transformer are obviously different [3]. Therefore, if multiple transformers operate at the same time, it is necessary to reasonably distribute the total load, ensure its economy, and optimize the operation of all transformers, so as to effectively control the transformer loss. Both active power loss and reactive power loss will be correspondingly reduced, so as to achieve the effect of energy saving and energy consumption reduction.

2. Select appropriate automatic voltage regulator

During the operation of the distribution transformer, the active power loss can be determined based on the square of the voltage of the distribution network, and the two are in a positive proportion. Technically, the gear of the load tap of the distribution transformer needs to be adjusted, and the reactive power compensation on the bus should be switched, and the compensated capacitor should be corresponding, so that the distribution network has a high voltage quality level during the operation. Properly adjust the voltage of the distribution network so that the transformer can achieve the effect of energy saving and consumption reduction. Empirically, if the overvoltage of the distribution transformer has exceeded the rated voltage value and the amplitude reaches 5%, the internal iron loss will increase by 15%. If the amplitude has reached 10%, the iron loss will correspondingly increase, even exceed 50%. At the same time, the no-load current value will be greatly increased, thus increasing the reactive power loss of the system.

When the distribution transformer is in operation, necessary control measures shall be taken for the corresponding equipment to prevent overvoltage, so as to ensure that the transformer is in continuous and healthy operation, prolong its service life, reduce its internal iron loss and excitation loss accordingly, ensure its stable operation and improve efficiency. Therefore, if the distribution transformer has a high power conversion rate, it is necessary to actively select new energy-saving distribution transformer. In order to achieve the automatic effect of voltage regulation, the role of automatic voltage regulator can be played to automatically track the power supply and distribution system. Due to the influence of load fluctuation, the input voltage value changes. At this time, the internal voltage can be automatically adjusted to ensure stable voltage output. The automatic voltage regulator itself is a three-phase autotransformer, and its output is kept constant. When the voltage of the power supply and distribution system fluctuates, it can play the role of the controller to adjust the voltage in real time and ensure the stable output voltage. In this way, the power supply quality of the power supply and distribution system is guaranteed, the power supply level is improved, and the effect of energy saving and consumption reduction can be achieved.

3. Adopt the reactive power compensation to improve the load power

factor

Various induction electrical equipment are installed in the distribution network system, among which the number of induction motors is very large. When the equipment is in operation, not only the active power of the distribution network is consumed, but also the reactive power is consumed, so as to maintain the electromagnetic balance of the system. As distribution network reduces reactive capacity, the $\cos\Phi$ value in system power factor will be reduced, while the energy consumption will be correspondingly reduced during the operation of the distribution transformer. The application of reactive power compensation device can dynamically compensate the reactive power of the distribution network system, make the reactive power of the distribution network maintain a dynamic balance state, reduce the load current, and make the active loss and reactive loss decrease correspondingly during the operation of the transformer. The voltage deviation of the distribution transformer can be maintained within the allowable range, and the reactive power regulation can be done well. At this time, it is necessary to select the capacitor voltage regulator and use the compensation capacitor. When the distribution transformer operates, the reverse voltage regulation energy saving technology is applied to ensure its normal operation and achieve good energy saving effect.

4. Maintaining three-phase load balance in operation of distribution transformer

If the energy consumption of the distribution transformer is very large, an important reason is that the three-phase load cannot be kept balanced, which will increase the load loss. When the balance state cannot be maintained, the total three-phase loss is the total energy consumption. Especially when the three-phase imbalance has reached the maximum value during the operation of the transformer, the system loss can be three times as much as the balanced load. The distribution transformer cannot reach the three-phase load balance state, and its energy consumption will be reduced. At this time, the line loss on the high-voltage side will increase seriously. When the imbalance of the distribution transformer has reached the maximum value, the power loss will increase during the operation of the high-voltage line, and the range can reach 12.5%. Therefore, the operating conditions of 10kV distribution transformer shall be designed reasonably. When entering the construction stage and later maintenance stage, the power load shall be scientifically counted to ensure that the designed power supply and distribution system lines are more scientific. At this time, the technical measures adopted shall be progressiveness, and the three-phase load of the transformer shall be kept in a balanced state, and the long-term performance shall be guaranteed. As for the location of the transformer, it is better to be in the load center [6]. When entering the maintenance stage, play the role of the monitoring system to monitor the voltage of the power supply and distribution system in real time and adjust unreasonable conditions in time. If the single-phase electrical equipment with very large capacity is installed in the 10kV distribution network system, its specificity shall be ensured and connected to the high-voltage line of the power supply and distribution system. Reactive power compensation shall also be carried out, and harmonic elimination devices shall be used to make the power factor of the power supply and distribution system relatively high, maintain its safe and stable operation and ensure its energy conservation. Therefore, the three-phase load is adjusted to ensure that the transformer is maintained in a balanced state, thereby ensuring the low loss operation of the distribution transformer.

Conclusion

Through the above research, it can be clear that during the operation of 10kV distribution transformer, in order to obtain good energy saving and consumption reduction effect, corresponding technical measures must be taken. It leads to the fact that the distribution transformer can be optimized in real time and the comprehensive energy consumption can be reduced. In the research of this paper, four technical methods are proposed, that is, the load between transformers should be reasonably distributed, the appropriate automatic voltage regulator should be selected, the reactive power compensation method should be adopted to improve the load power factor, and the three-phase load balance should be maintained during the operation of the distribution transformer, so that the goal of energy saving and consumption reduction of the distribution transformer can be realized.

References

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