Proceedings of International Conference on Educational Discoveries and Humanities
Hosted online from Plano, Texas, USA.
Date: 1st April, 2023
ISSN: 2835-3196 **Website:** econferenceseries.com

ANALYSIS OF THE OPERATION MODE OF THE SYNCHRONOUS COMPENSATOR

Nurali Berdyarovich Pirmatov
Scientific Supervisor: TashSTU Professor

Rakhmatov Gofur Ulug'bekovich
120M-21 Master
TashSTU named after Islam Karimov

Annotation:
The main consumers of electrical energy, in addition to active power, consume reactive power from the generators of the system. Consumers requiring large magnetizing reactive currents to create and maintain magnetic flux include induction motors, transformers, induction furnaces, and others. As a result, distribution networks usually operate with lagging current.

Keywords: electricity, reactive power, currents, power factor.

INTRODUCTION

The reactive power generated by the generator is obtained at the lowest cost. However, the transfer of reactive power from generators is associated with additional losses in transformers and transmission lines. Therefore, to obtain reactive power, it becomes economically beneficial to use synchronous compensators located at the nodal substations of the system or directly at consumers.

MATERIALS AND METHODS

Synchronous motors, due to DC excitation, can operate with cos φ = 1 and do not consume reactive power from the network, but during operation, with overexcitation, they give reactive power to the network. As a result, the power factor of the network is improved and the voltage drop and losses in it are reduced, as well as the power factor of generators operating in power plants is increased.
Synchronous compensators are designed to compensate for the power factor of the network and maintain a normal level of network voltage in areas where consumer loads are concentrated.

ISSN: 2835-3196 Website: econferenceseries.com

RESULTS AND DISCUSSION

Synchronous compensator - a synchronous machine operating in motor mode without a load on the shaft with a changing excitation current.

In the overexcited mode, the current leads the mains voltage, that is, it is capacitive with respect to this voltage, and in the underexcited mode it is lagging, inductive. In this mode, the synchronous machine turns into a compensator - into a reactive current generator.

Normal is the overexcited mode of operation of the synchronous compensator, when it gives reactive power to the network.

Synchronous compensators are devoid of drive motors and, from the point of view of their mode of operation, are essentially synchronous motors operating at idle.

In this regard, compensators, as well as capacitor banks serving the same purpose, installed at consumer substations, are also called reactive power generators. However, during periods of decline in consumer loads (for example, at night), it often becomes necessary to operate synchronous compensators also in an underexcited mode, when they consume inductive current and reactive power from the network, since in these cases the mains voltage tends to increase and to maintain it at a normal level, it is necessary load the network with inductive currents, causing additional voltage drops in it.

To do this, each synchronous compensator is equipped with an automatic excitation or voltage regulator, which regulates the magnitude of its excitation current so that the voltage at the compensator terminals remains constant.

In addition to compensating reactive currents of inductive industrial loads, synchronous compensators are needed on power lines. In long transmission lines at low loads, the capacitance of the line predominates, and they operate with a leading current. In order to compensate for this current, the synchronous compensator must operate with a lagging current, that is, underexcited.

With a significant load of the power transmission line, when the inductance of electricity consumers predominates, the power transmission line operates with a lagging current. In this case, the synchronous compensator must operate with a leading current, i.e. overexcited.

A change in the load on the power transmission line causes a change in the reactive power flows in magnitude and phase, leading to significant voltage fluctuations in the line. As a result, there is a need for regulation.

ISSN: 2835-3196 **Website:** econferenceseries.com

Synchronous compensators are usually installed at district substations.

To regulate the voltage at the end or in the middle of transit power lines, intermediate substations with synchronous compensators can be created, which must regulate or maintain the voltage unchanged.

The operation of such synchronous compensators is automated, which creates the possibility of smooth automatic control of the generated reactive power and voltage.

To implement an asynchronous start, all synchronous compensators are supplied with starting windings in pole pieces or their poles are made massive. In this case, the direct method is used, and, if necessary, the method of reactor start-up.

In some cases, powerful compensators are also launched with the help of starting phase asynchronous motors, mounted with them on the same shaft. In this case, the self-synchronization method is usually used to synchronize with the network.

Since synchronous compensators do not develop active power, the issue of static stability of work for them loses its sharpness. Therefore, they are manufactured with a smaller air gap than generators and motors. Reducing the gap makes it easier to wind the excitation and reduce the cost of the machine.

The rated apparent power of a synchronous compensator corresponds to its operation with overexcitation, that is, the rated power of a synchronous compensator is its reactive power with a leading current, which it can carry for a long time in operating mode.

The highest values of current and power in the underexcited mode are obtained when operating in the reactive mode.

CONCLUSION

In most cases, underexcited mode requires less power than in overexcited mode, but in some cases more power is needed. This can be achieved by increasing the gap, but this leads to an increase in the cost of the machine, and therefore the question of using a mode with a negative excitation current has recently been raised. Since the active power synchronous compensator is only loaded with losses, it can operate stably even with a slight negative excitation.

ISSN: 2835-3196 Website: econferenceseries.com

REFERENCES

1 Vasiliev, A.A. Electric part of stations and substations: textbook. allowance for universities / A.A. Vasiliev, I.P. Kryuchkov. - 2nd ed., revised. and additional – M.: Energoatomizdat, 2010. – 576 p.
2 Rozhkova, L.D. Electrical equipment of stations and substations. / L.D. Rozhkova, V.S. Kazulin. - 3rd edition, 2017. - 648 p.
3. Alekseev B.A. Extending the service life of power transformers. New types of transformer equipment. CIGRE-2002// Power stations. 2013. No. 7.
4. Bystritsky G.F. Power equipment of industrial enterprises. Proc. allowance for students. higher textbook establishments. - M.: Publishing Center "Academy", 2013. - 304 p.