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QUALITY IMPROVEMENT STUDIES ELECTRICITY AND REDUCTION OF LOSSES IN POWER LINES

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Abstract
The article explores the possibility of using an IGCT thyristor (with an integrated gate) in high-current high-power rectifier systems and STATCOM voltage converters together with series-connected control devices for longitudinal compensation-controlled voltage source CVS that regulate power flows.

Keywords: IGCT -Integrated thyristor with a switched gate; power lines; STATCOM- static synchronous compensator; UPC- Longitudinal Compensation Control Devices.

Introduction

Since gaining independence in 1991, the Republic of Uzbekistan has done a lot of work to integrate into the global electric power industry. At the same time, the electric power industry was only a part of the overall strategy for the formation of Uzbekistan as an integral part of the world economy. It is becoming a common requirement for high-quality electricity consumption The quality of electricity depends on the organization of the supplier of electricity for high-voltage power lines (PTL) and on the consuming organization for low-voltage power lines.

The territorial main electric lines of the Republic of Uzbekistan include sections with power lines with high voltage from 220 kV to 500 kV and partially with a voltage of 110 kV power lines. Through Uzbekenergo, electricity is transmitted to the regions of the republic and neighboring states. Total length of power lines with a voltage of 04-110 kV (270,266.2 km). including 13,492.3 km with a voltage of 35 kV; with a voltage of 10 kV – 88,211.0 km. High-voltage lines with a voltage of 500 kV – for more than 2390.2 kilometers, with a voltage of 220 kV – 8150.9 kilometers, with a voltage of 110 kV – more than 1098.3 kilometers. [1].

During the transmission of electricity in power grids, there are losses of electrical energy for the following reasons, which are divided into three types.

• Technical losses caused by the aging of equipment, deviations of modes from the nominal ones, errors of metering devices, etc.

• Commercial – the difference in readings between the energy supplied and the energy consumed: commercial losses also include theft of electricity.

• Technological – electricity consumption for own needs.

Numerous factors contribute to the additional increase in losses in backbone networks, the most significant of which are the following:

- Wear and tear of equipment; more than 60% of electrical substation equipment has been in operation for more than 30 years.
- Lack of funds allocated for the development and reconstruction of power grids.
- The cross-sections of power lines used do not meet modern requirements.

Power transmission lines (PTL) are constantly affected by weather conditions. Ambient temperature, precipitation, atmospheric pressure, humidity, and wind speed and direction are important parameters that need to be measured to monitor weather conditions. Knowing the current weather situation along the power line can reduce the number of power outages. Sensors and weather monitoring systems should be located along power lines. Reliable and Uninterrupted power supply to consumers is possible only with the introduction of effective measures to monitor weather conditions along power lines. [2]. Other types of losses that exist due to the presence of rotating elements of motors, higher harmonic components of currents in wires, asymmetry of the applied voltage and all other types of losses, the direct measurement of which is not possible, account for up to 10% of the total plant losses. Also, sinusoidality and non-symmetry of voltages are an important indicator of the quality of electricity, which is provided by the power supply company. Higher The harmonic components of the currents and the non-symmetry are created by the consumer of electricity himself.

Reduction of transmitted power losses is achieved by choosing the modes of operation of power supply networks. Active and reactive power losses depend on the voltage of the supply network. By selecting the voltage values in the load nodes of the power supply network, it is possible to achieve a significant reduction in the loss of active and reactive power transmitted through the power line [4].

Integrated thyristor Switched gate (IGCT) has become the preferred power semiconductor in medium-voltage industrial applications. Also in the energy management and traction markets, the versatility of this power switch has improved performance and traction. Reduce costs in various applications. [2]

Losses in electrical energy conversions Time to turn on the TV and time to turn off off Semiconductor gates are characterized by Accordingly, valve transition time From off to on and from on to off.

With IGCT manufacturing technology, thyristors are more suitable for a wide range of UseOn production equipment, the IGCT start-up delay time is reduced to about 1 µs due to its rigid gate switching. Thus, the spread of the IGCT delay time is very small, making it possible their series connections with small equalization gates. **[3]**

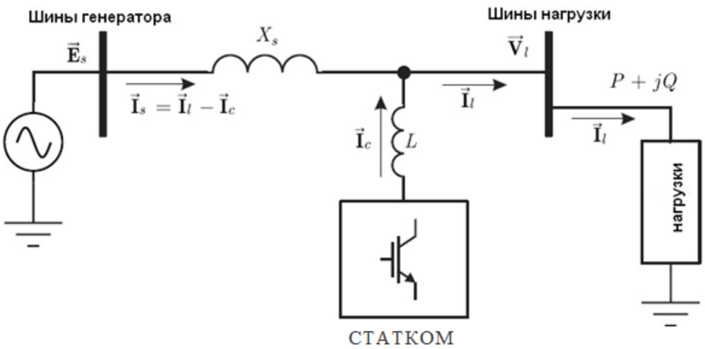
At the present stage, this is facilitated by the emergence and significant improvement of flexible AC power transmission systems (intermediate systems), which include STATCOM voltage converters that are switched on in parallel and UPC longitudinal compensation control devices that regulate power flows. These devices made it possible to create high-speed, multifunctional power converters with "efficient" control of the main parameters in a wide range with a limitation of the level of higher harmonics at the output. STATCOM devices allow you to reduce electricity losses along the power transmission line,

Fig.1. General view of the STATCOM device

With the advent of high-power high-voltage fully controllable devices such as IGCT and IGBT, the introduction of a new type of device called STATCOM (Static Synchronous Compensator) has begun, the task of which is to improve the quality of electricity and increase the efficiency of its transmission and distribution systems by compensating for reactive power. voltage regulation and increasing the stability of power systems. Compared to other traditional reactive power compensation devices, STATCOM has a number of advantages, as shown below:

• Better dynamic performance;• Ability to maintain the rated capacitive output current while the system voltage is low, which in turn provides higher dynamic transmission stability; • Due to the high switching frequency of the devices, STATCOM can actively filter the harmonic currents of the load;• Requires less space for installation (approximately twice as compared to others);• Lower level of active losses.

STATCOM is a controlled voltage source (UIN) with an internal resistance of almost zero. Its connection to the grid is made through a linear reactor, which ensures the conversion of the voltage difference between the network and the UIN into the output current of STATCOM, i.e. the conversion of the voltage source into a current source (Fig. 2).



Rice. 2. Single-line diagram of STATCOM connection to the network

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A vector voltage diagram illustrating the operating modes of STATCOM is shown in Figure 3. In reactive power consumption mode, the output voltage of the converter is less than the line voltage and is in phase with it. In the lasing mode, the output voltage of the converter is greater than the voltage on the line and in phase with it.

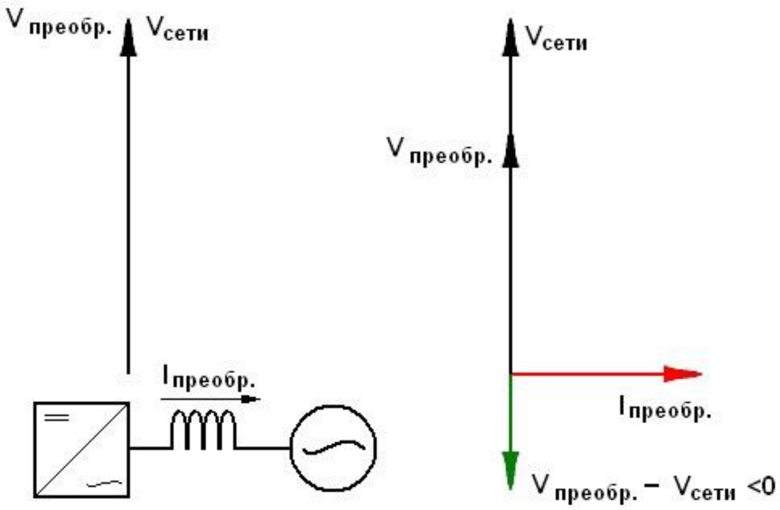

Fig.3. Vector diagram of stresses in different modes of STATCOM operation

Functional tests of the pilot sample, including two STATCOMs for a voltage of 35 kV and a rated power of ±100 Mvar, gave the following results:

Low-signal performance.
Response time (delay) to a step-by-step change of the setpoint does not exceed 4 ms;

Redundancy of the power part.
Full restoration of STATCOM operation occurs in 0.26 seconds after the breakdown of any bridge.

Higher harmonics.
The total level of higher harmonics up to 50 order in the output current was about 1.2%.

Loss
The total losses did not exceed 2.1 MW or 1.05% of the total reactive power of the unit.

Current R&D areas:
- elimination of switching failures; new reactive power management strategies based on machine learning techniques;
- Improvement of power quality due to selective compensation of voltage harmonics (active filtering);

- Use of solar photovoltaic inverters as STATCOM (PV-STATCOM);
- Improved damping of power fluctuations; coordinated use of multiple devices, zonal voltage regulation, etc., changing the STATCOM control from the usual classic current control to an even more convenient network shaping control (GFC) to allow STATCOMs to provide more supporting network services, such as the current response itself to changes in the network. mains voltage and/or amplitude; Changing the configuration from a triangle connection to a star connection to integrate energy storage devices (e.g., supercapacitors) necessary to provide an instantaneous power reserve (inertia) in the corresponding dimension. [5]

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