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Installation of Frequency Converters for Electric Motors Used in the Irrigation System and Research, Analysis of the Obtained Results

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ABSTRACT: This article presents an analysis of the results obtained by operating the ETsV 10-165-35 water pump electric motor used in the agricultural irrigation system using a frequency converter. Based on the results, the analysis of the shift angles between A and V phase voltages, symmetry of phase currents, active, reactive, full power and power coefficient before and after installation of the frequency converter on the electric motor is widely covered.

KEY WORDS: Electric drive, electric motor, water pump, phase current, symmetry of voltages, active power, reactive power, full power, frequency converter, electric circuit, power factor, time dependence graphs of electrical quantities.

I.MATERIAL AND METHODS

Probability theory was used to determine the reliability of electrical drives.

II.RESULTS AND DISCUSSION

Today, global climate change makes it important to use energy and resource-saving technologies in irrigation of agricultural fields. In performing these tasks, many countries are widely using drip irrigation technologies. This, in turn, requires the analysis of the tasks of improving energy-efficient, high-performance electrical systems suitable for this system. When installing frequency converters on electric motors, it is necessary to ensure the following conditions:

- Air temperature: -10˚C to 45˚C.
- Relative humidity: less than 90%, no water should enter.
- There must be no combustible materials, such as wood, near the frequency converter.
- Do not expose to direct sunlight.
- There must be no flammable liquids.
- There should be no dust, oil drops, metal dust.
- Absence of vibrations.
- There must be a stable surface on which the frequency converter is installed.
- The frequency converter should not be installed in a place where there is a source of electromagnetic interference[1].
- The higher the installation site is above sea level, the lower the rated power of the inverter. With a 100-meter rise in sea level, the ambient temperature is allowed to decrease by 0.5˚C.
- Good ventilation ensures good inverter performance. When placing the inverter in a special cabinet, the temperature there should not exceed 45˚C. If necessary, additional cooling systems should be used to maintain the required temperature. (3)
- It is recommended to install the frequency converter vertically, at a sufficient distance from other objects, so that there are no obstacles to the movement of the cooling air flow. [1,2]

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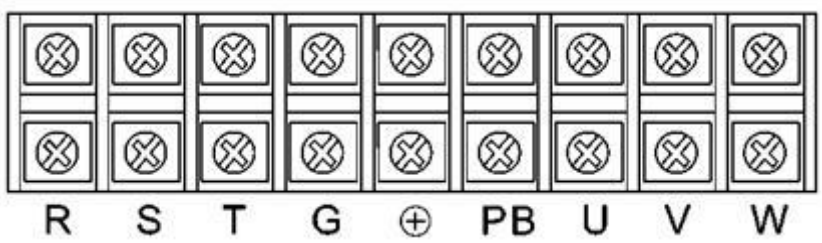

Figure 1. Standard connection terminal for 18,5/22 - 75 kVA frequency converters[1,2]

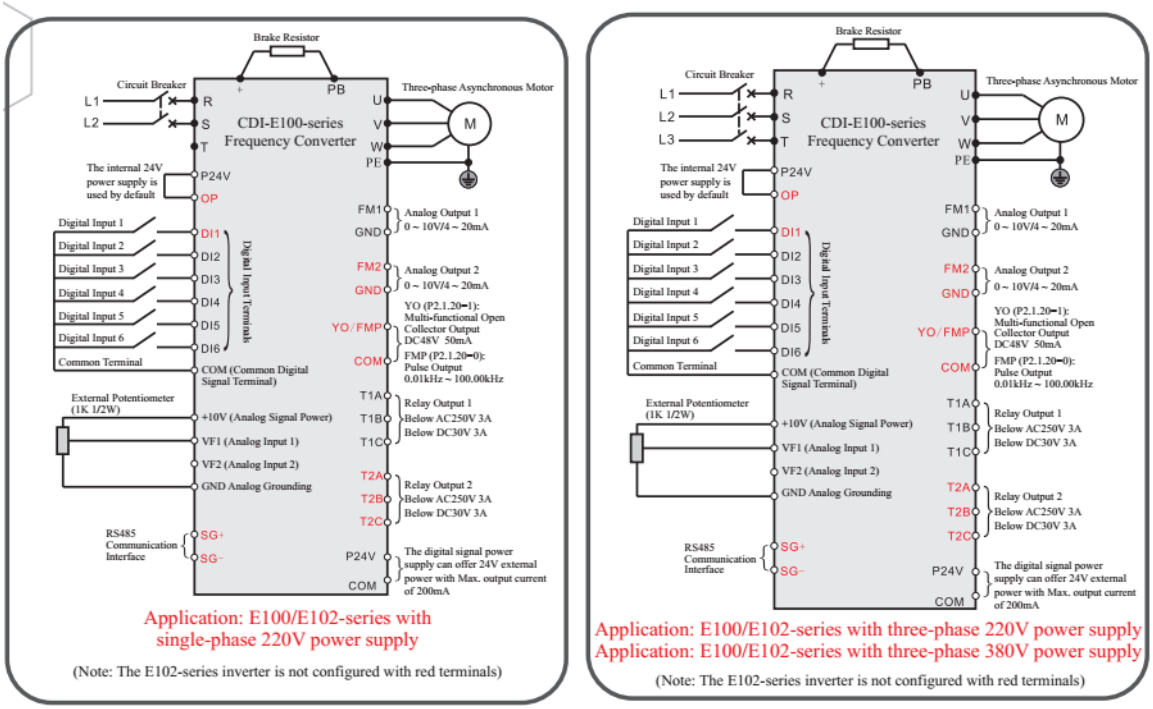

Figure 2. Connection diagram of Delixi E100G022 frequency converter [1,2]

R, S, T- input connection (power supply connection)
G is the ground terminal
"+", "-" - DC converter connection terminal
U, V, W - output connection (motor connection)
PB - connection with brake resistor [1,2]

III. Installing a frequency converter on an electric motor and analyzing the obtained results

Measurement results were obtained using the ETCR4700 electrical analyzer after the frequency converter was installed.

An ETCR4700 electrical analyzer was used to obtain the measurement results of the research work. Values such as active power, reactive power, full power, cos ph, symmetry between phases, symmetry between phase currents, symmetry between phase voltages and currents were determined using the ETCR4700 electrical analyzer[3].

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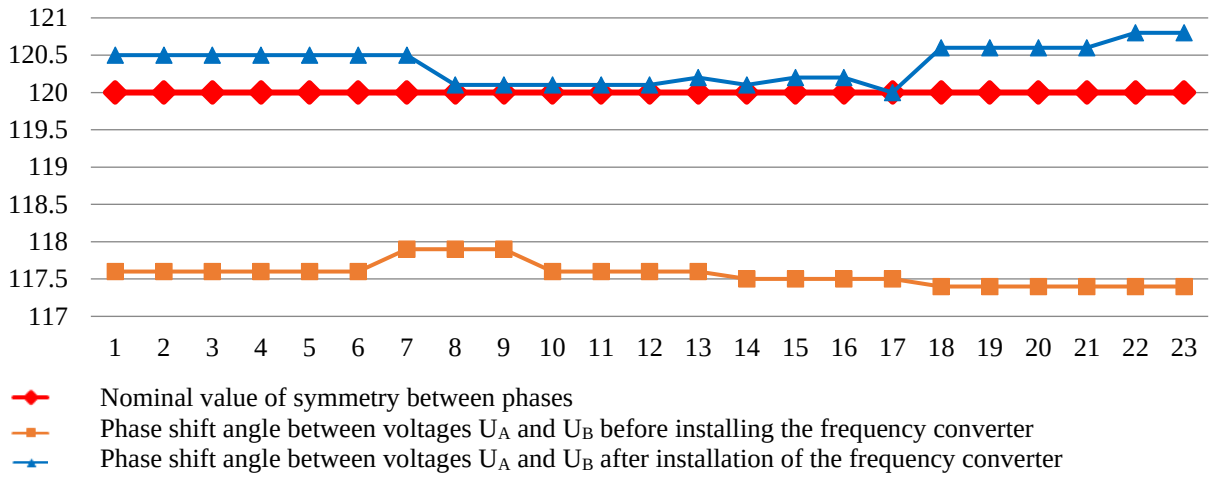

Figure 3. Symmetry between U_A and U_B phases

Figure 3 shows that the symmetry between phases U_A and U_B before the installation of the frequency converter was different from the nominal value, but after the installation of the frequency converter, it was very close to the nominal value.

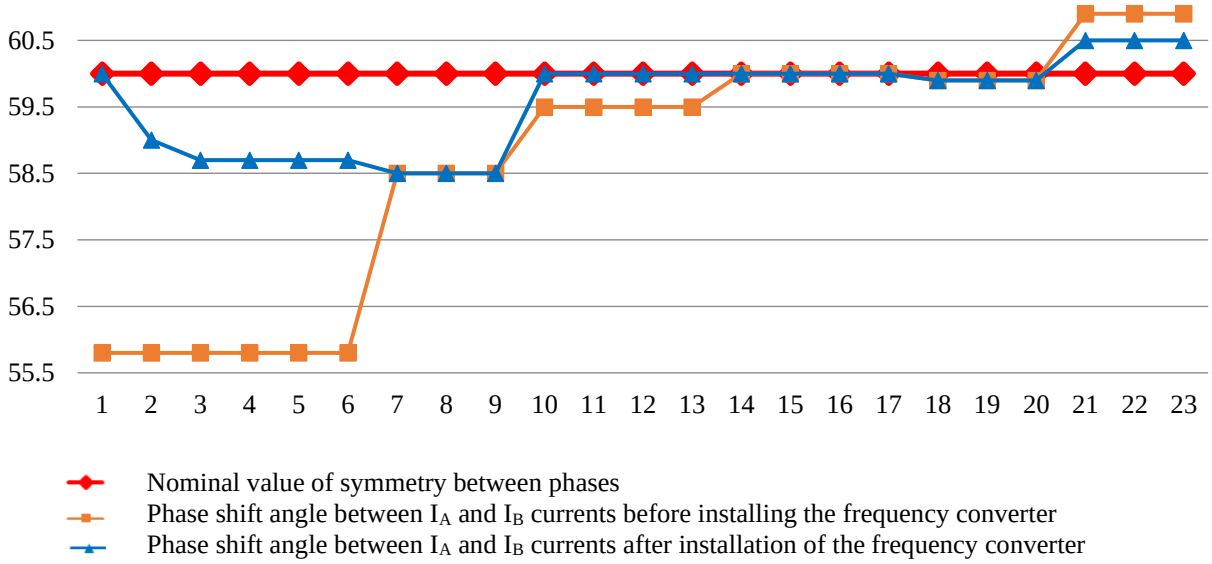

Figure 4. Symmetry between I_A and I_B phase currents

In this figure, it can be seen that the symmetry between the phase currents I_A and I_B before installation of the frequency converter is less than the nominal value, but after the installation of the frequency converter, it is very close to the nominal value.

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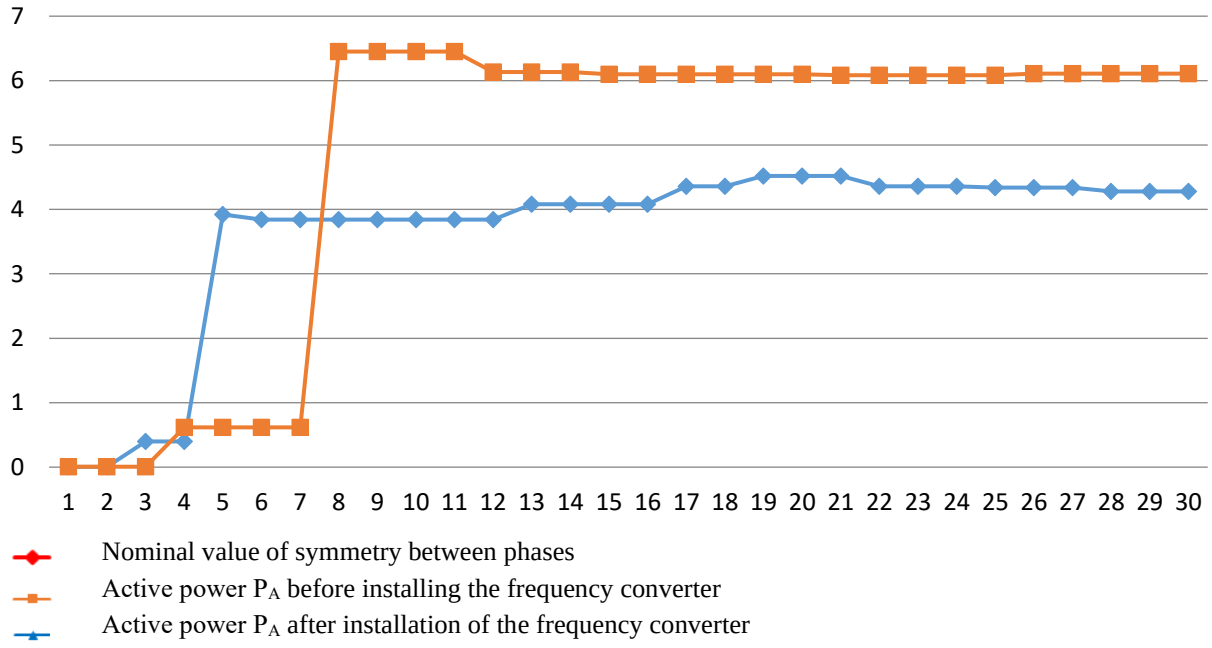

Figure 5. A-phase active power graph versus time

In this figure, we can see that before the frequency converter is installed, the active power in A-phase is high, but after the frequency converter is installed, it is significantly reduced. This ensures that the use of electric motors with the help of a frequency converter is energy efficient and at the same time ensures their reliable operation.

IV.CONCLUSION

It was determined that 23% of electricity can be saved as a result of installation and use of Delixi E100G022 frequency converter on the 22 kW water pump electric motor ETsV 10-165-35 in the irrigation system. As a result of installation of frequency converters on electric motors of this type, high economic efficiency is achieved.

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