dual-fuel installing duel fuels, it is possible to note a number of advantages in comparison with mono fuel units:

• In the absence of natural gas system automatically switches to work on diesel fuel;

• During transients the system automatically switches to work on diesel fuel.

When entering the working mode by the reverse process of transition to work on natural gas and diesel fuel. Do not forget about the fact that the first turbine was originally designed to work specifically with liquid fuels – kerosene.

Dual-fuel plants have still limited application and are not needed for most autonomous CHP, for this is a simple engineering solution.

6. Starts.

Gas reciprocating engine can be started and stopped any number of times, and it does not affect its motor potential . But frequent start-stop piston units, with the loss of auxiliary supply may entail wear the most loaded nodes (bearing, valves, etc.).

Gas turbine unit, due to sudden changes of thermal stresses in the most critical nodes and details of hot section of gas turbine unit with rapid start from a cold state, is preferable to use a constant and continuous operation.

7. Overhaul.

Overhaul of the gas turbine is 40000-60000 hours. With proper use and timely routine maintenance at the gas reciprocating engine, this figure also is 40000-60000 hours. However, there are other situations when the overhaul comes much earlier.

8. Capital investments and prices.

The cost of building gas reciprocating power plants "turnkey" in a building equipped with heat recovery systems and automation is a top-level, depending on the power plant capacity from 900 to 1300 euros per 1 kW of installed capacity.

9. Conclusions

Reciprocating installation can be used as well as a backup or emergency power sources.

The closest competitors of reciprocating units are gas micro turbines. However, prices for micro turbines are strongly up ~ $ 2500-4000 per 1 kW of installed capacity.

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Cables for VFD systems

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Nowadays used a frequency method of smooth regulation of electric drives, built on the bases of asynchronous motors with a short-circuited rotor. This method is based on the using of frequency converters (FC). The power part of the FC consists of a controlled rectifier, filter and autonomous inverter based on the pulse-width modulation (PWD). The great advantages of using frequency converters are of high accuracy and the ability to control constantly the torque and speed of a motor. Also this system has some significant defects: there

is strong electromagnetic emitting and high overvoltage in the power cable and the motor windings.

The high level of electromagnetic interferences is caused by very short intervals of switching-on and switching-off IGBT transistors and the high pulse of a frequency inverter (up to 20 kHz). This leads to a distortion of the converter sinusoidal output voltage. It leads to a distortion sinusoidal voltage on the inverter output. Generally strong electromagnetic emitting is conditioned by a power cable. It induces interferences on the elements of distribution network, devices and information networks. A good shielding of cables provides some neutralization of this emitting.

Another problem is the increased electrical loads on the insulation system. The voltage, generated by the frequency inverter, has the fundamental wave approximately a sinusoidal form with a frequency from 0 to 400 Hz depending on the rotation speed. However, during the operation some higher harmonics are produced at frequencies about 100 MHz. The signal of fundamental frequency and higher harmonics are transferred by a power cable to an electric motor.

The passage of a pulse signal with a steep front induces the wave processes in the cable, leading to overvoltages at the motor adapters.

Wave processes are most dangerous for the insulation of AD winding, because there may arise significant overvoltages (up to 1000 V) at nominal voltage 400 V. When the voltage of the electric field quickly rises on the front of the wave, noticeable dielectric losses arise in the insulation of a machine. Increasing the carrier the frequency of PWD also leads to the probability of occurrence overvoltage and dielectric losses. This is done to improve the energy component of a frequency converter and to approximate useful component of the output voltage of a converter to sinusoidal. Because of these processes the insulation life of AD was reduced to 3-4 years. PWD methods rendered beneficial effect on the output current of autonomous voltage inverters (AVI) and approximated it to a sinusoid. Also these methods simultaneously converted earlier "painless" rectangular form of output voltage for the engine to the series of rectangular pulses, following with a high frequency and having the leading edge of high steepness. Thus, the main drawback of the frequency control using are large electrical loads on the electrical insulation and supply cable. The insulation is rapidly destroyed and the system is failed under the influence of this load.

Electrical loads are adversely affected on the reliability of the supply cable. The formation of impulse waves is possible during the work on the ends of the cables, created overvoltages because of the harmonics reflections (the effect of the reflected wave). This effect arises when the supply cable length exceeds the length of the harmonic wave. If the length is less than the harmonic wave length, the transient processes take place at the output of the frequency inverter. As a result generation the voltage exceeding is rated in 2 – 3 times. It creates alternating loads on the polymer insulation. This factor must be taken into account during designing the cable insulation to avoid insulation damages (for example, because of the formation of an arc between a conductor and a shield). Moreover, overvoltages, acting with the frequency up to 10^{-4} sec, can exceed the value of the voltage supply in 10 times. As a result the life of the supply cable is reduced quickly.

Recently, special cables for variable frequency drives with a pulse-width modulation are developed and produced by the leading international cable companies ("LAPPKABEL", "The Okonite company", "AlphaWire", "HELUKABEL" and the others).

The design features of these cables:

1) Crosslinked polyethylene is used as an insulation. It has great dielectric properties and resistance to corona discharge, giving it an advantage over standard polyethylene or PVC.

2) In the shielding of cables copper or aluminum sheaths are used, providing a high noise security for the low frequency range from 1 MHz to 30 MHz.

3) Symmetrical cable design is used. Bare stranded copper conductors, located in the outer layers of the cable, are used as a grounding.

Nowadays in Russian Federation the work by the creation of such a type of a cable is at the beginning stage. There is not enough information about using the systems of a variable-frequency drive, the methods and criteria of the resistance to overloads, the ways and means of the protection to a corona discharge. In the course of the project is planned to develop cable products, adapted to work in the VFD with the pulse-width modulation, as well as the recommendations for its using.

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Basic design and common types of nuclear reactors

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This article reviews the construction of the existing nuclear reactors. Due to the fact that in many countries approximately 20% and even more of the generated energy is nuclear energy, the development of nuclear energetics is a priority today.

1. The fission process

Before considering the question about the basic design and common types of nuclear reactors we need to review the physical principles of generating heat and electrical energy by a nuclear power station. Given enough fissile material, such as ^{235}U, fission leads to the production of a self-sustaining chain reaction in which the neutrons arising from a given fission cause another fission reaction, which in turn causes another one and so on. Each fission reaction produces two or three neutrons and with an average of about 200 MeV energy. Since only one neutron is required to cause fission, others are available in excess.

One should note that there are supercritical systems, neutrons progressively increase the rate of fission, which is basic of atomic bombs. However, in a nuclear reactor excess neutrons are often absorbed rather than used to produce more fissile material. In addition, thermal or slow neutrons (kinematic energy of less than 10 eV) are used to support the controlled chain reaction. Absorbing excess neutrons often occurs by control rods and slowing down occurs by the moderator.

2. The components common to most types of nuclear reactors

To begin with, in the core, the **fuel** (uranium, plutonium or thorium) undergoes fission so that a lot of heat is released.

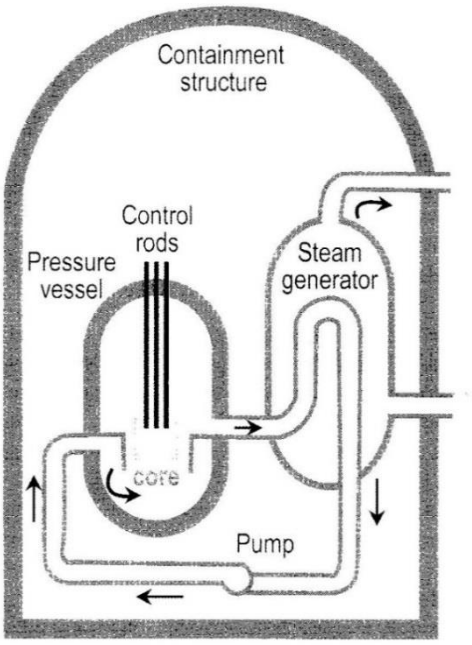

Figure 1. A schematic diagram of nuclear reactor.