Synchronous compensator

Synchronous compensator (SC) is a synchronous motor running in an idle mode. Effectiveness of compensation reactive sources depends not only on the power equipment, but also on the regulatory systems that control these sources. So, for the SC regulatory effect increases significantly when using automatic voltage regulation (AVR). Such systems provide excitation control not only when supervised parameter deviations, but when you reject modes of the compensator and power system as a whole.

However, the possibilities of AVR are limited by inertia windings of synchronous machines. This problem can be solved by rapidly changing magnetic flux due to the saturation of individual sections of the artificial magnetic circuit with its special magnetizing windings.

Synchronous compensator (SC) in underexcitation mode consumes from the system current with inductive component, the inductive component, the more, the more underexcitation . With overdrive SC consumes network of capacitive current, loading line with reactive power and thereby reducing the voltage at the node. At a current equal to the excitation current idling compensator network of active current is consumed due to losses in the windings of the equipment.

Capacitor batteries

Along with the SC, capacitor batteries have become widespread for the purpose of RP compensation. They got a lot of popularity for cheapness and ease of operation . Introduction of new technologies and materials for manufacturing these sources RP has allowed to reduce the specific volumes, increase the service life, reduce power losses in capacitors, leading to cheaper equipment. BC to an applied sinusoidal AC give the network outpacing capacitive current thereby relieving power lines to transport RM. Voltage in this node increases.

Voltage regulation using the capacitor takes place stepwise, when connecting or disconnecting of additional capacitors. Gradual control is one of the most significant shortcomings of the SRP.

CONCLUSION.

In comparison with the voltage regulation capacitors a compensator has considerable advantage. Since regulation is smooth and combined with the latest systems of AVR compensators regulation occurs continuously, constantly maintaining high static stability. When designing electricity supply system the choice of a means of compensation have to be evaluated. Investments to install SC and BC vary considerably, however, and their effectiveness varies.

References:

1. http://forum220.ru/reactive-power-compensation.php.
2. http://electrolibrary.narod.ru/9/99.htm.

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Water as reactor coolant

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The coolant is a liquid or gaseous substance which is used for the removal of heat from the core. This heat is released in the process of nuclear fission.

The heat must be captured and transferred for use in electricity generation. To do this, reactors use coolants that remove heat from the core where the fuel is processed and carry it to electrical generators.

The coolant of the reactor determines its design, safety performance and economy of nuclear power plant (NPP).

General parameters for a good coolant.

Reliable long-term operation of a nuclear reactor can be implemented, if heat is intensively produced from nuclear fuel and moderator.

For efficient coolant work, it must fulfill a number of key specifications. Most basically, it must have efficient heat transfer properties. The coolant must also be a fluid that can fill the interstices of the core and be pumped to a steam generator or turbine.

Relevant considerations for reactors are:

- A large specific heat.
- High efficiency.
- Cost-effectiveness.
- High reliability.
- Low operating pressure at high temperatures [4].

The choice of the coolant is determined by the requirements of reactor installations and depends on conditions of their use.

I'd like to note that the coolant affects significant aspects of the reactor itself, such as the operating temperature and pressure, the size of the core, and methods of fuel handling.

Currently, water is widely used in different fields of industry as a coolant, due to the wide distribution of water in nature and its special thermodynamic properties, which associate with the structure of molecules.

The two major types of water-cooled reactors are light water reactors (PWR) and boiling water reactors (BWR).

In a boiling-water reactor (BWR), the water boils directly in the reactor core to make steam that is piped to the turbine.

In a pressurized-water reactor (PWR), the coolant water is kept under increased pressure to prevent boiling. It transfers heat to a separate stream of feed water in a steam generator, converting that water to steam.

For both boiling-water and pressurized-water reactors, the water serves as the moderator as well as the coolant. Both light water and heavy water are excellent neutron moderators. Reactors using heavy water operate on natural uranium fuel. The high pressure necessary for water-cooled power reactors determines much of the plant design [1], [6].

To meet the varied requirements to the quality of the water consumed in generation of electric and thermal energy, there is a need special physical – chemical treatment of natural water. This water is essentially the raw material, which after treatment (purification) is used for the following purposes:

1. As source materials for the production of steam in boilers, steam generators, nuclear reactors, boiling – type evaporators, steam converters;
2. To condense exhaust steam in steam turbines;
3. For cooling of various machines and units TPP and NPP;
4. As the coolant in the heating systems and hot water systems.

The most important properties of water are:

- Heat capacity: specific heat is the amount of heat that must be passed 1 kg of a substance (e.g., water) to warm it up by 1 degree. Conversely, a substance gives the same amount of energy when cooled.

- The volume change during heating and cooling: all natural materials expand when heated and contract when cooled. The only exception to this rule is water.
- Characteristics boiling when changing external pressure: if water is heated in an open tank, it boils at a temperature of 100 degrees C. If you measure the temperature of boiling water, it will appear that it is equal to 100 C. Therefore, the constant consumption of heat is used to evaporate water, i.e. changes in its physical state.
- Cavitation: cavitation is the formation of gas bubbles in the result of pressure below the pressure of vaporization of the pumped liquid to the impeller inlet [7].

The use of water as a coolant and coolant – moderator in nuclear plants has several advantages.

1. The technology of such reactors is well studied and practiced.
2. Water, having a good heat transfer properties, is simply pumped and at low-cost power.
3. The use of water as a coolant allows direct steam generation in the reactor (boiling water reactor).
4. Conventional chemically desalinated water is cheap.
5. The use of water ensures the safe operation of the reactor.
6. In reactors with water coolant-moderator it's possible to achieve a negative temperature coefficient of reactivity, which protects the reactor from a higher power.
7. The ability to create blocks of capacity up to 1600 MW [2], [5].

Disadvantages of water.

1. The presence of impurities and gases makes water chemically reactive with metals. Water has a high corrosive ratio to most metals.
2. Water freezing. This is especially true in areas where winters are cold. As a result of freezing, which leads to an increase in the amount of water turned into ice, pipes may "burst".
3. The possibility of an accident with a leak of coolant and the need of funds for its compensation.

In conclusion, I'd like to summarize that water is a common coolant and meets general parameters for a good coolant.

The use of water as a nuclear reactor coolant requires some features in design and operation of the power plant.

Water is incompressible fluid, capable of accumulating heat and when cooling it can release large amounts of heat.

Water is always available, you just need to supply it to the heating system. It is the source of life on our planet and any possible leakages do not pose a threat to health.

References:

1. Braf S., Karolin V. “English in 30 days”.
2. Levin Century. E. Nuclear physics and nuclear reactors. 4-e Izd. M: Atomizdat.
3. Matveeva G.N., Tolmacheva V.F. "Calculation of water treatment plants at TPPs".
4. Petrov P.A. Nuclear power plants", 1958.
5. Petunin VP Heat-and-power nuclear installations M: Atomizdat, 1960.
6. Sterman PS, Tevlin S.A., Sharkov A.T. "Thermal and nuclear power", 1982.
7. http://ru.teplowiki.org.