Қазақстан Республикасы Тәуелсіздігінің 30 жылдығына арналған «Сейфуллин оқулары – 17: «Қазіргі аграрлық ғылым: цифрлық трансформация» атты халықаралық ғылыми – тәжірибелік конференцияға материалдар = Материалы международной научно – теоретической конференции «Сейфуллинские чтения – 17: «Современная аграрная наука: цифровая трансформация», посвященной 30 – летию Независимости Республики Казахстан.- 2021.- Т.1, Ч.2 - Р.424-425

DESIGN OF POWER SUPPLY SYSTEM FOR AUXILIARY RECEIVERS

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Electrical receivers for station / substation auxiliaries are mainly electric drives of working machines and mechanisms, which consume up to 90% of all auxiliary power. Examples include pumps, fans, hoists, and others. The remaining 10% of power consumers are represented by lighting fixtures, heating units, converters and welding transformers. The design of the power supply system for auxiliary consumers (PSAC) is carried out only after the completion of such stages as the choice of electric motors, calculation of lighting [1], determination of the loads of other consumers at voltages of 6-10 kV and 0.4 kV AC and 0.23 kV DC.

The first stage in the design of the PSAC is the selection of a schematic diagram of electrical connections and its binding to the main circuit. Power supply for auxiliary power consumers, both working and backup, is carried out by taking power from the main circuit using step-down transformers or reactors. For especially responsible consumers of auxiliary needs (AN), standby independent power sources are provided: diesel generators, batteries with converters and inverters, etc.

Auxiliary power consumers are a responsible subsystem of a station / substation, since failures of this subsystem lead to accidents at stations and in the power system. Auxiliary power plants are also consumers of a significant part of the generated energy. This is especially true for thermal power plants. So, for example, at pulverized coal CHPPs, the load of AN can reach 14% of the installed capacity, at gas-oil combined heat and power plants - 7%.

The power consumption of the AN of the dead-end substation is 50-200 kW, and that of the nodal substation is from 200 to 500 kW.

The initial data for the design of PSAC are a list of electrical receivers at all voltages, their power and reliability category according to the Rules for the Arrangement of Electrical Installations (RAEI). There are two types of auxiliary power consumers: responsible and non-responsible. Responsible ones include electrical receivers, the failure of which leads to disruption of the normal functioning of the entire electrical installation (power plant or substation) or to an accident. Such receivers belong to the first category according to the RAEI and

require the creation of a redundant AN power supply system with two or three independent power sources.

Non-responsible receivers are those, the failure of which does not lead to disruption of the operation of the station, but causes delays in repair and maintenance work, and also creates inconvenience in the work of personnel. These are receivers of workshops, laboratories, auxiliary shops and others. They belong to the second category according to the RAEI. For their power supply, 1-2 independent sources are provided in order that the interruption in the power supply does not exceed the time required for operational switching or replacement of a failed element [2].

As for the rated voltages of AN networks of power plants, the highest voltage is 6 kV or 10 kV, and the lowest is 0.4 kV or 0.66 kV. Thermal power plants usually use a higher voltage of 6 kV. At hydroelectric power plants, the main mechanisms are powered from a 0.4 kV network, and individual large mechanisms are powered from a 6 kV or 10 kV network. At substations, the AN network voltage is 0.4 kV.

Electric motors rated for 6 kV have better technical and economic indicators than motors of the same power for 10 kV. Higher mains voltage corresponds to lower normal mode and short-circuit currents, easier conditions for self-starting of electric motors and lower costs for cables and switching protective devices.

In the AN power supply system in AN switchgears, switchboards and assemblies at all voltages, a single sectioned busbar system is used. The working power supply of the electrical receivers of one unit (boiler, steam generator, turbine) is carried out according to the block principle from one power source [3], and the backup power supply is from another.

The maximum power of 6-10 kV AN transformers is taken equal to 1000 kVA, the corresponding short-circuit voltage is 8%. At a lower power of the transformer, the short-circuit voltage is from 4.5 to 5.5%. Automatic switches 0.4-0.66 kV are used as switching-protective devices in the circuits of electric motors and supply lines of assemblies and panels. As for the fuses, they are permissible only in the circuits of lighting, welding and non-responsible motors.

Computer-aided design systems for auxiliary electrical installations make it possible to determine the voltages of the AN power supply system, the power of the AN working transformers, their connection schemes to the main circuit, options for the AN backup power supply of all sections and other issues. It should be noted that the main solutions for PSAC schemes of stations of various types are strictly regulated in the norms of technological design, and the developed standard designs of power supply systems can be easily adapted to the specific conditions of any facility.

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