
STEAM-TURBINE, GAS-TURBINE, AND COMBINED-CYCLE PLANTS AND THEIR AUXILIARY EQUIPMENT

Specific Features of the Schematic Solutions Adopted in the Steam Turbine Units Produced by the Ural Turbine Works and Used as Part of Combined-Cycle Plants

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Abstract—Specific features of the schematic solutions adopted in the steam turbine units designed and produced by the Ural Turbine Works for use as part of combined-cycle plants are considered.

Keywords: steam turbine unit, combined-cycle plant, heat-recovery boiler, valve assembly, horizontal delivery-water heater, condenser

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Since 2006, specialists of the Ural Turbine Works (UTZ) have developed and manufactured several types of steam turbine units (STUs) intended to operate as part of a combined-cycle power plant (CCP) for a number of cogeneration stations (CSs) in Russia and for the Minsk TETs-3 cogeneration station in Belarus [1–5]. The list and composition of the above-mentioned STUs produced at UTZ are given in the table.

As is seen from the table, all these STUs operate as part of heat-recovery CCPs equipped with multiloop heat-recovery boilers (HRBs) containing two or three loops. The number of loops is determined in the course of elaborating the concept of a concrete CCP and depends on many parameters, in particular, on the initial and final temperature of gas turbine gases.

The STU turbines are made with one, two, and three cylinders and connected to their own generator. The gas turbines operating as part of CCPs are also connected to their own generator.

As examples, Figs. 1 and 2 show the basic thermal circuits of STUs: a two-loop T-63/76-8.8 turbine and a T-113/145-12.4 turbine, and Fig. 3 shows the basic thermal circuit of a Tp-35/40-8.8 steam turbine unit.

A simplified regeneration system is used in all of these STU circuits. The condensate is preheated in the coolers of the main ejector, gland steam ejector, and in the gland steam heater. The condensate gas heater (CGH) built into the HRB serves as a high-pressure heater.

All STUs except for the Tp-35/40-8.8 turbine must operate in the high-pressure part at sliding parameters of steam, due to which they are fitted with a throttle steam admission system. Standalone assemblies of

high-pressure valves (HP VAs) receiving live steam from the HRB primary (high-pressure) loop are used as combined stop and control valves (SCVs), see Figs. 1, 2. The designs of turbines used in such STUs have certain advantages [1]. It should also be noted that the circuit arrangement for supplying high-pressure steam to the turbine does not contain a flushing device (if necessary, flushing operations can be performed during operation at sliding parameters), nor does it contain startup bypasses, due to which the circuit has a simpler configuration. At the same time, pipelines from the valve assemblies to the turbine cylinder appear in the scheme, which give rise to additional (although insignificant) loss of live steam pressure. The influence of stored steam volumes during a growth of turbine rotation frequency above the preset level (overspeed) is also checked in these pipelines. The Tp-35/40-8.8 steam turbine unit receives steam to its high-pressure part from the common-station live steam header and is equipped with a nozzle steam admission system comprising the traditional stop valve and control valves mounted on the turbine cylinder. In view of this circumstance, the scheme of the Tp-35/40-8.8 turbine contains, in contrast to the other STU configurations, a startup SCV serving to start the turbine at the nominal parameters of steam upstream of the stop valve (see Fig. 3).

A low-pressure steam loop is present in all STU schemes (see Figs. 1–3). Steam is admitted either into the turbine chamber (compartment) or into the space between the cylinder shells (if a two-shell design is used). Stop and control valves made in a common assembly are also installed in the line supplying steam from the low-pressure loop. The number of supply