RECONSTRUCTION ON THE HYDROELECTRIC STATIONS
OPERATED BY THE LENINGRAD DISTRICT ADMINISTRATION
OF POWER FACILITIES

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Six hydroelectric stations with an overall capacity of 670,000 kW, including the Lenin-Volkhov station, which was placed in service toward the end of 1926, the Lower Svir' station, which has been in service since the end of 1933, and the Lesogorsk station, which was introduced in 1937, operate in the Leningrad power system. The structures and equipment of these three plants have been in operation for 48, 41, and 37 years, respectively; the equipment suffered partial damage during the Great Fatherland War of 1941-1945. The service lives of the Svir', Svetogor', Svetogorsk, and Narva hydroelectric power stations are also relatively long, and amount to 20-25 years. These circumstances predetermine the corresponding wear experienced by the equipment and structures, their aging in a technical sense, and the resultant need for reconstruction.

Significant work on the rebuilding and modernization of the hydromechanical equipment and hydraulic structures, basic power equipment, electric circuits and apparatus, and auxiliary equipment has already been performed, and a large volume of technological and automatic-systems equipment capable of various technical decisions has also been installed in the hydroelectric stations of the Leningrad District Administration of Power Facilities (LDAPF).

As a result of long-term operation, including the destruction and evacuation ordered during the Great Fatherland War and the subsequent reconstruction, the hydraulic turbine guide vanes at the Volkhov station were recently found to be highly worn, the runners had suffered significant erosion and corrosion, and the windings, iron stator mounts, thrust bearings, and other subassemblies of the hydraulic generators, and the electric equipment were found in poor condition; as a result of critical crane wear, it was prohibited from further operation, and the railroad turntable was shut down. After raising the intake level 2 m above the design level, the corresponding head increase on the turbines shifted the effective zone into a low-efficiency region (80-82% efficiency) with the units of the Volkhov station operating at rated capacity, while the mean weighted efficiency of modern hydraulic units reaches 87-88%. As a result of the wear on the turbine runners, the hydraulic units at this station are presently even less efficient, and the annual losses in electric-power generation are quite significant. This station has complex and obsolete electric circuits, particularly the supply circuits for internal requirements.

In connection with an increase in the capacity of the power system and electric communications, a significant portion of the electrical apparatus does not accommodate short-circuit currents at the present time. Thus, the state of the equipment at the Volkhov station dictates the replacement of all basic and auxiliary equipment at some future date.

An abbreviated design of a new radial-axial hydraulic turbine, which makes it possible to increase the output of each unit to 12-12.5 thousand kW, and total capacity of the Volkhov station to 100,000 kW was developed by the Leningrad Metal Working Plant (so-named at the 22nd Congress of the Communist Party of the Soviet Union). Planning for the complex reconstruction, which stipulated that the first heavy-duty hydroelectric power station built in our country in accordance with a design developed by the State Commission for the Electrification of Russia be refitted with new equipment built at the modern technical level, was begun. The sound condition of the concrete in the hydraulic structures and experiments conducted on a model of a new runner made it possible to avoid any alterations to the submerged section of the turbine passages.

The reconstruction of the spillway dam of the Volkhov station is now complete. A continuous dam superstructure, consisting of 15 bulkheads, the openings between which are spanned by flat roller gates controlled by a gantry crane that traverses the dam, was constructed. The complete superstructure facilitates the flow of flood...
Fig. 1. Floating gates used for draft tubes. 1) Open box-type compartments; 2) floats (ballast compartments); 3) suspension beams; 4) rotating bar frame.

waters past the station, makes it possible to eliminate the annual work of removing and replacing temporary wooden panels, and lessens the work of removing the debris that enters the turbine trash gates. Work has been completed on the construction of a new fishway in lieu of the planned fishway, which appeared to be unworkable. The new structure is a fishway designed in accordance with the type of fishway employed at the Volzhsk 22nd Congress hydroelectric station. Introduced into service in 1975, the fishway has made it possible to accelerate recovery of the Volkhov whitefish industry.

Stoplogs have been used for some time at the hydroelectric stations of the Vuoksa network as repair stops for the draft tubes and gates of the spillway dams. The major preparatory work required and the difficulty encountered in placing the stoplogs, which requires mandatory use of divers, render them hardly worthwhile; the downtime of the units for overhaul was increased by 2–5 days. In recent years, operating personnel of the electric power stations, in conjunction with the Special Design Office, Lengidrostal, and the Leningrad Hydromechanical Equipment Plant of the Gidromontazh Trust, introduced floating gates to facilitate repair of the draft tubes at both hydroelectric stations, and also for the openings of the cylindrical gates of the spillway at the Lesogorsk station.

The floating gate (Fig. 1) consists of a flat steel panel with two cylindrical steel floats. The floating gate is drawn toward the unit to be repaired (or to a spillway gate), hinge connected to a cantilever beam, submerged after filling the floats with water, and rotated, and comes to rest across the opening of the draft tubes or spillway [2]. When the gate is being placed over the draft tube, a brief loading restriction is required for the overall station, since the crew handling the gate is hindered by the high velocity in the tailrace. After gaining some experience and mastering the tackle system, the gate is installed during a single shift. The gate is raised in the reverse order by blowing out the floats with compressed air. The annual savings due to introduction of the stops has amounted to 14,000 rubles at two hydroelectric stations.

In conjunction with the pontoon gate employed for the draft tubes, a pontoon is used to repair the runners. The pontoon is made in the form of a complete closed sesquitoroid filled with foam plastic. When it is set into place, the water from the draft tube is partially removed, and the pontoon is rotated about the lower hinge and assumes a horizontal position on floating. The pontoon is subsequently disconnected and passed under the runner. The draft tube and lower portion of the runner chamber are refilled with water and the pontoon is raised by floating, and after attaining a predetermined elevation, is secured to the hub of the runner by four connecting rods. After completing these operations, the area is dewatered and the pontoon serves as a working platform for the repair of the turbine runner. After completing the repair work, the pontoon is withdrawn in reverse order, connected to the gate, and raised [3]. Use of the floating repair gates and scaffolding for the repair of the turbine runner not only re-