Part 8

RENEWABLE ENERGY SOURCES

8.5. Tidal power plants

8.5.1. Methods of tidal power plants construction

V.A. Vasilyev, B.V. Tarnizhevskiy, OJSC "ENIN"

Use of tidal energy hasn't yet received a wide application. The total installed capacity of tidal power plants (Tidal PPs) maintained world-wide makes 270 MW, including Tidal PPs "Rans" of 240 MW in France. In Russia since 1968 test Kislogubskaya Tidal PP with capacity of 0,4 MW is in operation at Kola peninsula. Despite of a small power of this PP, its construction and test operation allowed to define and develop the basic directions of scientific and technical progress in tidal power industry.

As large Tidal PPs should have a rather extended dam by nature of energy used, its cost appreciably defines the amount of capital expenses for creation of Tidal PPs. At construction of Kislogubskaya Tidal PP an essentially new the so-called floating method of PP dam creation, developed by L.B. Bernstein, was used. According to this method the dam sections of thin-walled steel concrete construction are made ashore and are towed to the installation site, where they are flooded and filled with a ballast that gives an essential economy of capital investments. This method is recognized in the world as the most effective way at building the dams of Tidal PPs. The cost characteristic of Tidal PP construction in Russia and abroad is resulted in tab. 8.7.

Table 8.7. **The cost characteristic of Tidal PP construction in Russia and abroad**

Name of Tidal PP, country (capacity in mln kW; generation in bln kW·h)	Type of hydro unit, wheel diameter, m	Stage, year	Currency (year)	Capital investments	Cost price of electricity
				for l kW of the installed capacity	Currency unit /(kW·h)
"Rans", France (0,24; 0,5)	Capsular, 5,3	In operation, 1966	centime (1995)	200	18,5 at: 22,6 at HPPs; 34,2 at TPPs; 26,1 at APPs
Kislogubskaya test PP, Russia (0,0004; 0,01)	Capsular, 3,3	In operation, 1968	ruble (1968)	1400	—
"Annapolis" test PP, Canada (0,019; 0,03)	"Straflo", 8,6	In operation, 1984	canadian dollars (1982)	4200	—
"Severnaya", England (8,64; 17,0)	Capsular, 9,1	Project, 1989	pound st. (1986)	958	0,49
"Mersey", England (0,7; 1,4)	Horizontal of the firm "Esher-Viss", 8,0	Project, 1991	pound st. (1991)	1380	0,69
Tugurskaya, Russia (8,0; 19,5)	Horizontal of the firm "Esher-Viss", 10,0	Project, 1996	US (1999)	1055	0,21
Mezenskaya, Russia (11,4; 38,9)	Orthogonal, 10,0	Materials for feasibility study, 2002	US (2002)	800*	0,19*

* Approximately.

Hydro turbine equipment

Cost and efficiency of Tidal PP equipment, mainly, of hydro turbines, are also of a great importance. Working out of the effective and cheap orthogonal hydro unit for Tidal PPs, characterized by technological simplicity in manufacturing, developed in the Open JSC "NIIES", became an essential domestic property. Such hydro unit is installed at Kislogubskaya Tidal PP, being under trial operation.

The orthogonal turbine of the new unit essentially differs henceforth from the applied axial reversible turbines. Its feature consists in that direction of the shaft rotation and turbine characteristics at a change of the stream direction in the turbine water conduit as a result of alternation of inflows and outflows, do not change. Thanks to simplicity of the design, less metal consumption and high adaptability to manufacture, the cost and terms of manufacturing of the new hydro power equipment are twice less.

Operation of Tidal PPs

A vital issue at Tidal PP operation is fouling of concrete and nonmetallic surfaces by vegetative and animal organisms. An operating experience of Kislogubskaya Tidal PP showed that the fouling remains at low temperatures (to 4 °C), repeated alternate freezing and thawing, high speeds of water stream (to 11 km/s), and a quantity of the fouling biomass makes from 5 to 10 kg/m^2 in a zone of variable levels and to 230 kg/m^2 in a ground water conduit.

In order to prevent from the fouling, a method, consisting in hypochloride use at concentration of 1 g/m^3 and completely solving this problem, is developed.

The specified high technologies in construction and operation of Tidal PPs and creation of equipment essentially improve the estimated technical and economic parameters of Tidal PPs (800 … 1050 $/kW and about 20 cent/(kW·h)).

In Russia areas of possible application of Tidal PPs are the coasts of Barents, White and Okhotsk seas. Predesign materials on creation of Mezenskaya Tidal PP at the White sea with capacity of (11 … 19) 106 kW, Tugurskaya Tidal PP at Okhotsk see with capacity of (7 … 8) 106 kW and some other ones are developed. Huge investments in these Tidal PPs at the specified huge capacities postpone the terms of their creation.