Part 8

RENEWABLE ENERGY SOURCES

8.5. Tidal power plants

8.5.2. Overview of development of tidal power plants as of 2014

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ABSTRACT

During half a century of tidal power plants development they did not become wide spread. A number of power plants under operation is not great, they are located in Great Britain, India, Canada, China, Russia, USA, France and some other countries. The most famous is a tidal power plant "La Rans" (France), it has a 800 m dam, the longest in the world, it also serves as a bridge with a highway. The capacity constitutes 240 MW_e. Other well known plants are South Korean Sikhvin (254 MW_e), British SeaGen, Canadian "Annapolice" and Norwegian "Hammerfest". In Russia (the former Russian Federation as a part of USSR) since 1968 an experimental 1.7 MW_e Kislogubskaya tidal power plant on Barents Sea cost is in operation. Despite of small total capacities of tidal power plants in the renewable balance, their attractiveness is still substantial. In Russia and abroad a number of plants with capacities of tens of GW_e are under design. The article contains the materials from the first version of section 8 "Renewables" of the Informational System of Moscow Power Engineering Institute (http://osi.ecopower.ru), prepared by JSC ENIN [1] in 2011 and modern materials available later.

Brief description. A sea bay is enclosed from the sea by a dam, in its body hydro turbines are installed. During a tide (and a maximal water level may reach 13 m), water is reserved, then gates are shut down and during the water decline the reserved water is let out through turbines. For a long time the problem of tidal power plants was low efficiency of low-head turbines (up to 40 %). Russian specialists developed an orthogonal hydro turbine (reactive, transverse-jet – water flow comes transvers the rotor axis; it is equipped with blades of special configuration [2]. The efficiency increased to 60…70 %, it is twice more compact than other types. This gave an impulse to new plans of introduction of tidal power plants in Russia. A demonstration 1.5 MW_e unit passed tests with a success at Kislogubskaya plant. This turbine became a prototype for all other turbines of tidal power plants which are under design works in Russia.

Types and capacities of energy equipment at which it is recommended or possible to implement the technology under consideration.

Low-head 1.5…4 MW_e orthogonal hydro turbine, manufactured by FGUP "Sevmash Works". Their number for a concrete power plant is defined under the plant design.

Range of applicability*:*

- power plant must be sited on a sea cost;
- power output takes place only twice a day during water decline;
- power plant must be connected to a power grid;
- power plant operations in winter time.

Restrictions on application:

- excessive capital investments for small-scale tidal power plants;
- for siting of a power plant it is necessary to find a convenient place with a vast appropriate bay.

Advantages and disadvantages

Advantages:

- general advantages characteristic for all of the renewables (no emissions of pollutants and GHGs, organic fuel savings, diversification of energy sources, company's image increase aspects, etc.) and besides:
- low operational costs;
- environmental security of tidal power plants according to [3] (dams are biologically transparent; decrease in salt content in the reservoir of the plant, marine fauna and ice conditions differ from the natural state only by 0,05…0,07%, i.e. practically negligible; ice regime in the neighbor plant pool is mitigated; ice-hummocks in the pool disappear together with preconditions of their formation; no pressing of ice on dam constructions; erosion of the bottom and movements of bottom deposits are fully stabilized during the first two years of operation; floating technology of dam construction provides preservation of environment at the plant's site);
- favorable factors at the pool of the plant (climate mitigation at neighbor territories of the plant's pool; protection of the coast line from storm impacts; more possibilities to develop marine culturing in connection with almost twice increase in marine biomass products).

Disadvantages:

- high capital investments (for building 8 GW_e Mezenskaya tidal power plant of the design output of 38.9 bln kWh, some 650 bln RUB of investments will be needed);
- power is generated only during water decline;
- there is an impact on fish fauna;
- marine fouling of concrete and non-metal surfaces by vegetable and organisms and necessity to use hypochlorite to struggle with them.

References in Russia

At various stages of designing there are the following tidal power plants [3]: 12 MW_e Northern (Severnaya) on Kolsky peninsula, Mezenskaya in Arkhangelsk province and Tugurskaya in the Far East region. The latter two are included in RF General Scheme of allocation of power objects until 2020. Pre-designing of some other plants are under way.

Information on existence/absence of author's rights on the implemented technology, developers and/or legal owners of the technology.

A patent RU 2216644 [2] for orthogonal turbine was issued in Russia.

REFERENCES

1. **В.А. Васильев, Б.В. Тарнижевский**. Раздел 8 «ВИЭ» в ОИС НДТ в энергетике России, 2011 (http://osi.ecopower.ru, версия 2011)
2. **RF patent RU 2216644 (**http://partkom.com/patent)
3. www.niies.rushydro.ru)