

Дюдяев Илья Алексеевич, Майорова Виктория Васильевна

Севастопольский государственный университет

Научный руководитель: **Браславская Елена Алексеевна**

Севастопольский государственный университет

Ilya A. Dyudyaev, Viktoria V. Mayorova

Sevastopol State University

Scientific advisor: **Elena A. Braslavskaya**

Sevastopol State University

**ПЛАВУЧИЕ АЭС – БУДУЩЕЕ МАЛОЙ АТОМНОЙ ЭНЕРГЕТИКИ
FLOATING NUCLEAR POWER PLANTS – THE FUTURE OF SMALL-SCALE
NUCLEAR POWER GENERATION INDUSTRY**

Аннотация. В статье рассматривается единственная в мире плавучая атомная теплоэлектростанция «Академик Ломоносов», которая относится к атомным станциям малой мощности. Данная станция была спроектирована с целью обеспечения электроэнергией удаленных труднодоступных территорий Российской Федерации, а также объектов промышленности стратегического значения. Она круглогодично снабжает теплом и электричеством удаленные районы Арктики и Дальнего Востока. Вместе с тем плавучая атомная теплоэлектростанция помогает решить две основные задачи: первая касается замещения выбывающих мощностей Билибинской атомной электростанции и Чаунской тепловой электростанции; вторая – это обеспечение энергией основных горнодобывающих компаний, находящихся на западной Чукотке в Чаун-Билибинском энергоузле. Также в статье рассмотрены основные достоинства плавучих атомных станций, показан их потенциал в составе водоопреснительного комплекса, проанализированы проблемы использования станций, а также приведены возможные страны-заказчики плавучих АЭС, исследованы их особенности как экспортеров.

Abstract. The article discusses the world's only floating nuclear thermal power plant “Akademik Lomonosov”, which is a small-capacity nuclear power plant. It was designed to supply electric power to remote hard-to-reach territories of the Russian Federation, as well as to strategically important industrial facilities. It supplies year-round heat and electricity to remote areas in the Arctic and the Far East. At the same time, the floating nuclear thermal power plant helps solve two main problems: the first concerns replacement of retired capacities of the Bilibino nuclear power plant and the Chaun thermal power plant; the second is supplying energy to the main mining companies located in the Chaun-Bilibino power hub in western Chukotka. The article also discusses the main advantages of floating nuclear power plants, demonstrates their potential as a part of the desalination complex, analyzes the problems of using the plants, discusses possible customer countries of floating nuclear power plants, and investigates characteristics of these countries as exporters.

Ключевые слова: плавучая атомная электростанция, плавучий энергоблок, атомная электростанция малой мощности, водоопреснительный комплекс, «Академик Ломоносов».

Key words: floating nuclear power plant, floating power unit, low capacity nuclear power plant, desalination complex, “Akademik Lomonosov”.

Energy is very important in today's world. After all, everything we use requires energy. And the further away, the more energy we need. Many Russian and foreign scientists believe that nuclear industry is the most promising direction for the development of energy systems, despite all the

dangers associated with radioactive materials handling, which is the main fuel for nuclear power plants.

Floating power unit (FPU) in Russia is highly demanded and this is particularly true for the regions of the Far North and the Far East, which are not a part of the united energy system and require reliable and economically-viable energy sources. The FPU can also be used as a part of a water desalination complex, then reverse osmosis technology or multistage evaporation units are used. Many countries in Africa, Asia, and Europe, which experience a great shortage of fresh water, are interested in these complexes [2].

The only example of a FPU today is the floating nuclear thermal power plant (FNPP) “Akademik Lomonosov”, which is classified as a low-capacity nuclear power plant. This project is made for the purpose of a reliable year-round supply of heat and electricity to remote regions such as the Arctic and the Far East. FNPP helps to solve two main problems: the first concerns the replacement of retired capacities of the Bilibino NPP and Chaun thermal power plant; the second is supplying energy to the main mining companies located in the Chaun-Bilibino power hub in western Chukotka [3, p. 2-3].

The FNPP consists of:

1. Floating power unit with two KLT-40S reactor installations and two steam-turbine plants.
2. Hydraulic engineering facilities, which ensure installation, FPU shoring, and transferring generated heat and power to the shore.
3. Onshore facilities created to transfer the generated electric and thermal energy to external networks for onward distribution to consumers [1].

The hull of the floating power unit is all-welded, divided by bulkheads into compartments forming two units – residential and technological. The technological unit contains two reactor installations, two steam-turbine plants, auxiliary systems and equipment, which provide normal operation of the power unit. The reactor compartment and the nuclear fuel handling compartment are in the central part of the FNPP. These compartments are separated from the rest ones by watertight bulkheads, which function as biological and physical shielding. Turbine generator and electrical engineering compartments are in the bow of the vessel. Auxiliary installations compartment and residual unit are at the back of the vessel, where dormitories and other facilities are located. The power plant is divided into two parts – a nuclear (main) and a non-nuclear (auxiliary). The nuclear part includes two KLT-40S reactor installations with thermal capacity of 150 MWt each and two steam-turbine plants with turbine generators with an electrical capacity of 35 MWt [2]. The total capacity of the FNPP is 70 MWt of electricity and 300 MWt of thermal power (Figure 1).

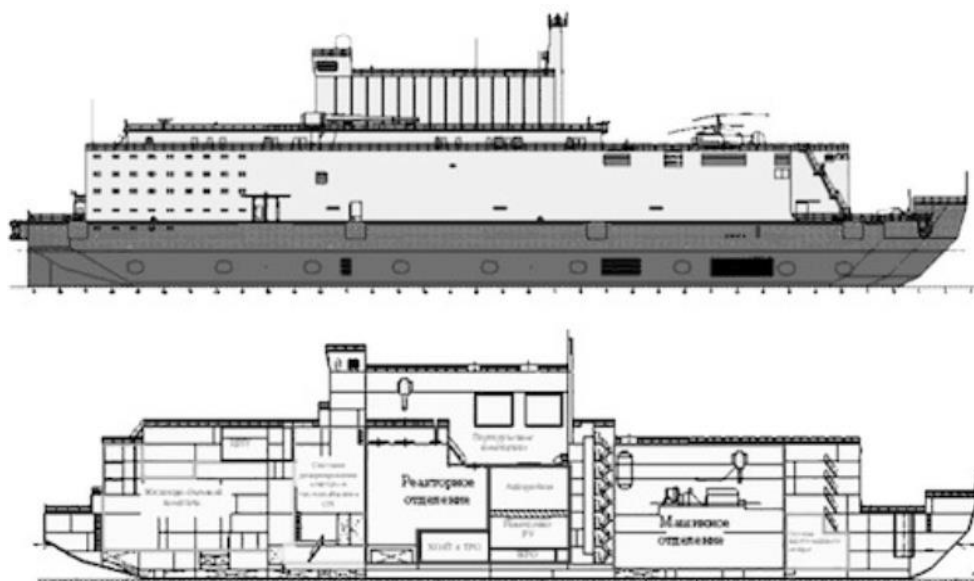


Figure 1. Hull of the floating power unit

JSC Concern “Rosenergoatom” is preparing FNPPs for mass production, and carries out work on searching for prospective sites for FNPP establishment in the Chukotka Autonomous District, Republic of Sakha (Yakutia), and other regions of Russia. Recent assessments show that it is economically viable to use FNPPs for supplying energy to natural gas production and transportation facilities when exploiting hydrocarbon and other mineral deposits. Many foreign countries are also interested in these plants, including countries in Asia, Africa, Latin America and the Middle East. The potential use of FNPPs in these foreign countries is as a part of nuclear desalination complexes [2].

China has also commended the potential benefits of mobile nuclear power plants. Under the leadership of China National Nuclear Corporation, a consortium of Chinese organizations was established to design and build low capacity floating nuclear power plants. They will be sent to the places where they are needed and will be used, for example, to operate drilling units of offshore oil and gas deposits, to supply electricity to remote facilities of the islands in the South China Sea, to heat and desalt, or these FNPPs could be used as engines for powerful nuclear-powered icebreakers. Plans are underway to build 20 floating nuclear power plants in China [2].

Thus, the operation of the FPU helps to solve the following problems:

- electricity supply to remote and inaccessible areas of the Russian Federation and CIS countries as well as industrial facilities of high strategic importance;
- desalination of sea water;
- reduction of northern deliveries of fossil fuels.

We can conclude that objective circumstances demonstrate the increasing relevance of small-scale nuclear power generation industry not only in Russia, but also in other countries all over the world.

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Сведения об авторах: Дюдяев Илья Алексеевич, Майорова Виктория Васильевна, студенты кафедры «Ядерные энергетические установки», Севастопольский государственный университет, Севастополь, Россия, e-mail: ntv5.5@mail.ru, vmaiorova0801@outlook.com.

Сведения о научном руководителе: Браславская Елена Алексеевна, старший преподаватель кафедры «Иностранные языки», Севастопольский государственный университет, Севастополь, Россия, e-mail: eabraslavskaya@sevsu.ru.

Information about the authors: Ilya A. Dyudyaev, Viktoria V. Mayorova, Students of Nuclear Power Installations Department, Sevastopol State University, Sevastopol, Russia, e-mail: ntv5.5@mail.ru, vmaiorova0801@outlook.com.

Information about the scientific advisor: Elena A. Braslavskaya, Senior Lecturer of Foreign Languages Department, Sevastopol State University, Sevastopol, Russia, e-mail: eabraslavskaya@sevsu.ru.

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