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Russian Diesel Icebreaker Fleet and Its Place in the Economic Development of the North *

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Abstract. The article studies the development of Soviet and Russian marine civilian diesel icebreakers. The history of their commissioning is analyzed and the main points of their service in the North are investigated. The Soviet and Russian stages of their construction and operation, which were approximately equal in duration, were compared. The author's diagram of this development is made. The absolute dominance of Finnish shipbuilding in the process of construction of diesel marine civil domestic icebreakers has been revealed. The reasons of transition to icebreaker building in Russia, the main problems in this direction of development are found. The values of diesel civilian icebreaker fleet necessary for effective operation of navigation in the North are determined. The existing prospects and needs for the development of diesel civil icebreaking fleet in Russia are formulated. The key tactical and technical data of sea diesel icebreakers are compared. The author's diagram shows the outstripping growth of ice-carrying capacity with simultaneous decrease of specific power of diesel icebreakers. A brief analysis of the main events in the history of each particular icebreaker is carried out, and a set of 10 main directions of application of diesel civil icebreakers of Russia in the North is summarized. A kind of rating of these directions has been compiled, among which some very rare ones have appeared.
Keywords: *diesel icebreaker, Arctic, Russia, economy, fleet, North, Northern Sea Route*

Introduction

One of the most important tools for the development of the Russian North is the marine diesel icebreaker fleet, the economic model of which differs from the model of using nuclear icebreakers. Diesel icebreakers often operate in smaller regions, where the use of their engine systems is most effective. How great are the achievements of the USSR and Russia in marine diesel icebreaker shipbuilding and operational efficiency? Does it make sense to preserve diesel icebreakers against the background of the development of the nuclear icebreaker fleet [1, Aleksushin G.V.]?

History of Russian marine diesel icebreakers

In the USSR, 18 diesel sea icebreakers of five different projects were built during 37 years (1954–1991): 3 — Voima (Icebreaker6): Kapitan Belousov (commissioned on 31.12.1954), Kapitan

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Voronin (20.10.1955) and Kapitan Melekhov (29.09.1955) [2, Boechin I.], 5 — Moskva (Icebreaker7): Moskva (11.06.1960), Leningrad (30.10.1961), Kiev (07.12.1965), Murmansk (30.05.1968) and Vladivostok (19.05.1969), 3 — R-1039 (Icebreaker6): Ermak (30.06.1974), Admiral Makarov (12.06.1975) and Krasin (28.04.1976), 4 — 1101.0 (Icebreaker7): Kapitan Sorokin (14.7.1977), Kapitan Nikolaev (31.01.1978), Kapitan Dranitsyn (02.12.1980) and Kapitan Khlebnikov (29.05.1981) and 3 — Mudyug (Icebreaker6): Mudyug (29.10.1982), Magadan (29.12.1982) and Dikson (17.03.1983) [3, Aleksushin G.V.].

This list and the analysis within the framework of this publication did not include military and combat diesel sea icebreakers of the USSR and Russia [4, Aleksushin G.V.].

The number of Soviet and Russian diesel civilian sea icebreakers is presented in the diagram created by the author in Fig. 1, taking into account the duration of their service (the separator in the figure shows 1991 as the border between the Soviet and Russian periods):

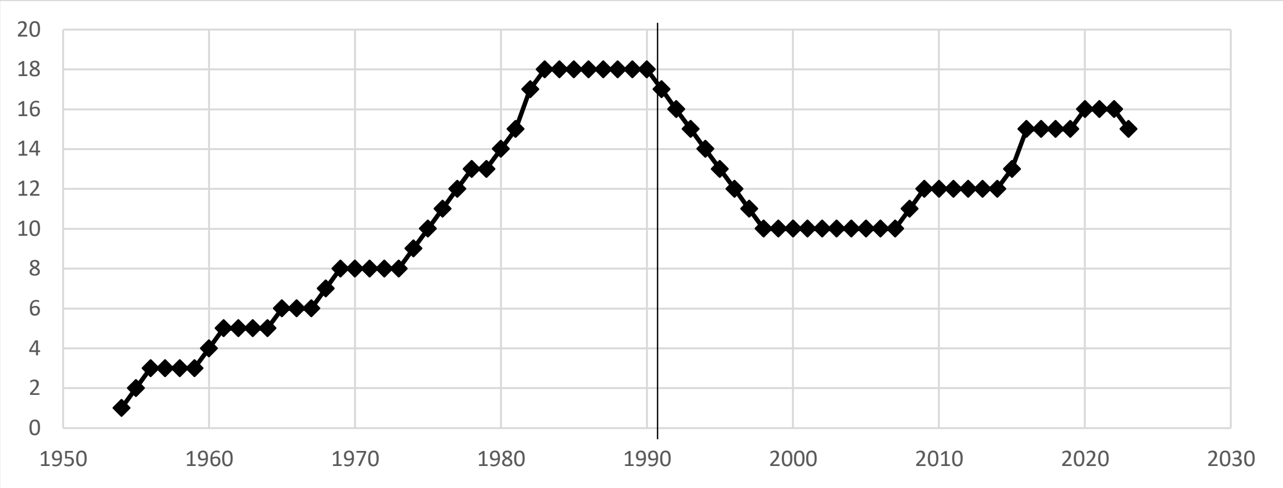


Fig. 1. Number of Russian sea diesel icebreakers in different years. Compiled by the author.

However, the statement “built in the USSR” does not accurately reflect the essence: all 18 Soviet icebreakers (100%) were built in Finland. In other words, it turns out that the USSR had no experience in building diesel sea civilian icebreakers of its own. Finns consider the reason for choosing their shipyard for the construction of Soviet icebreakers to be a consequence of the superiority of their products and a subjective factor: when the Minister of Trade A. Mikoyan met with the manager of Wärtsilä, Wilhelm Wahlforss, he expressed satisfaction with the quality and productivity of the three Voima-class icebreakers and said that even more powerful icebreakers were needed for polar waters, formulating the requirements for them. Wohlforss asked Erik Holmström, manager of the Hietalahti shipyard, and Ernst Bäckström, the company’s icebreaker specialist, if they could build such a vessel. Bäckström agreed and made a sketch of an icebreaker with a capacity of 22,000 hp. Wahlforss took the sketch to a meeting in Moscow in 1954, where he had dinner with Mikoyan. Mikoyan was delighted: *“For three years I have been asking our own shipyards for the opportunity to build such an icebreaker, but all I got in return was a negative shake of head!”* [5].

In the Russian Federation, over a slightly shorter period of time — 32 years (1991–2023) — 6 diesel sea icebreakers of three projects were built: 2 — 2190.0 (Icebreaker6): Moskva (11.12.2008) and Sankt Peterburg (02.12.2009), 3 — 2190.0M LK-16 (Icebreaker7): Vladivostok (24.09.2015), Murmansk (26.02.2016) and Novorossiysk (20.11.2016) and 1 — 2260.0 LK-25 (Icebreaker8): Viktor Chernomyrdin (03.11.2020) [3, Aleksushin G.V.]. The Vympel Design Bureau entered the diesel-icebreaker practice with three icebreakers of the 2190.0M project [6].

The gradual abandonment of the construction of diesel icebreakers at Finnish shipyards is torturous and long. The first series of two icebreakers was built at the Vyborg Shipyard with Finnish diesel engines. The second series was created at the Finnish shipyard owned by the United Shipbuilding Corporation (USC), the engines were also Finnish. The difficulties of cooperation with Finland led to an excessive construction period for the Viktor Chernomyrdin — as much as 8 years, from 2012 to 2020. The construction of the last series at a shipyard purchased in Germany resulted in the Germans' illegal refusal to complete the ship due to sanctions. The second ship in this series is being built at the Vyborg Shipyard. Both ships were again supposed to have Finnish diesel engines. Now Russian diesel icebreaker building is experiencing an unprecedented crisis due to the lack of sufficient capacity. When this problem is solved, the creation of diesel sea icebreakers will be sufficient in quality and quantity.

Obviously, there is a need for a fundamental rejection of imported diesel engines — this is what holds back our icebreaker construction the most. We need serial production of domestic reliable, economical and environmentally friendly diesel engines [7, Shatrovskiy D.A.]. The icebreaker under construction now will be equipped with D-500 diesel engines from Kolomna Plant with 12 (for diesel locomotives), 16 (for ships and submarines) or 20 (for power engineering) cylinders (i.e., 12SD500, 16SD500 and 20SD500, respectively) — with a variable output from 4,760 to 10,000 hp. In fact, this ship will become the first completely domestic diesel sea civilian icebreaker.

Fig. 1 shows the dynamics of development of domestic diesel-powered offshore icebreakers — their peak of 18 units occurred in 1983–1990, after which their number started to decrease, the lowest number being in 1998–2007 — 10 vessels. Then the number started to grow, and in 2020 it reached 16 units, almost returning to the maximum achieved, but in 2023 it decreased to 15 icebreakers.

At the moment, 1 icebreaker of project 2190.0M2 LK-18 (Icebreaker7) Vyborg is under construction (2026–2028?). Thus, the current group of 16 icebreakers is being tried to maintain with minimum losses. Plans to increase the diesel sea icebreaker fleet are unknown. Obviously, the new Kolomna diesel engines, which have been put into production, can solve the issue of serial construction of new icebreakers. The problem with the creation of propulsion systems remains. The previous icebreakers were equipped with Finnish engines, now they need to be replaced with Russian ones.

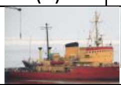
Despite the threefold superiority of the USSR over the Russian Federation in the number of icebreakers built (18 versus 6+1), the significance of Soviet construction, in contrast to the progress of nuclear icebreakers, which are an achievement of the USSR, is extremely low. However, it was in the post-Soviet history of our country that a successful and promising practice of building diesel civilian sea icebreakers was created at the Admiralty shipyards, the Baltic and Vyborg plants. Apparently, they will be the sites for building new icebreakers and their series. However, given the current innovative construction of a heavy nuclear icebreaker at the new Zvezda shipyard in the Far East, it is possible to build diesel icebreakers there.

Reduction in the power of domestic marine diesel icebreakers with an increase in their icebreaking capacity

The intention of designers to constantly reduce the specific power of marine diesel icebreakers is evident from Table 1.

Table 1

Comparison of technical characteristics of domestic diesel sea icebreakers[1,2]

	Voima (3)	Moskva (5)	R-1039 (3)	1101 (4)	Mudyug (3)	2190.0 (2)	2190.0 M (2)	2260.0 (1)	2190.0 M2
									
Displacement in tons (full/standard)	5360/4500	/13290	20247	12290-17280	8100	14300	14317	22258	14086.9
Width, m	19.4/18.7	24.5/23.5	26.05	26.5	20.92/22.2	28.02	27.5	29	27.5
Shaft power, kW	**9750**	**22000**	**36000**	**22320**	**13000**	**21000**	**21000**	**34800**	**18000**
Specif. power, kW/t	**1.819**	**1.655**	**1.778**	**1.297**	**1.604**	**1.468**	**1.4667**	**1.5634**	**1.2857**
Speed on clear water, knots	16.5	18.6	19.5	19	17.45–16.5	16	16–17	17	17
Ice capacity, m	**0.8**	**1.5**	**1.8**	**1.5**	**0.9–1.15**	**1**	**1.5**	**2–3**	**1.5**
Crew, people	28		90	28	30–25		40	60	40

Despite the constant decrease in specific power, icebreaking capacity is growing, which is evident from the diagram created by the author (Fig. 2).

[1] Power values are highlighted in bold.
[2] Source: [3, Aleksushin G.V., p. 3].

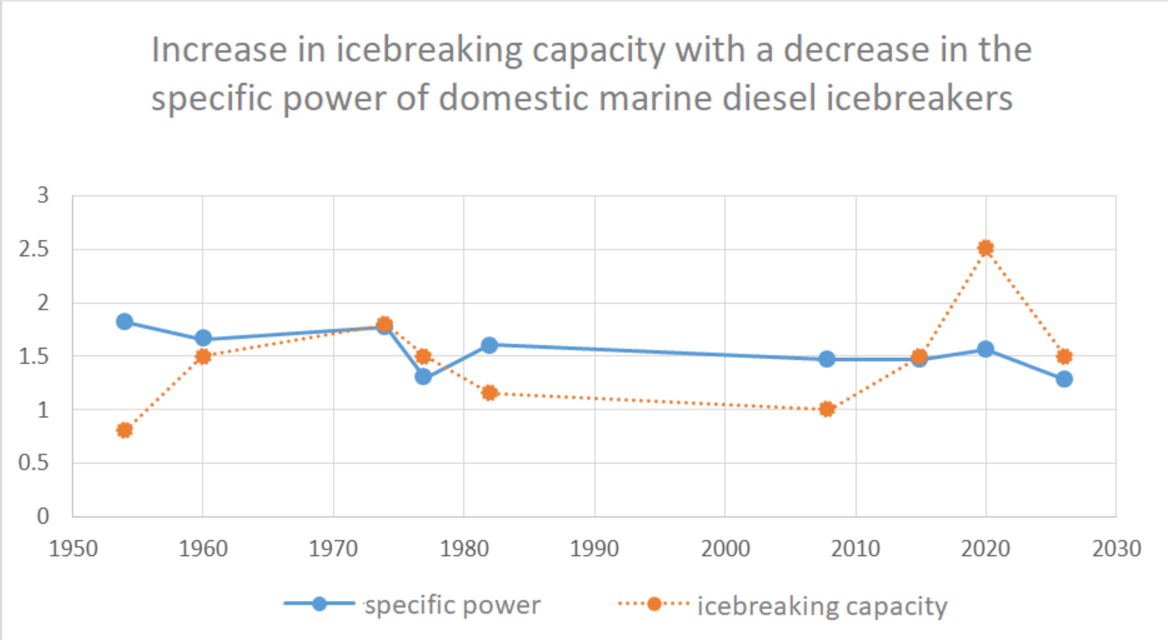


Fig. 2. Specific power and icebreaking ability of Russian marine diesel icebreakers in different years[3].

This gives several positive prospects at once: reduction of toxicity of diesel icebreakers and their fuel consumption with a simultaneous increase in the capabilities for guiding ships and delivering cargo. This opportunity becomes available due to the application of various innovations by shipbuilders with the shape of the icebreaker hulls, new materials and technologies [8, Klimashevskiy S.N.].

From the perspective of global perception of the diesel icebreaker civilian fleet, its main disadvantages are [9, Temnikova A.A.]:

- limited fuel supply on ships, which is enough for 1-2 months of operation. During the navigation season, which can last 8 months or more, a diesel icebreaker can burn fuel in an amount several times greater than its weight, spending time on refueling;
- emissions of combustion products into the atmosphere.

Use of marine diesel icebreakers to solve the economic problems of the North

The icebreaker Kapitan Belousov was sailing along the Northern Sea Route (NSR) for 21 years, having led 3200 ships through heavy Arctic ice, after which, since 1975, it has been working in the Azov Sea. In general, the icebreakers of the Voima project that operated in the North were hampered by their front propellers. However, the icebreakers designed for the Baltic performed well in the Arctic. Kapitan Voronin worked in the North longer than Kapitan Belousov and carried 4240 ships along the NSR, Kapitan Melekhov — 7000 ships along the White Sea.

The icebreakers of the Moskva series were originally designed to guide ships along the NSR. The Moskva icebreaker demonstrated significant capabilities in 1961, helping several dozen Soviet ships in the Arctic. The icebreaker made a passage along the NSR from Murmansk to Vladivostok in just 10 days in mid-October, proving the possibility of extending the navigation period until mid-

[3] Compiled by the author.

autumn. Since then, Moskva has served the eastern part of the NSR from Vladivostok. The same icebreaker participated in the rescue operation. A unique situation — in 1966, Moskva was awarded the Order of Lenin for successful service on the NSR. The Murmansk icebreaker evacuated the SP-31 station.

The lead icebreaker in the R-1039 series, Ermak, served the drifting polar stations SP-30 and SP-31. The vessels of this series were involved in rescue operations. In 2006–2016, in the Tatar Strait, the icebreakers of this series, Admiral Makarov and Krasin, escorted large-capacity tankers with crude oil to De-Kastri as part of the Sakhalin-I project. Admiral Makarov worked near the port of Vanino in 2017 and in the White Sea in 2018. In 2020, Krasin worked in the Kara Sea.

The Project 1101.0 lead icebreaker, Kapitan Sorokin, received a new unique stem to study its efficiency. The stem became more square, the vessel did not break the ice with its weight, but cut it with the hull lines, the broken ice was not thrown into the laid channel, which allows to make clean, wide ice-holes. The other “Kapitans” of this series successfully worked on the NSR, now — more in the Baltic. Kapitan Dranitsyn and Kapitan Khlebnikov were modernized for Arctic tourist cruises, participated in iceberg towing, rescue and scientific expeditions. The latter worked near the port of Magadan.

The icebreaker Mudyug also received an experimental Thyssen-Vaas stem, unlike the stem of Kapitan Sorokin. On not too thick ice, the vessel left a wide and convenient channel for ships; the icebreaker’s work was finished in the North — it was transferred to the Baltic, which is ideal for it. The icebreaker Magadan initially operates in the Far East in the Sea of Okhotsk, it participated in rescue operations and scientific expeditions. Dikson operates in the White Sea.

Both icebreakers of Project 2190.0 Moskva and Sankt Peterburg were built to ensure year-round transportation of crude oil from the terminal in Primorsk. Therefore, they are ready for secondary tasks — extinguishing fires and combating oil spills. In 2018–2020, Moskva worked near Sabetta. In 2021–2022, Sankt Peterburg replaced it there, and Moskva worked in the Far East.

The Project 2190.0M icebreakers Vladivostok and Murmansk, which continue their series, are stationed in the Baltic, but often worked near the port of Sabetta to provide icebreaking services for Arctic LNG terminals. Their “sistership” Novorossiysk worked in the White Sea in 2017 and in the Baltic in 2018. In 2022, its place of operation became the port of Vanino.

The icebreaker Viktor Chernomyrdin also works in the Baltic; it was tested in the Kara Sea, and is now positioned as Russia’s main cruise icebreaker for the next few years.

The general directions of use of diesel sea icebreakers in the USSR and Russia can be seen:

- guiding vessels through northern water areas in general and along the NSR in particular;
- participation in specific commercial projects for guiding vessels along certain routes;
- delivery, landing, support and return of drifting polar stations (at least seven icebreakers are known to have participated in station programs);
- participation in various rescue expeditions (people, animals, ships and stations);
- conducting scientific research (primarily hydrographic and oceanographic);

- working as experimental sites for testing technological innovations;
- cruises with tourists;
- extinguishing fires;
- fighting oil spills;
- cargo transportation.

Conclusion

To summarize, it should be noted that 7 out of 46 current icebreakers are nuclear and 39 are diesel. But many diesel icebreakers are of a port status, and only a small number are linear ones. If we take the entire history since 1954, 26 large diesel marine civil icebreakers are not much more than 20 nuclear ones. Undoubtedly, diesel linear icebreakers were important both for the USSR and now for the Russian Federation. However, the growing requirements for reducing the toxicity of ships and the ongoing miniaturization of nuclear power plants put the class of diesel sea icebreakers on the verge of survival. Only one such icebreaker is currently under construction, and the timing of its commissioning is unclear. Domestic diesel icebreakers, against the background of foreign countries, some of which are building similar ones and have their groups, do not look as large-scale as unique nuclear ones. It is especially difficult for Russian diesel icebreakers to compete with Finnish ones, which, in fact, were the Soviet diesel icebreakers. However, it is necessary to take into account the difficult economic situation with a gradual transition from their Soviet construction in Finland to full production in Russia. This is not just a necessity, but inevitability. The ageing of the existing icebreakers requires their replacement. The current plans to build four icebreakers for the NSR only emphasize this. The possibilities of tourism on icebreakers are gradually changing: tourists are being transferred from nuclear to diesel ones [10, Aleksushin G.V.]. Probably, it makes sense to take this need into account when designing and building new diesel icebreakers.

References

1. Aleksushin G.V. *Atomnye ledokoly: monografiya* [Nuclear Icebreakers]. Samara, 2023, 27 p. (In Russ.)
2. Boechin I. “Voyma” i potomki [“Voima” and descendants]. *Tekhnika — molodezhi*, 1995, no. 9, pp. 48–49.
3. Aleksushin G.V. *Dizel'nye grazhdanskie morskie ledokoly SSSR i Rossii: monografiya* [Diesel-Powered Civilian Icebreakers of the USSR and Russia]. Samara, 2023, 31 p. (In Russ.)
4. Aleksushin G.V. *Voennye i boevye ledokoly SSSR i Rossii. monografiya* [Military and Combat Icebreakers of the USSR and Russia]. Samara, 2023, 27 p. (In Russ.)
5. Zilliacus B. Wilhelm Wahlforss: Benedict Zilliacus kertoo Wärtsilän voimamiehestä. Wärtsilä, 1984. 364 p.
6. Milavin S.A. Arkticheskoe napravlenie v proektakh KB “Vympel” [The Arctic Direction in the Projects of the Vimpel Design Bureau]. *Morskoy vestnik*, 2020, iss. S1 (14), pp. 50–53.
7. Shatrovsky D.A. Advanced High-Power Plants for Sea-Going Vessels. *Shipbuilding*, 2015, no. 5 (882), pp. 33–35.
8. Klimashevskiy S.N. Development of Multifunctional Diesel Arctic Icebreakers Appearance Is a Modern Paradigm of Their Designing. *Shipbuilding*, 2010, no. 3 (790), pp. 26–29.

9. Temnikova A.A. Analysis of the Risk Factors of Exploitation of Diesel Icebreakers. *Vestnik of Astrakhan State Technical University. Series: Marine Engineering and Technologies*, 2015, no. 1, pp. 42–50.
10. Aleksushin G.V., Shatunova M.S. Russian Arctic: Water Tourism Development Prospects. In: *Young Scientists of Russia: Collection of Articles of the IV All-Russian Scientific and Practical Conference*. Penza, Nauka i prosveshchenie Publ., 2020, pp. 90–92. (In Russ.)

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