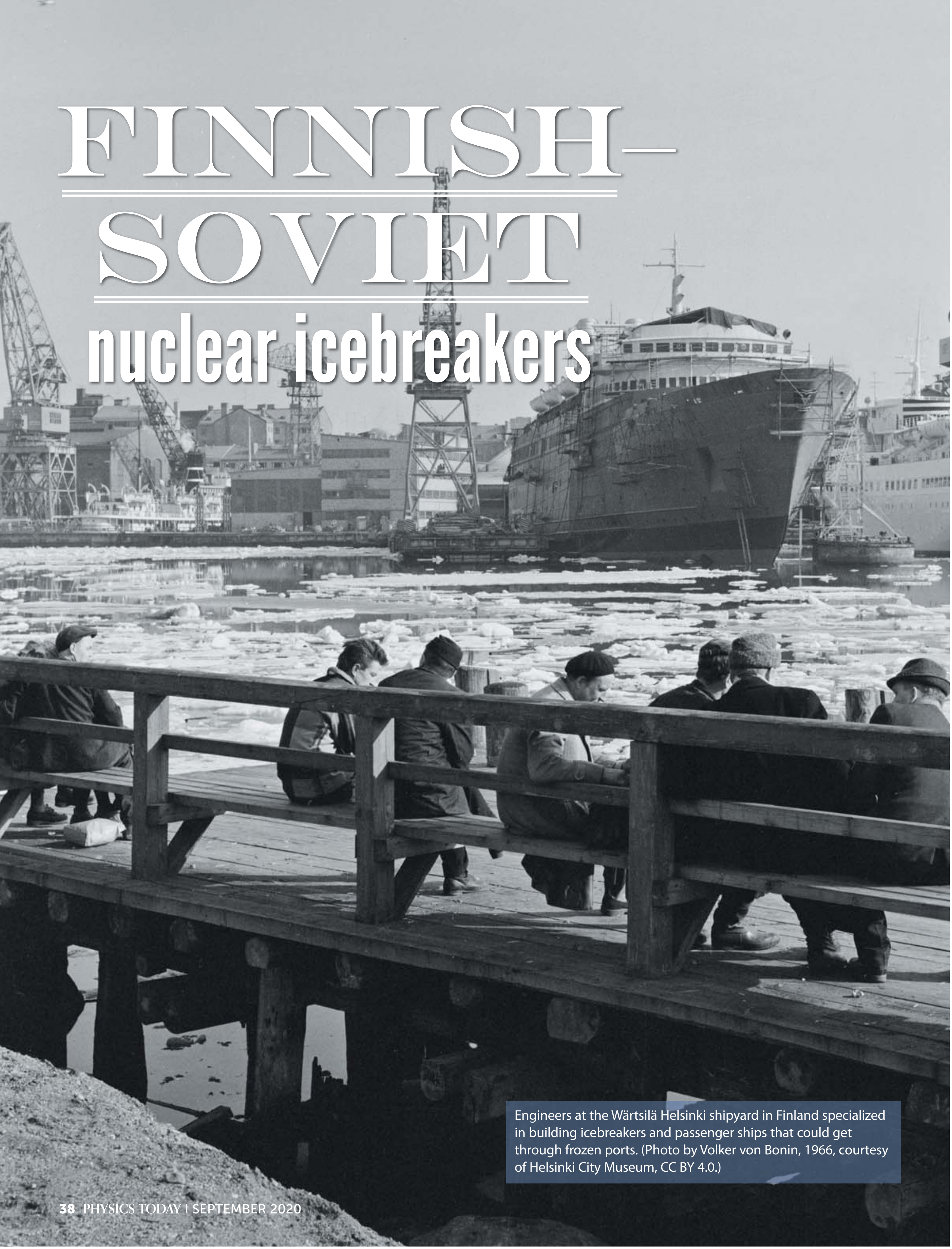
FINNISH–SOVIET nuclear icebreakers



Engineers at the Wärtsilä Helsinki shipyard in Finland specialized in building icebreakers and passenger ships that could get through frozen ports. (Photo by Volker von Bonin, 1966, courtesy of Helsinki City Museum, CC BY 4.0.)

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During the Cold War, Eastern and Western manufacturers found good reasons to collaborate, even on a technology as sensitive as nuclear vessels.

In the spring of 1988, the shipbuilding company Wärtsilä in Helsinki, Finland, delivered the newest addition to the Soviet nuclear fleet: the icebreaker *Taymyr*. It was a rare occasion: During the Cold War, only two countries had built nuclear icebreakers, the gigantic vessels capable of opening up the Northern Sea Route (see figure 1). The first was the Soviet Union, which had expertise in nuclear propulsion and a long Arctic coastline. The second was Finland, a small country that had no expertise in building nuclear-powered vessels, no direct access to Arctic waters, and a lack of domestic demand for polar icebreakers.

Nuclear-powered ships carried heavy-weighted political meaning during the Cold War contest for ideological supremacy and national preeminence. They radiated state power, the capability of homegrown engineers, and national prowess.[1] That the Soviet Union, a nuclear superpower, ordered those imposing vessels from its small neighbor instead of building them itself was unprecedented.

The Finnish–Soviet nuclear icebreakers project was realized only because of the two countries' particular relationship and the politicized framework of East–West technology transfer. But the project diverges from the better-known Cold War stories of state-initiated strategic technology development. This story is about transnational cooperation rather than international competition, and its key actor was a private company rather than a government-backed enterprise. It's a story of how a small country harnessed technology to handle its strong neighbor rather than of how a big country used technology as a tool of power.[2]

Ships of national importance

In many ways, the Soviet Union and Finland were exact opposites. The Soviet Union was a vast and populous country, a nuclear superpower, and the leader of the socialist empire. Finland, on the other hand, was a sparsely populated capitalist country that had lost the Winter War of 1939–40 and the Continuation War of 1941–44 against its eastern neighbor. Unlike other small Eastern European countries, Finland was not occupied as a result of the war, and it maintained its democratic government. Yet its position in the no-man's-land of neutrality remained a sensitive issue throughout the Cold War.

The two countries did have at least one thing in common: interest in icebreakers. In Finland, foreign trade depended on the state icebreaker fleet during the winter months when all its ports froze. For the export-oriented country, uninterrupted maritime transportation was critical for national well-being, and surveying the coastline was essential for national sovereignty.[3] In the Soviet Union, icebreakers had been central to exploring and exploiting northern territories.[4]

The heavy-duty icebreakers were essential for supplying Siberian coastal traffic. After the onset of the Cold War, the strategic importance of the Arctic Ocean increased because it was the shortest route between the US and the Soviet Union. In both Finland and the Soviet Union, the public enthusiasm toward the giant state vessels went beyond their maritime function. They were widely recognized symbols of strength and power with well-known ship names. The icebreakers were technological monuments that contributed to Finland's national identity as a northern industrial country and to the narrative of Soviet socialist Arctic conquest.[5]

After World War II, the Soviet leaders felt it imperative to secure the strategic 1340-kilometer-long border with Finland. To that end, they needed it to have a trustworthy and compliant government, though not necessarily a communist one. The postwar priority of the Finnish government was to stay away from the superpower conflict and promote economic cooperation with East and West. Recognizing Soviet security interests, the Finnish leaders adopted a policy of neutrality that dominated foreign relations throughout the Cold War.

Finland had to balance its capitalist and democratic principles with pragmatism in establishing a stable relationship with the Soviet Union. The economic agreements that were launched after the war developed into a political relationship that demonstrated the diplomatic balance between domestic and international pressures.

For the Soviet Union, trading with neutral Finland benefited its economy and provided a potential extension for its domestic production. For Finland, economic cooperation with its socialist neighbor provided stability in domestic and international affairs and accounted for about a fifth of its foreign trade. The seemingly unsatisfiable Soviet demand for refined goods and machinery provided steady income for the growing Finnish urban working class. The arrangement demonstrated to Soviet leaders that a capitalist, friendly Finland was a more useful neighbor than an occupied, unstable satellite country. Even though most of Finland's foreign trade was directed to Western markets, the Finnish–Soviet agreements evolved into a symbol of peaceful coexistence between the communist and capitalist countries.[6]

After World War II, the Soviet Union desperately needed new tonnage. Having lost the war, Finland was forced to pay reparations worth $300 million, of which ships made up a considerable share. Most of them were relatively simple cargo ships and barges, but the large quantity required Finland to open new docks and to modernize its existing shipbuilding capacity. Once the reparation deliveries were completed in 1952, the Soviet market remained lucrative because many new yards weren't cost competitive with those in Western countries. From the Soviet point of view, the ship imports from Finland provided a way to rebuild its war-torn merchant fleet and bypass the export restrictions that limited purchases from more established Western shipbuilding countries.

The initiative for Finland to export icebreakers to the Soviet Union came from the private-owned company Wärtsilä in the early 1950s. It owned one of Finland's biggest shipyards in Helsinki, and it already had some experience building Finnish state icebreakers. Wärtsilä aspired to manufacture ice-going vessels that required specialized knowledge and would provide higher profit margins than simple cargo ships.

The rationale for the Eastern-oriented business strategy was clear. Demand for Baltic icebreakers was limited, but the Soviet Arctic offered almost endless market potential. The Soviet Union contracted with Wärtsilä in the early 1950s for the first of three *Kapitan*-class icebreakers, which were capable of cutting through ice in the Baltic Sea. From 1959 to 1969, Finland built a series of five *Moskva*-class polar icebreakers that were designed to cut through multiyear Arctic sea ice.

Early in the Cold War, icebreakers were strategic vessels that served military purposes. Originally, the Western bloc's Coordinating Committee for Multilateral Export Controls restricted the Soviets from buying such vessels from most Western countries. But the Finnish government understood the icebreakers to be civilian-service vessels, which did not conflict with the Finnish policy of military neutrality. For the Soviets, outsourcing part of their icebreaker building to Finland saved their advanced shipbuilding capacity for military vessels.

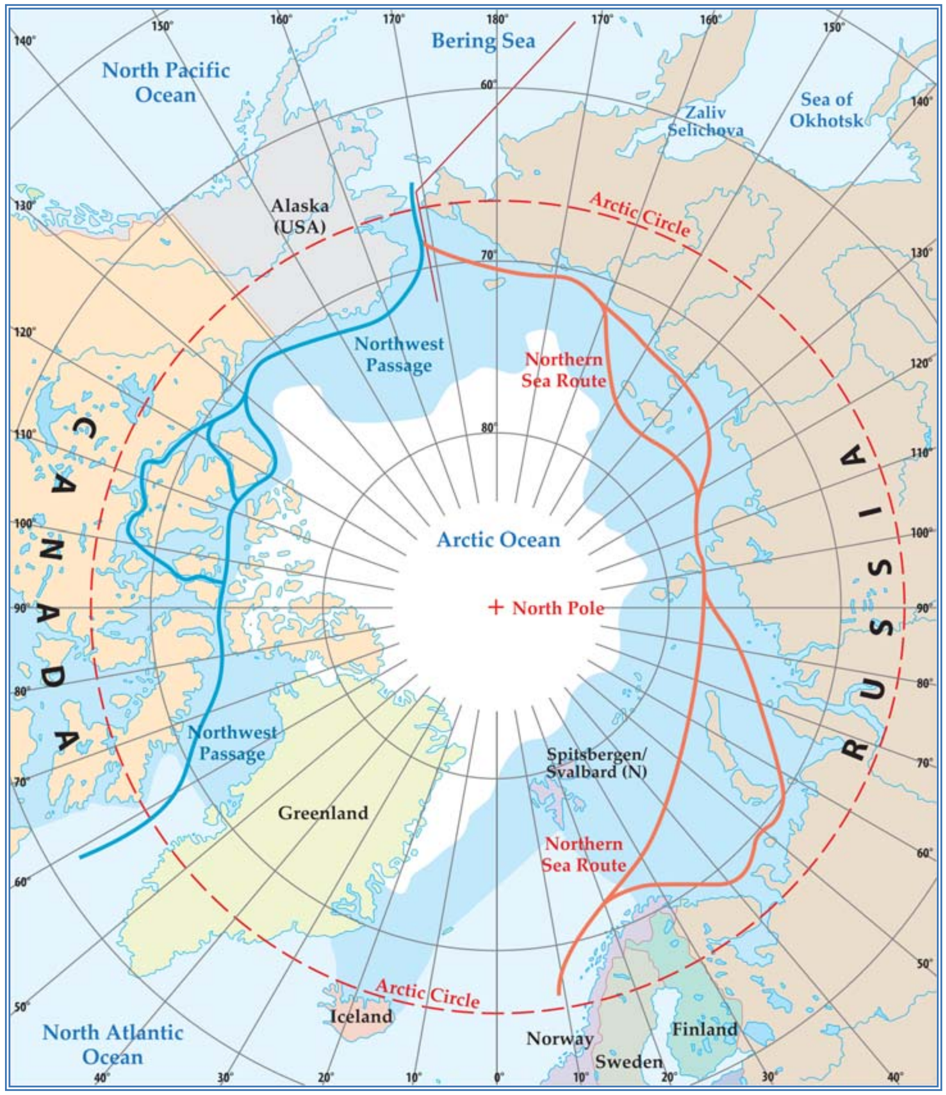

FIGURE 1. THE NORTHERN SEA ROUTE running along the Russian Arctic coast is an alternative route to travel between Europe and Asia but is usually only navigable with icebreaker vessels. (Image by iStock.com/Rainer Lesniewski.)

Promise of the atom

After World War II, nuclear technology encompassed a dual promise of life and death: fear of total destruction and hope for endless energy and well-being. When the dust had settled in Hiroshima and Nagasaki, scientists and politicians began looking to harness nuclear power for both military and civilian uses.

The widespread enthusiasm spanned a vast range of technical fantasies, from nuclear-powered trains and airplanes to pacemakers and typewriter-sized reactors for households. Global leaders recognized that the peaceful application of nuclear energy could also be used as propaganda to achieve cultural, political, economic, and technical goals.

From a technological perspective, naval architects who often struggled with the overall weight of a vessel found the lightness and durability of nuclear fuel especially attractive. Only a smidgen of uranium-235 was required to generate the same amount of energy as tons of diesel. A ship with a nuclear reactor on board seemed to promise a capacity to travel longer distances at lower cost and higher speed than vessels with alternative power sources.

The US military submarine *Nautilus* was the first vessel to realize those expectations. During sea trials in 1955, it traveled submerged at unprecedented speeds 10 times as far as any previous submarine. In the same year, President Dwight Eisenhower proposed building nuclear-powered merchant ships as part of his Atoms for Peace program. Four years later, Mamie Eisenhower christened the NS *Savannah*, a nuclear-powered cargo–passenger ship with a dual purpose of testing nuclear propulsion in a merchant ship and manifesting US expertise.

The Soviet Union launched the first nonmilitary nuclear surface vessel in 1957. The icebreaker *Lenin* had three pressurized-water reactors, which provided steam for turbines connected to electrical generators that drove the ship's propellers. *Lenin* was a considerable feat in the Cold War technology race and functioned as a prestigious symbol of socialist progress, as figure 2 illustrates.

In addition to serving civilian functions, both *Savannah* and *Lenin* demonstrated to the public the national technological competence and the potential uses of nuclear power. At a smaller scale but equally ambitious, other seafaring countries, including the nearby Scandinavian countries Sweden, Norway, and Denmark, examined the feasibility of nuclear merchant vessels, although they never launched any.

Whereas the Scandinavian countries entered the atomic age supported by their Western allies, Finland was still recovering from World War II and trying to adjust to the new international order. Early in the Cold War, Finland could not pursue nuclear power without endangering its fragile neutrality.

Despite not being a participant in the nuclear-technology race, Finland aspired to be a technologically advanced modern country. Its engineers followed foreign-technology journals, which provided them with copious reports of novel nuclear applications and new research projects. They read the same literature as their foreign colleagues and became enthusiastic about the possibilities of nuclear power.

Match made in heaven

The founding of the International Atomic Energy Agency in 1957 provided a way for Finland to obtain research reactors and opened a long-awaited opportunity for the Finnish engineers to satisfy their thirst for knowledge. When the Helsinki University of Technology started to offer nuclear-physics courses in 1959, among the students was Christian Landtman, a young technology manager from the Helsinki shipyard. Mathematics and theoretical physics astonished the practical mechanical engineer, and the laboratory exercises inspired his confidence in the applicability of nuclear physics.

The news of the Soviet nuclear icebreaker *Lenin* reached Finland in 1958 and roughly coincided with both the introduction of nuclear studies and Wärtsilä's entrance into the Soviet Arctic technology business. Landtman and the other young shipbuilding engineers at the Helsinki shipyard were struck by the concept of nuclear-powered polar icebreakers. Compared with the 22 000-shaft-horsepower (shp) diesel engines on *Moskva*, the reactors on *Lenin* could produce almost twice as much power for a year of nonstop travel. *Moskva* used 110 tons of diesel daily and required monthly refueling, which made it impractical in the most remote Arctic conditions, with long distances between the few ports. The long operational range of nuclear reactors and the lightness of their fuel met the challenges of the Arctic conditions, and the ice-strengthened hulls of polar icebreakers could protect the reactors.

After finishing an introductory course on nuclear physics, Landtman visited the construction sites of US icebreakers and the nuclear cargo ship *Savannah*, which was displayed proudly for foreign shipbuilders. US competence did not overawe the Finnish engineer. At a time of technological optimism, a nuclear icebreaker appeared feasible to the ambitious Landtman and to the shipyard of engineers who shared his confidence.

A paper icebreaker

Under the leadership of Landtman, Wärtsilä expanded its design functions and created a relatively large and skilled drawing bureau with expertise in tailor-made special vessels. At the turn of the 1960s, the bureau sketched a draft of a 50 000-shp nuclear icebreaker. In his presentation to German shipbuilders in 1961, Landtman recounted how Wärtsilä had installed in the hull of the icebreaker *Moskva* an intermediate form of the reactors used in *Savannah* and *Lenin*. He boasted that neither the space nor weight constraints had caused any problems.[7]

However, anyone familiar with Finnish winter navigation would recognize that a strong and expensive vessel would be overengineered for Baltic ice conditions. The only possible customer for a nuclear icebreaker was the Soviet Union. Eisenhower had recently vetoed domestic nuclear icebreaker plans because of the high costs and low priority. Other Arctic-bordering countries had such infrequent traffic that a heavy-duty nuclear-powered icebreaker was unnecessary.

In Moscow in 1961, Wärtsilä's managers presented the nuclear icebreaker project to their contact person at Morflot, the Soviet Ministry of Merchant Marine and principal operator of the Soviet Arctic fleet. Although Morflot was interested, the Finnish proposal was exceptional and undoubtedly expensive. It needed to be politically valuable to supersede other conventional ship orders of the Soviet planning economy. Being nuclear and an icebreaker was simply not enough.

Without any tested experience in nuclear propulsion, the Finnish shipyard could promise nothing new to the Soviets. The Baltic shipyard in Leningrad had already demonstrated the domestic capability in building *Lenin* for polar conditions. What the Finnish project could offer, though, was a channel to Western technology. The Soviet foreign-trade strategists expressed an interest in ordering a nuclear icebreaker, under the condition that it would be powered by a Western reactor. *Lenin*'s original reactor installations malfunctioned and were suspected of causing accidents.

Technology transfer from West to East had already been used by the Soviets to modernize their economy in the interwar period, and they emphasized its role in the economic strategies in the 1960s.[8] In the ideological contest for the future, the Soviet Union thought it pragmatic to take advantage of capitalist technological developments.

The Finnish shipyard executives sent inquiries for marine nuclear propulsion systems to all possible Western producers. Whereas the US and West German companies refused to sell nuclear technology that would end up in the Soviet Union, the UK, Sweden, and France appeared receptive to the idea. British and Swedish reactors eventually dropped out of the running, primarily because the buyer prioritized reactor reliability and did not want to pay for the R&D that remained to be done. That left France as the only possibility. Landtman was invited to join the visit of Finland's atomic energy advisory board to the French Atomic Energy Commission in 1965, which indicated the high political priority of the project.

In France, the Finnish request for a marine nuclear reactor was received positively. However, while the French were pondering their response, the Soviets abandoned their original idea and instead opted to use their own reactors for the nuclear fleet. Simultaneously, they announced their own nuclear icebreaker project. The *Arktika*-class concept had an astonishing 70 000 shp; the Finnish design utilized 50 000 shp. Despite the setback, Wärtsilä kept itself busy building seven conventionally powered polar icebreakers and five smaller river and harbor icebreakers for the Soviet Union.

But the Finnish nuclear icebreaker project survived. In 1970 a Finnish weekly magazine published a cover story on Landtman. He told his interviewer that the Helsinki shipyard's nuclear icebreaker project was on hold because it lacked a reactor, but he didn't mention that it also needed a hull, detailed plans, and a contract. Until the late 1970s, the Finnish nuclear icebreaker was little more than a fascinating idea and some technical drawings used to gauge Soviet interest. The project existed merely on paper, but it was still influential in making the Helsinki shipyard a serious actor in nuclear shipbuilding.

Repurposing the nuclear icebreaker

The 1970s marked a turning point in the public perception of nuclear technologies as postwar enthusiasm gradually gave way to realism. Project after project proved that nuclear propulsion was still more expensive and riskier in merchant shipping than oil-fired engines. The US's *Savannah* was retired in 1971 and never reached a break-even performance. The German nuclear cargo vessel *Otto Hahn* was completed in 1968 and was deactivated in 1979. The Japanese nuclear cargo ship *Mutsu* was blocked by protesters in her home port before the first test run. The early proponents of the nuclear merchant marine were hampered by real or imagined concerns about safety that prompted several ports to turn the ships away. In 1975 the *Guardian* opined, "The fact is that nuclear powered merchant ships cannot trade like other ships because they frighten the life out of governments and people."[9]

In Finland, the Helsinki shipyard resurrected its nuclear icebreaker project to help solve new problems. The structure of Finnish–Soviet trade had always been asymmetric: Finland imported crude oil and raw materials and exported machinery and refined products. From the 1970s on, the Soviets increasingly pushed to replace that colonial trading relationship. Although that aspiration barely affected the laws of supply and demand, joint technology projects between the two countries became politically invaluable. Collaborative projects demonstrated the Soviet Union's technical advancements, facilitated knowledge diffusion, and served as propaganda to trumpet their peaceful coexistence to the world. In its relationship with Finland, the Soviet Union wanted to be a technological pioneer, not a technology importer.

The Soviets attempted to increase the use of their own products in every ship they ordered from the Finnish shipyards. Soviet delegations were particularly eager to sell main engines because they made up a high share of a ship's total value. Most Finnish executives were equally eager to reject those sugges-

FIGURE 3: THE NUCLEAR ICEBREAKERS *Taymyr* (left) and *Vaygach* (right) were designed for travel in shallow coastal waters but are capable of breaking thick multiyear Arctic ice. (Photo courtesy of Aker Arctic.)

tions and provide business to their own engine producers. Instead, they tried to fill the quotas for Soviet content with simpler navigation systems, radio equipment, and some metal products, such as anchor chains. Although the Soviet Union had no legal way to force private enterprises to buy unwanted components, the Finnish shipyards realized they had to address the Soviet trade aspirations to remain on good terms.

When Wärtsilä proposed using the nuclear icebreaker as a potential Finnish–Soviet collaboration in the spring of 1977, shipbuilding engineers and politicians concerned with foreign trade approved. The Helsinki shipyard proposed designing and building the icebreaker, whereas the Soviet Union would construct and install the nuclear reactors. The combination of Finnish icebreaker expertise and Soviet nuclear technology was justified technically and economically. Wärtsilä had never planned to develop its own reactor technology. Outfitting an icebreaker with Soviet reactors was less a concession than a creative response to Soviet demands.

To differentiate the Finnish project from Soviet-built nuclear icebreakers, Wärtsilä specified it as a shallow-draft nuclear icebreaker. Because of their deep draft, *Arktika*-class icebreakers in the Soviet nuclear fleet were capable of reaching anywhere in the Arctic Ocean except the shallow coastal waters. To build an icebreaker that could go through two-meter-thick ice and navigate the shallow rivers and coast of Siberia, a company had to combine scientific understanding and technical experience in ice mechanics, naval architecture, and icebreaking. Wärtsilä had already demonstrated that specialized expertise in their other shallow-draft icebreakers.

At that stage, Wärtsilä's promotion of the nuclear icebreaker project resembled political lobbying more than technical marketing. It focused on persuading high-ranking Soviet politicians to order a Finnish vessel. In December 1978 Finnish president Urho Kekkonen returned from his visit to the Soviet Union with news that Morflot was willing to order two nuclear-powered icebreakers from Wärtsilä. Besides the nuclear reactors, the Soviet Union wanted to deliver special low-temperature hull steel originally developed for its submarines, turbines, and propellers. Those contributions raised the Soviet share of the project to about 13% of the cost and elevated the icebreaker project to showcase Finnish–Soviet scientific, technical, and industrial cooperation.

The two countries signed an official agreement in November 1980. For a project that had been launched almost 20 years earlier, the milestone was important, but the commercial negotiations were not completed until years later. The Soviets were known to announce valuable contracts during celebrations of important anniversaries, and that made the Finnish delegation excited on the eve of national holidays. Finally, in 1984, during the festive week commemorating the 1917 October Revolution, the Soviets agreed to sign the order for two nuclear icebreakers.

Four years later, in 1988, the first ship of the class was named *Taymyr*, after an old imperial Russian icebreaking steamer and the northernmost part of the Eurasian mainland. *Taymyr* is shown in figure 3 with its sister ship *Vaygach*, which was launched later the same year and completed after two years.

As the first nuclear-powered ship ever launched in Finland, *Taymyr* enjoyed undivided attention from the public. But the two nuclear ships were never radioactive in Finland. The icebreakers left Helsinki powered by temporary oil-fired boilers on the helicopter deck. Once the ship had docked in Leningrad, the Baltic shipyard installed the reactors. Having completed the project, Finland joined a group of just a few countries that built civilian nuclear vessels, even as most postwar nuclear dreams had withered away.

Ships carry political weight

Finnish shipbuilding engineers had an apolitical identity. Engaging in business with the Soviet Union was about generating profits. Yet as the history of the Finnish–Soviet nuclear icebreaker demonstrates, politics did matter for technological development. Even the Finnish engineers were aware of the political weight the nuclear ships carried. For them, Cold War politics was among the various means of persuasion the shipyard used to promote its product for its only potential customer.

At the beginning, the Soviet Union saw the Finnish nuclear icebreaker project as a channel for Western marine-reactor technology. At the end, the project motivated the industrial and technical cooperation between a private shipyard and Soviet governmental institutions. The Finnish state and the shipyard could display the nuclear icebreaker project as a symbol of advancement and a commitment to new technology and progress. The lure of the atom kept the project alive before the first contract was signed 20 years in, a long time for a profit-driven, privately owned company working on a nonmilitary project.

Technical qualities seemed to justify the Finnish–Soviet project: enough horsepower to break through thick polar ice, a long duration of fuel enabling independent operation in the Arctic, and a hull shape and lightness that together allowed the Finnish-built ships to navigate waters too shallow for other nuclear icebreakers. However, the first 20 years proved that closing the deal demanded more than technology. The project survived because Wärtsilä creatively and persistently aligned it with Finland's and the Soviet Union's political agendas. It was big enough to showcase technological cooperation across borders but did not challenge other Soviet nuclear projects. It was strategic enough to be prioritized above other projects and civilian enough not to endanger Finland's neutrality policy.

The Finnish–Soviet nuclear icebreaker project was political without being entirely governmental, and nuclear without being radioactive. But it was truly a child of the Cold War and would not have been possible without the politicized framework of the Finnish–Soviet technology trade. International crises such as a war always shape technological development by creating restrictions and opportunities. The full scale of the unexpected effects can often be evaluated only in hindsight.

This feature is adapted from "Flashy flagships of Cold War cooperation: The Finnish–Soviet nuclear icebreaker project," Technology and Culture ***60****, 347 (2019), with the permission of Johns Hopkins University Press.*

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