At the current stage of Russia’s socioeconomic development, a priority objective is a national complex project for the modernization and industrial development of eastern territories from the Urals to the Pacific Ocean. Most of the country’s natural resources are concentrated right here. The “eastern vector” of the domestic policy was outlined in the Message of the Russian president [1] and in a number of strategic documents associated with the development of Siberia, the Far East, and the Arctic [2, 3]. The opportunity for sustainable development of these regions and Russia as a whole depends on factors such as resource self-sufficiency, military potential, a high educational level of people, a broad front of scientific research, and the availability of territories of advanced development [4–6]. In addition to the above conditions, it is necessary to implement a system of organizational, programmatic, and scientific-and-engineering measures that take into account the geographical, natural–climatic, transportational, energy, and other specifics of Russia’s eastern regions. The objective posed should be solved as national complex projects, and the efficacy of upcoming investments suggests taking into account scientific—engineering aspects and factors that ensure accelerated progress of territorial—industrial complexes, territorial clusters, and zones of advanced development. Hence, we need to develop and implement a new state scientific—engineering policy to advance further Russia’s northern and eastern regions. The following provisions should underlie such a policy:

• the engineering level of the existing energy, heat, and water supply systems, and well as waste water treatment and (household and industrial) waste utili-
     zation technologies is extremely low and requires a cardinal change;

• the objectives of ensuring the anthropogenic, environmental, and energy security of regions in the zones of cold climate, as well as of complex engineering facili-
     ties, should prevail;

• the contradiction between the requirements for industrial, as well as new territorial, development and the need to ensure natural—anthropogenic, as well as environmental, security can be resolved only by a complex approach to risk planning and management based on interdisciplinary studies that ensure the suc-
     cessful advancement of state-of-the-art facilities of the technosphere on the territories of northern and arctic regions; and

• machines, structures, and equipment, as well as the large-scale construction of unique engineering structures and critically important and hazardous industrial facilities, can be implemented widely only using innovative developments and technologies, which require the relevant scientific and technological tracking at the stages of creation, production, and operation of such products.

MACHINERY MODIFIED FOR THE ARCTIC: BACKGROUND

By the early 1950s, the importance of northern regions in providing economic recovery for our country and in implementing its geopolitical and strategic interests and goals had increased significantly. However, industrial production in the severe climatic conditions of the Russian North posed many problems associated, in particular, with the working capacity and service life of machines and structures. Only science could meet the emerging challenges, and Acade-
micians M.A. Lavrent’ev, B.E Paton, S.V. Serensen, N.V. Cherskii, and S.V. Vonsovskii initiated intensive systemic studies on the fundamentals of the low-temperature strength, reliability, and durability of engineering machine-building structures and exploration and mining machinery, as well as construction and transportation sites, including the main gas pipelines, designed for operation in northern regions.

The next stage in solving the problems of developing Siberian, Far Eastern, and Arctic territories was the introduction of findings obtained during scientific pursuit. In 1964, the Supreme Council of National Economy under the USSR Council of Ministers adopted a special resolution to improve the reliability and durability of machines, equipment, and metal structures designed for operation in the north at low temperatures. A Scientific Council was established at the USSR Committee for Science and Technology named Machines and Materials Designed for Operation in Low-Temperature Conditions. At the suggestion of this council, a state standard, GOST 15150-69 “Machines, Instruments, and Other Technical Products: Modifications for Various Climatic Regions: Categories; Operating, Storage, and Transportation Conditions as Affected by Environmental Climatic Factors,” was developed in 1969 and brought into effect in 1971. This document was of great importance for the formation of requirements on machines, equipment, and materials operated in moderate (M) and cold (C) climates.

In the 1980s, executive and programmatic documents envisaged the introduction of a wide range of machines and equipment of the northern modification, including exploration, mining, road construction, lift-and-carry, automobile, and off-road machinery, and machines for maintenance, diagnostics, and repairs right on the operating ground, special types of machinery, auxiliary equipment, etc. The key targets envisaged the development of nearly 300 machines and pieces of equipment in the C modification, more than 90 of which were newly designed machinery. By the end of the 1980s, 58 cold-resistant (industrial rubber, fuel, lubricant, and metal) materials; 9 new steel-making technologies and regimes of treatment of cold-resistant metals and alloys; and 16 new methods and standard documents for strength calculations, metal testing, and machinery operation were developed under the R&D plan. Out of the planned 90, Soviet industry manufactured 53 types of machines in the C modification, including 15 automobiles for various purposes: open-pit dump trucks, trucks, maintenance crew vehicles, road-trains, and off-road machinery.

Important for the design of machines and structures was the development of a standard document, Construction Rules and Regulations: Loads and Effects (SNIP 2.01.07-85), in 1985. During its preparation, the territory of the Soviet Union was zoned (in 2008 the zones were updated for the territory of the Russian Federation), and regions were identified by estimated snow cover weight (eight regions), by average wind speed and pressure (eight regions), by glaze ice thickness (five regions), and by average summer and winter air temperatures (regional boundaries were designated in the temperature range from +25 to −50°C). The territorial zonation by the above parameters gave the opportunity to make more detailed strength and resource calculations and more justified decisions on the choice of structural materials.

Noteworthy is the significant organizational and technical contribution to and scientific achievements in the design of machinery for the north by the teams of industrial and academic institutes, including the Blagonravov Institute of Machine Science, RAS; the Larionov Institute of Physical—Technical Problems of the North, RAS Siberian Branch; the Baikov Institute of Metallurgy and Metal Science, RAS; the Paton Institute of Electric Welding, National Academy of Sciences of Ukraine; the Russian State Research Center TsNIITMASH; the Mel’nikov TsNIIPS; the Kucherenco TsNIISK, and the Bardin TsNIIchM. Largely thanks to their efforts, the problems of the design of machinery of the arctic modification have not lost their value and support on behalf of industrial enterprises in the 1990s and 2000s. Thus, it was possible to preserve not only the continuity, scientific traditions, and research potential of academic organizations but also the production practices of industrial enterprises. Nevertheless, the volume of scientific research in structural strength and materials science at low temperatures decreased substantially, and the output of machinery for the north practically stopped in the crisis conditions of the first post-Soviet decade.

**SPECIFICS OF CREATING MACHINERY FOR THE NORTH AT THE CURRENT STAGE**

The new demand for R&D results associated with machinery for the north was created by long-term plans to implement large investment projects in the Urals, Siberia, the Arctic, and the Far East. Several strategic documents were prepared at the top governmental level, among which we should note the Strategy of Socioeconomic Development of Siberia until 2020 (approved by directive no. 1120-r of the Russian government on July 5, 2010), the Plan of Measures for the Implementation of the Strategy of Socioeconomic Development of Siberia until 2020 (approved by directive no. 924-r of the Russian government on May 28, 2011), and The Strategy to Develop the Russian Arctic Zone and to Ensure National Security until 2020 (published in 2011).

The intensive development of the riches of Siberia and the Russian North in general became especially topical as the major proved natural reserves in the