JPRS L/10593

17 June 1982

USSR Report

TRANSPORTATION

(FOUO 4/82)

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

APPROVED FOR RELEASE: 2007/02/09: CIA-RDP82-00850R000500070039-7

JPRS L/10593

17 June 1982

USSR REPORT

TRANSPORTATION

(FOUO 4/82)

CONTENTS

 [III - USSR - 38d FOUO]

MOTOR VEHICLE

MOTOR ROADS IN FAR NORTH

Moscow AVTOMOBIL'NYYE DOROGI SEVERA in Russian 1981 (signed to press 11 Nov 80) pp 1-6, 247-248

[Annotation, introduction and table of contents]

[Text] The basic principles of the design, construction, maintenance and repair of motor roads with different pavement types in the northern construction-climate zone are presented. Emphasis is placed on road susceptibility to drifting snow and on roadbed construction on the marshlands which are so common in the north. Some questions of surface ice formation and the measures used to protect against surface ice are examined. The book is intended for engineering and technical personnel involved with the design, construction, repair and maintenance of motor roads and may be of interest to the transportation institute students.

Introduction. The expansion of mineral extraction and processing in the northern regions of western and eastern Siberia and in the far north requires the development in these regions in the next few years of large economic complexes and the introduction into continuous operation of the Baikal-Amur railway [BAM].

Extensive road construction in these regions will make it possible to markedly increase the extraction of oil and gas in western Siberia and organize the successful construction of several large industrial complexes.

General-use paved roads are being built along the BAM to aid in the construction of this rail line.

In the design and construction of roads in the subject regions it is necessary to consider carefully the peculiarities of the natural and climatic conditions.

The primary natural characteristics of the severe climate regions[1] include the following: extremely varied lithological and temperature characteristics of

1. SNiP [Construction Norms and Regulations] II-A.6-72: "Construction Climatology and Geophysics" identifies in the Soviet Union the northern construction-climate zone. including not only the regions of the north but also a large part of the territory of eastern Siberia and the Far East. Because of the variety of natural conditions three subzones are identified which are further broken down into four subregions. Highway climate zoning, defined in accordance with SNiP II-D.5-72 and other normative documents and examined in detail later on in the present volume, is used for the design of motor roads.

soil distribution; unfavorable nature of the active-layer soils from the viewpoint of road construction (primarily frost-susceptible silty-sandy loams and clayey loams with poor load-carrying ability upon thawing); the presence in many cases of subsurface ice near the upper edge of the permafrost formation, exposure of which leads to thermokarst phenomena in the roadbed area; extensive boggy areas (marshes); large number of days with blizzards and snowstorms (up to 12-15 days a month in the winter in the far north); considerable intensity of snow migration and snowdrift blocking of the roads; presence in many areas of surface ice formations; extensive soil heaving and the appearance of frost heave mounds.

In the subject regions the connection between the design solutions and the technology and organization of operations takes on particular importance. The principles used in the design of the road structures (for example, retention of the moss and vegetative cover in the fill subgrade) must be implemented by the technological schemes used, otherwise there will inevitably be deformation and sometimes even failure of the road structures.

An important factor in road design is the necessity for carrying out thermotechnical calculations of the thawing and settling processes in order to justify fill heights and the depth of replacement of unfavorable subgrade soils. In those areas where the subsurface ice lies at a shallow depth the design must ensure the presence above this ice of a frozen soil layer at least half a meter deep in order to prevent thawing of the ice during operation of the road.

When designing a roadbed using local cohesive soils it is necessary to predict any possible soil modulus of deformation (elasticity) increase and pavement heaving in order to ensure the specified operational characteristics.

Experience in road construction shows that the specific nature of manifestation of the natural peculiarities of the subject regions requires strict adherence to the following basic principles of road construction: construction of the roadbed for the most part in fills (the relative length of the cuts should not exceed 3-4 percent), use in most cases of free-draining materials for construction of the roadbed, and giving the roadbed a form which minimizes snow drifting problems; replacement of the silty ice-saturated soils with free-draining soils when making cuts and in neutral areas; use of thermal insulating layers in the subgrade of fills and cuts and on slopes with close-by fossil ice; stabilization of the slopes of fills, side ditches and cuts in the case of unfavorable properties of their constituent soils; use of measures to stabilize fills on sloping ground; construction of fills from macrofragmental materials in areas of surface ice formation; retention of the moss and vegetative cover in the subgrade of the road structures; use of pavements for which nonuniform heave mounds are less critical (low-type and light-duty high-type pavements).

During the polar night the construction sites should be lighted and operation of individual crews and small groups away from the primary operating units is forbidden. Heated facilities for short-term personnel relaxation, for eating and to provide assistance to accident and frostbite victims must be provided at all the primary work sites; these facilities should be equipped at all times with food supplies, warm clothing, medical supplies and hot water. Heated tents or mobile homes on sled-type trailers can be used as warming stations.

During preparation for operations under arctic conditions the work units operating at locations remote from the permanently occupied stations should be provided with special clothing and footwear, mobile homes, thermos units and heating equipment, fuel and food. The efforts of the medical personnel are directed toward carrying out prophylactic measures to prevent frostbite and providing medical assistance to frostbite victims. During planning and organization of the operations we determine the work schedule and the allowable time of personnel stay in the open air, particularly at low temperatures and with strong winds. With account for the weather conditions we establish the machinery productivity norms and the production capabilities of the work teams. Vehicle drivers and the personnel of units working far from the housing facilities are furnished sleeping bags. Transport vehicles should travel in convoys whenever possible. The convoys should include repair vehicles and vehicles with heated bodies. In the course of road construction constant communication should be maintained with the weather service and the work crews should be provided with information on any possible weather changes. The width of timber clearings is limited and clearing should be accomplished by sawing down the trees without removing the stumps. When constructing roads in the southern regions of the northern construction-climate zone the forest clearings should be wider (preferably accomplished a year before the construction of the roadbed), the moss and vegetative cover should be removed, the stumps pulled out, and floorings and coverings of timbers laid down in the subgrade of fills being erected in marsh areas. The "push away" fill principle is widely used in roadbed construction in order to retain the moss and vegetative cover in the limits of the roadway. Road operations are carried out on a broad front with the objective of the fastest possible joining up of the completed segments and protection of the subgrade soils against deep thawing. Equipment is delivered to the work sites primarily during the winter, when the "roadability" of the ground (particularly in the far north) is better, and also by river in the ice-free period. In the winter the burrow pits are protected against snow and in the spring against water from the melting snow. Winter motor roads are used extensively for construction vehicle movement. The machines are selected with account for the time of year and the natural and climatic peculiarities of the region (machines with improved flotation are required for spring and summer operations, vehicles with improved frost resistance of the basic components and with heated cabs, i.e., winterized vehicles, are required for winter operations).

All the road and bridge construction equipment should be prepared well ahead of time for operation at low temperatures, with strong winds and in the polar night: the cabs and the battery and engine compartments should be sealed and heated, the vehicle fleets should be provided with devices for group preheating of the engines, and the bodies of trucks intended for personnel transportation should be heated; outside parking areas and temporary vehicle parking areas should be protected against drifting snow. Cold-resistant rubber should be used on the wheeled vehicles when the air temperature reaches -40°C or lower.

The highway scientific-research institutes and many colleges and design, construction and operational organizations have recently done much to improve the quality of motor road construction in these regions. Thus, on the basis of study of the experience in pavement construction in the northern regions there have been developed the principles followed in the specification of regional pavement types. On the basis of correlation of the experience in combatting surface ice on the railroads and motor roads there have been developed the fundamentals of surface ice formation forecasting, and the designs of the devices used in combatting surface ice and the methods of their analysis have been improved.

With account for field experience and the scientific and engineering developments of the last few years, in the corresponding divisions of this volume we present coordinated and field-proven recommendations, supplementing and expanding the normative documents relating to the survey, design and construction of motor roads in these regions.

Table of Contents

9576
CSO: 1829/194

RAILROAD

UDC 621.331:621.311(031)

NEW HANDBOOK ON ELECTRICITY SUPPLY TO RAILROADS--VOL I

Moscow SPRAVOCHNIK PO ELEKTROSHABZHENIYU ZHELEZNYKH DOROG in Russian, Vol 1, 1980 (signed to press 20 Oct 80) pp 1-8, 255-256

[Title page, annotation, foreword, and table of contents from book "Handbook on Electricity Supply to Railroads", edited by Professor K. G. Markvardt, doctor of technical sciences, Izdatel'stvo "Transport", 11,000 copies, 255 pages]

[Text] Title Page

Title: "Spravochnik po Elektroshabzheniyu Zheleznykh Dorog v Dvukh Tomakh" [Handbook on Electricity Supply to Railroads, in two volumes]

Editor: Professor K. G. Markvardt, doctor of technical sciences

Place and Date of Publication: Moscow, 1980

Publisher: Izdatel'stvo "Transport"

Annotation

Volume one of the handbook collects and summarizes material on designing electricity supply devices, calculating their parameters, feeder and substation currents, voltage in the traction system, and energy and power losses. It gives information on regulating and compensating devices, presents materials on overloads and stray currents and protecting against them, and considers the influence of electrified railroads on adjacent lines, power supply to stationary nontraction consumers, and questions of station illumination and safety precautions. The Rules of Technical Operation of Railroads and technical specifications, instructions, and orders from the Ministry of Railroads were used in compiling the handbook. It is intended for engineering-technical workers in railroad transportation, and may also be useful to students at higher educational institutions and tekhnikums.

The book has 211 illustrations, 111 tables, and a bibliography with 126 entries.

The book was written by the following persons: Foreword — P. M. Shilkin; Chapter 1 — B. Ye. Geronimus and I. B. Mostinskiy; Chapters 2-5, section 6.2, and Chapter 7 — G. G. Markvardt and E. S. Brzhozovskiy; sections 6.6, 9.1-9.3, and 9.6 — G. G. Markvardt; section 6.1 — G. G. Markvardt, K. G. Markvardt, and E. V. Ter-Oganov; section 6.3 — Yu. M. Nikitin; section 8.2 — V. P. Il'yashenko;

section 8.1 — G. G. Markvardt and T. V. Polyakova; sections 6.4 and 6.5 — L. A. German; sections 6.7 and 10.4 — V. A. Kislyakov; sections 9.4 and 9.5 — M. I. Veksler; sections 10.1-10.3 — R. M. Borodulin; Chapter 11 — V. D. Radchenko and Ye. N. Dagayev; sections 12.1-12.3 — N. G. Sergeyev; sections 12.4-12.9 — A. V. Kotel'nikov; Chapter 13 — G. A. Minin, I. V. Pavlov, and V. P. Semenchuk; sections 14.1-14-4 and 14.6 — A. N. Poplavskiy; section 14.5 — Ye. A. Mogilevskiy; Chapter 15 — N. N. Firsanov; Chapter 16 — Ya. A. Zel'vynskiy, B. I. Kosarev, and M. V. Khlopkov.

The editorial board was composed of: V. A. Kislyakov, G. G. Markvardt, A. S. Markov, V. N. Pupynin, N. D. Sukhoprudskiy, Yu. V. Flink, M. V. Khlopkov, P. M. Shilkin, and L. I. Shukhatovich.

The reviewers were: Sh. S. Logua, B. E. Tevlev, G. S. Akopyan, K. Ye. Glebin, V. I. Gudkov, V. I. Ivanova, V. N. Pupynin, K. A. Lyubimov, A. , Mikhin, V. O. Degtyarev, and M. P. Ratner.

Foreword

Electrification of the railroads is an important element of technical progress in transportation. It allows a significant increase in the carrying and traffic capacities of the railroads, the efficiency of shipping work, and labor productivity. It makes it possible to improve working conditions and reduce consumption of fuel and energy resources. Electrification of trunk railroads promotes electrification of the entire national economy because the traction substations that feed the distribution networks are not used only for the needs of electrical traction, but also supply electric power to industrial enterprises, kolkhozes, and sovkhozes in nearby regions.

The rise in production of electricity in the country (see Table 1 below) and the development of electrical grids promoted electrification of the national economy, including railroad transportation.

Table 1. Development of the Electric Power in the USSR

	Installed Capacity, millions of kw			Electricity Production, billions of kw h		
Year	All Plants	Hydro Plants	Atomic Plants	All Plants	Hydro Plants	Atomic Plants
1913	1.1	-	-	2.0	-	-
1935	6.9	0.9	-	26.3	3.7	-
1945	11.2	1.56	-	48.3	5.1	-
1960	66.7	14.8	-	292.3	50.9	-
1965	115.0	22.2	-	506.7	81.4	-
1970	166.15	31.4	0.9	740.9	124.4	3.7
1975	217.5	40.5	4.9	1,038.6	126.0	20.2
1979	255.28	50	10.2	1,238.2	172	54.8

The figures in Table 2 below illustrate growth in the length of electrified lines and the volume of work done by them.

Table 2. Length of Electrified Lines and Volume of Work Done by Them

Year	Length of Electrified Lines as % of Total System Length	Length of AC Lines, thousands of km	Length of Electrified Lines as % of Total System Length	Work Done by Electric Traction as % of All Rail Shipping
1930	0.52	-	0.2	0.3
1935	1.03	-	0.9	1.0
1940	1.9	-	1.8	2.0
1945	2.0	-	2.0	2.4
1950	3.1	-	2.6	3.2
1955	5.4	0.1	4.4	8.4
1960	13.8	1.43	11.0	21.8
1965	24.9	7.95	19.0	39.5
1970	33.9	12.5	25.0	48.7
1975	38.9	14.8	28.2	51.7
1979	42.4	16.8	30.1	53.6

The principal stages in electrification of our country's railroads are given in Table 3 below, while Table 4 shows the characteristics of electricity supply systems.

Table 3. Principal Stages in Electrification

Years	Name of Stage or Section	Length, km	Remarks
1912	St. Petersburg — Oraniyenbaum	-	Work begun on electrification of the sector; stopped in connection with the beginning of World War I
1926	First list of railroads being electrified	-	The Council of Labor and Defense, in conformity with the Goelro plan, ratified the first lists of lines to be electrified before 1930; their total length was 372 km.
1926	Baku — Sabunchi — Surakhany	19	First suburban traffic sector, electrified with 1.2 kv direct current
1929	Moscow — Mytishchi	17.7	Suburban traffic sector electrified on 1.5 kv direct current

[Table continued, next page]

[Table 3 continued]

Years	Name of Stage or Section	Length, km	Remarks
1932	Zestafoni — Khashuri	61.5	First sector for freight and passenger traffic, electrified on 3 kv direct current
1926-1941	Electrification of USSR railroads in the years of the first five-year plans	1,880	1,880 km of railroad were electrified, including 479 km in sectors with suburban traffic. The main electrified sectors were: Samtredia — Zestafoni, Khashuri — Tbilisi, Kizel — Chusovskaya — Goroblagodatskaya — Sverdlovsk, Kandalaksha — Murmansk, Zaporozh'ye — Dolgintsevo, Belovo — Novokuznetsk; suburban sectors in Moscow, Leningrad, and from Mineral'nyye Vody to Kislovodsk
1941-1945	Electrification of USSR railroads during the Great Patriotic War	446	The railroads switched to electric traction were chiefly in the Urals. Of 629 kilometers of rail lines dismantled in connection with the temporary occupation of part of Soviet territory, 339 kilometers were restored as the territory was liberated from the enemy.
1946-1955	Electrification of USSR railroads in the postwar years	3,331	Restoration of rail sectors dismantled during the war years was completed. The total length of electrified lines at the end of 1955 was 5,400 kilometers. The most important electrified sectors were the following: Zlatoust — Berdyaush — Kropachevo — Dema; Kizil — Yayava — Solikamsk; Goroblagodatskaya — Nadezhdinsk — Bogoslovsk; Novosibirsk — Inskaya — Chulymskaya; Barabinsk — Tatartskaya-Moskovka; Omsk — Isil'-Kul', and Baku — Baladzhary — Khurdalan; suburban sectors in Moscow, Leningrad, Kiev, Riga, and Baku.
1956-1960	Electrification of USSR railroads in the Sixth Five-Year Plan	8,437	The length of electrified USSR railroads at the end of 1960 was 13,800 kilometers. The following important sectors were switched to electric traction: Irkutsk — Slyudyanka; Zima — Mariinsk; Kurgan — Makushino; Omsk — Nazyvayevskaya; Bolotanya — Tayga; Kinel' — Pokhvistnevo — Abdulino; Kuybyshev — Syzran'; Chelyabinsk — Shumikha; Klin — Kalinin; Serpukhov — Tula — Skuratovo; Orel — Kursk; Ilovayskoye — Slavyansk — Lozovaya; Sochi — Veseloye — Gudauta.

[Table 3 continued, next page]

[Table 3 continued]

Years	Name of Stage or Section	Length, km	Remarks
1936	Ozherel'ye — Pavelets	137	Electrification of an experimental sector using 22 kv alternating current was completed.
1959	Chernorechenskaya — Krasnoyarsk — Klyukvenaya (Uyar)	241	The beginning of extensive electrification of railroads using the single-phase current system with a voltage of 25 kv industrial frequency. In 1960-1961 electrification of the 1,222 km sector from Mariinsk to Zima using alternating current was completed.
1961-1965	Electrification of USSR railroads in the Seventh Five-Year Plan	10,812	The length of electrified railroads at the end of 1965 reached 24,900 km. The most important sectors switched to electric traction were: Shalya — Kungur — Perm' — Vereshchagino; Ilovayskoye — Rostov — Armavir — Belorechenskaya; Novokuznetsk — Cherepanovo — Barnaul; Pyatikhatki — Mironovka — Fastov; Yaroslavl' — Danilov; Lavochne — Stryy; Malaya Vishera — Kalinin; Abakan — Tayshet; Kirov — Balezino; Tselinograd — Karaganda; Sukhinichi — Bryansk; Penza — Povorino.
1961	Moscow — Baikal	5,500	The sector from Makushino to Isil'-Kul' was put into operation, completing electrification of the world's longest trunk line (in 1973 the line was extended to Karymskaya, making the total length 6,300 km).
1962	Leningrad — Leninakan	3,500	With the launching of the sectors from Malaya Vishera to Kalinin and Kavkazskaya to Belorechenskaya, electrification of this trunk line was completed (it was later extended to Yerevan, and then on to Sevan, increasing its total length to 3,611 km).
1964	Moscow — Gor'kiy — Sverdlovsk	1,748	With launching of the Kirov — Balezino sector, electrification of the trunk line from Moscow through Gor'kiy to Sverdlovsk was completed.
1966-1970	Electrification of USSR railroads in the Eighth Five-Year Plan	8,597	At the end of 1970 the length of electrified railroads was 33,900 km. The most important sectors switched to electric traction were the following: Slyudnyanka — Ulan-Ude — Petrovskiy Zavod; Tselinograd — Ashbasar — Tobol; L'vov — Sambor — Chop; Bryansk — Kiev;

[Table 3 continued, next page]

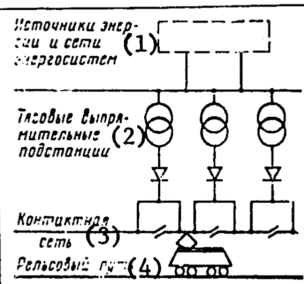
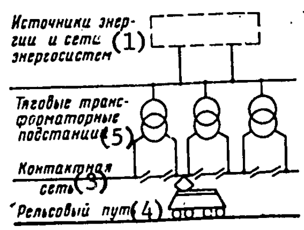
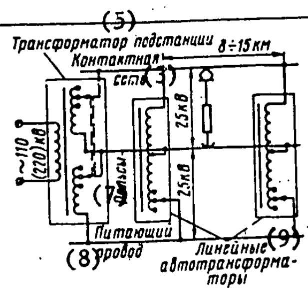
[Table 3 continued]

Years	Name of Stage or Section	Length, km	Remarks
			Georgiu-Dezh — Valuyki; Danilov — Buy — Svecha; Bogdanovich — Smychka; Krasnoarmeyskoye — Smychka; Krasnoarmeyskoye — Dneprodzerzhinsk; Baku — Udzhary, Yurga — Topki — Leninsk-Kuznetskiy, Minsk rail center.
1967	Moscow — Kiev — L'vov — Chop	1,712	Electrification of this internationally important trunk line was completed. It is connected to electrified railroads in Czechoslovakia and Poland.
1971-1975	Electrification of USSR railroads in the Ninth Five-Year Plan	4,797	At the end of 1975 the total length of electrified railroads was 38,900 km. The most important sectors electrified during these years were the following: Kurgan — Sverdlovsk; Sverdlovsk — Bogdanovich — Kandry; Petrovskiy Zavod — Chita — Karymskaya; Kandalaksha — Loukhi; Borodino — Vyaz'ma; Sevan — Shorzha — Zod; Beloretsk — Karlaman; and, suburban sectors in Kazan', Tashkent, and Vilnius.
1976-1980	Electrification of USSR railroads in the Tenth Five-Year Plan	4,500 (Plan)	After the Kazatin — Vinnitsa sector was switched to electric traction ahead of schedule, the total length of electrified lines by the 60th anniversary of the Great October Socialist Revolution reached 40,000 km. The most important electrified lines were: Srednesibirskaya — Irtyshskoye — Omsk; Prokhladnaya — Makhachkala — Derbent; Vyaz'ma — Orsha; Khabarovsk — Bira; Tselinograd — Ekibastuz; Bogdanovich — Tyumen'; and, Kazatin — Zhmerinka On 1 January 1980 the total length of electrified railroads was 42,400 km.

During the first years of electrification of USSR railroads a direct current system using voltages of 1.5 and 3 kilovolts was employed. In 1947 the decision was made to stop electrification using 1.5 kilovolts and switch lines electrified earlier to 3 kilovolts. This switch was completed in 1957.

Beginning in 1959 the 25-kilovolt alternating current system began to be used extensively along with the 3-kilovolt direct current system (see Table 4 below). In 1979 a sector from Vyaz'ma to Orsha (295 kilometers) was put into experimental operation using a power supply system of 2 × 25 kilovolts of alternating current.

Table 4. Characteristics of the Electricity Supply Systems of Electric Railroads

A	B	C	D	E	F
Direct Current		3,0	18—20	440—560	11,5
Alternating Current		25	45—50	140	7,5
Alternating Current		2×25	70—90	260	9,5

Key:
- (A) Electric Traction Systems;
- (B) Schematic Diagram;
- (C) Nominal Voltage, kv;
- (D) Distance Between Traction Substations, km;
- (E) Cross-Section of Wires of Catenary System of One Line, mm^2;
- (F) Expenditure of Nonferrous Metals per Kilometer of Operating Double-Track Line, tons;
- (1) Energy Sources and Power System Grids;
- (2) Traction Rectifier Substations;
- (3) Catenary System;
- (4) Track;
- (5) Traction Transformer Substations;
- (6) Substation Transformer;
- (7) Rails;
- (8) Feed Wire;
- (9) Line Autotransformers.

The transportation energy system has developed at a fast rate along with the transition of railroads to electric traction. Until 1950 railroads built their own small electric power plants. In subsequent years these unprofitable power plants would close and railroad consumers were connected in to state power systems. Table 5 below gives figures on consumption of electricity (without electric traction) by the railroads. Electricity is transferred to nontransportation users located in regions adjacent to the railroad through the distribution networks (see Table 6 below) and traction substations of the Ministry of Railroads. Electricity consumption for train traction is growing steadily. Table 7 below gives data on this for the period between 1955 and 1979.

Table 5. Electricity Consumption by Nontraction Railroad Consumers

Years	Energy Use by Railroad Consumers, millions of kwt-hrs	Percentage of Electricity Received from General-Use Power Plants	Number of Railroad Power Plants (operating)
1913	52	10	180
1925	71	20	431
1935	710	40	484
1940	853	50	1,277
1950	1,414	52	1,529
1960	3,338	59	1,244
1970	6,240	92	122
1975	7,704	95	54
1979	10,168	99.4	38

Table 6. Development of Distribution Grids

Years	Length of High-Voltage 6, 10, and 35 kv Lines, km	Length of Low Voltage Electric Grids, km	Number of Transformer Substations
1955	6,700	20,800	2,300
1960	14,600	35,400	6,500
1965	58,700	50,500	10,700
1970	99,600	57,000	48,200
1975	125,000	60,900	75,800
1979	161,800	66,400	111,300

Table 7. Total Electricity Consumption (Including for Electric Traction).

Indicators	1955	1960	1965	1970	1975	1979
Consumption of Electricity by Railroad Transportation, billions of kwt-hrs	6.0	13.7	26.7	38.0	48.9	55.85
Included in Above, Electric Traction	3.05	10.4	22.2	32.0	41.5	45.7
Production of Electricity by Ministry of Railroads' Own Power Plants, millions of kwt-hrs	1,528.5	1,387	969	541.2	415.2	338.8
Electricity Transferred to Nontransportation Consumers Through Distribution Grids and Traction Substations of Ministry of Railroads, billions of kwt-hrs	0.7	2.03	5.9	11.7	20.0	24.9
Included in Above, for Agriculture	0.08	0.3	1.15	3.7	7.0	8.3
Specific Consumption of Electricity for Train Traction, thousands of kwt-hrs/km	620	740	970	980	1,050	1,110

Many years of experience with operating electric traction have demonstrated its great technical and economic advantages not only over steam traction, but also over diesel traction.

The development of the transportation electrical power system fostered widespread introduction of automatic blocking, centralized dispatching, electrical centralization of switches, and automation of crossings. In addition to increasing traffic and carrying capacity, this led to growth in labor productivity, significantly improved train traffic safety, and facilitated a rise in the professional and technical level of railroad workers.

The electric traction power supply units and the transportation energy system are an important branch of railroad transportation. The basic line of future development for it will be raising the technical level and operating reliability by using more sophisticated equipment and modern materials, extensive employment of various regulating devices, introduction of automation and remote control, improvements in protective means, development and construction of diagnostic units to monitor the condition of structures and equipment, and raising the level of mechanization for repair and operations work.

Table of Contents

11,176
CSO: 1829/192

RAILROAD

UDC 621.331:621.311(031)

NEW HANDBOOK ON ELECTRICITY SUPPLY TO RAILROADS--VOL II

Moscow SPRAVOCHNIK PO ELEKTROSNABZHENIYU ZHELEZNYKH DOROG in Russian, Vol 2, 1981 (signed to press 3 Mar 81) pp 1-2, 389-392

[Title page, annotation, and table of contents from book "Handbook on Electricity Supply to Railroads", edited by Professor K. G. Markvardt, doctor of technical sciences, Izdatel'stvo "Transport", 11,000 copies, 392 pages]

[Text] Title Page

Title: "Spravochnik po Elektroshabzheniyu Zheleznykh Dorog v Dvukh Tomakh" [Handbook on Electricity Supply to Railroads, in two volumes]

Editor: Professor K. G. Markvardt, doctor of technical sciences

Place and Date of Publication: Moscow, 1981

Publisher: Izdatel'stvo "Transport"

Annotation

Volume two of the handbook presents materials on the layout, design, and diagrams of traction substations, and the selection and arrangement of electrical equipment. It summarizes the practical specifications of automation, remote control, and relay protection devices, and gives materials on calculations and installations of the catenary system. The material on installation and operation of electricity supply devices is singled out in separate chapters.

The handbook is intended for engineering-technical workers in railroad transportation who are involved with the operation, installation, and design of railroad electricity supply devices. It may also be useful to students at higher educational institutions and tekhnikums. The book has 225 illustrations, 261 tables, and 27 bibliographic entries.

The book was written as follows: Chapter 17 — Yu. N. Makas, Chapter 18 and sections 19.5, 19.9-19.12, 20.3, 20.7, 21.1., and 21.2 — V. M. Erlikh; section 20.4 — V. M. Erlikh and I. B. Mostinskiy; sections 19.1-19.4, 19.6-19.8, 20.1, and 20.2 — I. K. Davydova; section 20.5 — L. I. Shukhatovich; section 20.6 — V. A. Zimakov, L. I. Shukhatovich, and V. M. Erlikh; sections 21.3-21.5 — N. D. Sukhoprudskiy, V. Ya. Ovlasyuk, and G. M. Korsakov; sections 22.1, 22.4, and 26.4 — Yu. I. Goroshkov; sections 22.2 and 23.5 — Yu. V. Flink; section 22.3 — Yu. V. Kazantsev; sections 22.5, 23.1-23.5, and Chapter 24 — K. G. Markvardt;

sections 25.1, 25.2, and 25.3 — I. A. Belyayev; sections 23.6, 23.7, 25.4, and 25.5 — A. V. Frayfel'd; section 25.4 — R. Sh. Kalandadze; section 25.6 — V. A. Vologin; sections 26.1-26.3 and 26.5 — Ye. A. Baranov; sections 27.1-27.5, 27.7-27.9 — G. N. Brod; section 27.6 — G. G. Engel's; Chapter 28 — A. N. Shemyakin; Chapter 29 — P. M. Shilkin; Chapter 30 — N. A. Bondarev; chapters 31, 32, and 33 — L. S. Panfil'; sections 34.1, 34.2, and 34.7-34.14 — A. S. Markov; sections 34.3-34.6 — V. P. Luppov; Chapter 35 — L. D. Radosel'skiy.

The editorial board was composed of: V. A. Kislyakov, G. G. Markvardt, A. S. Markov, V. N. Pupynin, N. D. Sukhoprudskiy, Yu. V. Flink, M. V. Khlopkov, P. M. Shilkin, and L. I. Shukhatovich.

The reviewers were: V. P. Shurygin, V. A. Zorin, L. I. Belov, A. I. Zaytsev, V. O. Degtyarev, V. N. Pupynin, V. S. Popov, V. S. Sukharev, Yu. Ye. Kuptsov, G. N. Brod, and A. A. Portselan.

Table of Contents

Page

11,176
CSO: 1829/192

MISCELLANEOUS

PLANNING, ORGANIZATIONAL PROBLEMS IN REDUCING TRANSPORTATION COSTS

Moscow VOPROSY EKONOMIKI in Russian No 3, Mar 82 pp 42-53

[Article by A. Mitaishvili: "Transportation Costs of the National Economy"]

[Text] The document "Basic Directions of Economic and Social Development of the USSR for 1981-1985 and the Period Until 1990" contemplates a decline in specific transportation costs and expenditure of resources to convey freight and passengers. Solving this problem is very important for the national economy. Transportation costs constitute a significant part of total production and consumption costs and are one of the significant factors affecting production efficiency.

Reducing specific transportation costs in the value of final output makes production less dependent on sources of raw material and fuel; it allows more rational location of production throughout the territory of the country and broader introduction of progressive forms of large-scale mass production. High specific transportation costs per unit of output retard growth in the level of specialization and cooperation, while by contrast when freight shipping is less expensive there are broader opportunities for production specialization and interregional cooperation.

K. Marx, analyzing capitalist production and circulation, observed that "transportation costs play too important a role"[1] in the circulation of capital, that absolute transportation costs, where other conditions are equal, increase the cost of the commodity by an amount directly proportional to the distance that the commodity is moved. In this situation the relative amount of the given cost is also directly proportional to the volume and weight of the commodity.

Under contemporary conditions reducing specific transportation expenditures is becoming increasingly important in connection with the large scale of our economy and the growing distances between extracting and manufacturing sectors. This is causing a rapid rise in the volume of shipping and freight turnover, and therefore also in transportation costs. The freight turnover of transportation in the USSR grew rapidly in the 1960's and 1970's. It reached 6.7 trillion ton-kilometers in 1980, 3.9 times the volume of freight turnover in 1960 and 1.7 times the 1970 figure. The freight turnover of USSR transportation is 35 percent greater

---

[1] K. Marx and F. Engels, "Soch." [Works], Vol 24, p 169

than the freight turnover of U. S. transportation. This can be explained by the territorial features of the country and how production and distribution are organized.

In the 11th Five-Year Plan the volume of shipping work by transportation will increase 22 percent over 1980, reaching more than 8.2 trillion ton-kilometers in 1985. The territorial location of production and consumption has a decisive effect on the volume of freight turnover by transportation. The development and economic circulation of natural resources, in particular fuel and energy resources, in the eastern and northern regions of the country and the enlargement of production chiefly by reconstruction and expansion of existing enterprises are linked to an enlargement of the distribution (shipping) zone of the output produced, deepening economic ties among enterprises and regions of the country, and growth in shipping distance. This way of increasing production leads to growth in freight turnover and transportation cost and is economically justified if a decline in aggregate specific expenditures for production and circulation is secured.

Consideration of the transportation factor in siting, concentrating, and specializing production requires knowledge of actual transportation costs and mastery of the methods of calculating them in the future. Unfortunately, we do not at the present time have a scientifically substantiated and clearcut system of planning and recording actual transportation costs in the national economy. Determination of national economic transportation costs and singling out their role in the country's economy is made more difficult because certain methodological and organizational questions have not been solved. This is related to the fact that the current system of managing transportation and planning and recording transportation costs does not fully correspond to the economic nature of transportation as a sector of material production. It should be noted that economists do not disagree that freight transportation is an independent sector of material production and continues the process of production in the sphere of circulation and for the circulation sphere. In our opinion, however, the questions of delimiting the sphere of production and transportation as a sector of material production need greater clarification.

Transportation costs in the broad sense are the costs of national economic sectors related to moving articles both in the immediate process of production at enterprises (from the warehouse to the shop, within and among shops, and from the shop to the finished output warehouse) as well as among enterprises which are spatially remote from one another, which is the circulation sphere. K. Marx wrote that "movement of the object of labor and the means of labor and work force necessary to do this play an important role in any production process. For example, cotton is moved from the carding division to the spinning division and coal is lifted up out of the mine. The same phenomenon is observed on a larger scale when finished output is moved in the form of finished commodities from the independent place of production to another, spatially remote place. "Following transportation of products from the production site to another place there is also transportation of finished products from the production sphere to the consumption sphere."[2]

---

[2] Ibid., p 170.

Speaking of transportation as supporting spatial links, K. Marx pointed out that the circulation of commodities in space amounts to transporting them, and the transportation industry which carries on this circulation is an independent sector of production, differing in that it is a continuation of the production process in the sphere of circulation and for the circulation process.

The conveyance process in the circulation sphere consists of a series of operations: preparation of the freight for shipping, receiving it for shipping, loading it into means of transportation, taking it to the main line of the communications routes; movement itself, shipping along the line from the departure point to the destination; transshipping the freight from one type of means of transportation to another when it travels in mixed transportation involving two or more types of transportation; unloading at the destination point; and finally, delivering the freight to the customer's commodity warehouse. These operations in shipping finished output are transportation operations in the circulation sphere. Transportation costs consist of expenditures involved in the full cycle of the process of shipping freight from the finished output warehouse of the supplier to the customer's warehouse.

Transportation expenditures to move loads within an enterprise (industrial shipping) and in the circulation sphere (that is, between manufacturing enterprises and consumers) differ significantly in their economic nature. In the first case they are an element of the production process of the particular enterprise and support the production process. In this situation the enterprise's means of transportation are a part of the industrial process of production and take part in creating the physical product of labor. By their economic nature, therefore, the costs of industrial transportation belong with production costs and are included in them. But means of transportation that support the external spatial links of the enterprise continue the process of production in the circulation sphere and for circulation, regardless of whether they are legally independent. The production functioning of transportation does not create physical products of labor, although their cost goes up. Transportation costs as an independent sector belong to circulation costs, not to production costs. In practice, however, there is no such clearcut delineation between the costs of internal transportation and the costs of transportation as a sector of material production. The transportation expenditures of the national economy are significantly understated, while production costs are substantially overstated.

The present system of planning and recording transportation costs of the national economy violates the economic principle of delimiting the sphere of immediate production from circulation. To some extent the structure of transportation management leads to this. In organizational terms, USSR transportation is divided into general-use transportation and departmental transportation.

The functions of general-use transportation as a sector of material production that combines the transportation ministries of the USSR into a system include only part of the industrial process of shipping, moving freight along the main transportation lines. The most labor-intensive initial and final operations of shipping — loading general-purpose means of transportation, hauling freight to the station (port) of the trunk communication line, unloading at the arrival point, and delivery of the freight to the customer's warehouse — are related to the circulation sphere and performed by departmental nongeneral-use industrial transportation. Expenditures for these operations are included in production costs, which distorts the true figure for transportation costs of the national economy. Expenditures for these transportation operations are not planned and are not recorded in a separate expenditure sub-heading.

It seems to us that the category transportation costs of the national economy should include expenditures for performance of all the operations of the shipping process, beginning with loading the means of transportation and ending with unloading it. This necessitates transferring what is called external industrial transportation to the ministries in charge of general-use transportation. Pipeline transportation should also be included with general-use transportation serving the circulation sphere. Production enterprises and organizations must be left the essential means of transportation to perform internal industrial shipping. Expenditures involved in this kind of shipping should be included in production expenditures.

Calculations made at the Institute of Comprehensive Transportation Problems covering all the operations of the shipping process showed that the present system of planning and recording fails to cover about 25-30 percent of national economic transportation costs.

The figures given in Table 1 below characterize the relationships of growth in gross public product, freight turnover, and transportation costs calculated on the basis of the above-mentioned principle of delimiting the spheres of production and circulation.

Table 1. Growth in Gross Social Product, Freight Turnover, and Transportation Costs of the National Economy

	1970	1975	1980	1980 % of 1970
Gross Social Product, billions of rubles	643	862	1,072	166.7
Freight Turnover of All Types of Transportation, billions of ton-kilometers	3,955	5,482	6,772	171.2
Transportation Costs Related to Circulation Costs, in billions of rubles	28	41	55	196.3
Included in Above, General-Use Transportation, billions of rubles	19.2	26.9	33.5	174.4
Specific Transportation Costs, kopecks per ruble of gross social product	4.35	4.76	5.1	117.2
Included in Above, General-Use Transportation, kopecks per ruble of gross social product	2.98	3.10	3.12	104.4

Total calculated transportation costs of the national economy in 1980 were 55 billion rubles, almost four times greater than in 1960 and 1.96 times the 1970 figure. The growth rate of national economic transportation costs in the 1970 figure exceeded the growth rate of gross public product and freight turnover. In 1980 when gross social product had increased 1.68 times over 1970 and freight turnover 1.71 times, transportation costs were up 1.96 times. Specific transportation costs per ruble of gross social product produced increased. Specific transportation costs per ruble of gross social product were about 5.1 kopecks in 1980 compared to 4.35 in 1970. If we consider that during this time the structure of production changed significantly with an increase in the proportion of output with high costs, the growth and transportation expenditures per unit in physical terms would be even higher.

There are various reasons for the faster growth of transportation costs. The level of national economic transportation costs and their specific level depend first of all on the location of production and consumption, on the degree of concentration, specialization, and cooperation in production. Secondly, they depend on the system of the material-technical supply and marketing and the efficiency of transportation-economic links. In the third place, they depend on the structure of the transportation system itself and the distribution of shipping among different forms of transportation. Finally, they depend on the costs of transportation enterprises, which determine the level of shipping rates, and price formation policy for transportation services.

During the period under consideration there has been a significant change in the location of production, particularly the extracting sectors, and this has increased shipping distances. Most (about 90 percent) of fuel and energy resources are concentrated in Siberia, Kazakhstan, Central Asia, and the Far East, while the fuel consuming sectors are located chiefly in the European part of the country and the Urals. These regions have about 82 percent of the manufacturing sectors in national production. Their needs for fuel and energy resources are supplied by import from the eastern parts of the country.

In 1980 the average economic distance of shipments for the transportation system as a whole rose to 740 kilometers compared to 595 in 1970 and 460 in 1960. The greatest distances in internal shipping were in pipeline and rail transportation where the figures in 1980 were, respectively, 1,900 and 923 kilometers. If the savings on production and distribution costs covers the increase in transportation costs, then the increase in shipping distance and the growth in transportation costs that it causes cannot be considered a negative phenomenon.

F. Engels wrote that a society which has been liberated from the bonds of capitalist production, "having raised a new generation of comprehensively developed producers who understand the scientific foundations of all industrial production and have studied a whole range of production sectors in practice from start to finish, will create a new production force which will more than outweigh the labor of shipping raw materials and fuel from more remote points."[3] Cutting transportation expenditures is not a goal in itself. For example, when planning the

[3] Ibid., Vol 20, p 308.

location of petroleum refineries the question reviewed was selecting the optimal type of enterprise. Technical-economic calculations were made taking account of all elements of expenditures for both production and sales. The optimal variation was one with a large volume of refining where transportation costs increased more than 2.5 times. In the other alternative refining capacity was scarcely half as great, while the shipping distances for petroleum were 920 and 400 kilometers respectively. But this does not mean that we should not try to reduce economically unsound shipping when deciding questions of production siting, specialization, and cooperation. Establishing rational transportation-economic ties and reducing too-long, counter, and repeated shipments in planning the production and delivery of output is one of the important steps to reduce specific transportation costs and expenditure of resources for shipping.

There were also changes in the very structure of transportation in the 1970's and this influenced the level of costs. The share of railroad transportation in total freight turnover of the transportation system dropped from 63.1 percent in 1970 to 50.7 percent in 1980, as did the shares of maritime transportation (from 16.6 to 12.3 percent) and river transportation (from 4.4 to 3.6 percent). The share of pipeline and motor vehicle transportation in total freight turnover increased. These changes were reflected in the level of transportation costs because each type of transportation has its own characteristic level of prime cost of shipping and an average earning rate corresponding to it. The earning rates in motor vehicle and air transportation are much higher than in rail, water, and pipeline transportation. The earning rate in air transportation is about 190 kopecks per 10 ton-kilometers and 85 kopecks in motor vehicle transportation; for railroad transportation the figure is four kopecks, and in maritime transportation it is about five kopecks. The changes that took place in the structure of transportation, in particular the increase in the proportion of the most expensive type of transportation (motor vehicles) and a decline in the share of the least expensive forms (rail and water) led to the faster growth of transportation costs. It should be noted here that motor vehicle transportation accounted for about 45 percent of transportation costs in 1980 while its share of total freight turnover was about seven percent; the corresponding figures for the share of the railroads were 36 and 50 percent.

Optimizing the structure of the country's transportation system and rational distribution of freight shipments among different types of transportation are important reserves for reducing transportation costs in the national economy. Accelerated development of pipeline transportation for pumping petroleum products is very important. At the present time, however, the bulk of shipments of petroleum products continue to go by rail transportation, even though pumping petroleum through pipelines is much cheaper. Water transportation must also be used intensively for shipping bulk cargo. The use of motor vehicle freight transportation should be limited primarily to shipping within regions and cities. Moreover, new forms of transportation such as pneumatic container, pulp-pipeline, and conveyor transportation should be used extensively for such shipments in place of labor-intensive and fuel-intensive motor vehicle transportation. Motor vehicle transportation should be consolidated (above all in the cities) in unified general-use vehicle transportation enterprises.

At the present time 85 percent of the total truck fleet in the country is departmental transportation (industry, construction, and agriculture). Industrial, construction, and agricultural enterprises and organizations use a significant share of the vehicles belonging to them for intercity shipping. In 1980 the total freight turnover of motor vehicle transportation in the national economy was 432 billion ton-kilometers, which included 100 billion ton-kilometers for intercity shipping (with a prime cost of shipping of 60 kopecks per 10 ton-kilometers). The prime cost of intercity shipping in general-use vehicle transportation is about 38 kopecks for 10 ton-kilometers, which is 36 percent lower than the prime cost of such shipment by departmental transportation. If all intercity (that is, non-production) shipping done in 1980 by departmental vehicle transportation had been done by general-use vehicle transportation enterprises the national economy would have saved about 2.5 billion rubles.

The comparatively high level of transportation costs in the national economy is also linked, in addition to growth in shipping distance, to the structure of means of production consumed, material-intensiveness, and the quality of preparation for shipping. In 1980 transportation costs represented the following percentages of the cost of output in the extracting sectors: mineral building materials — 39.6 percent; products of petroleum extraction — 29.4 percent; logging products — 23.0 percent; ferrous metal ores and nonore raw material — 20.0; coal — 18.1 percent; products of the mining chemical industry — 17.2 percent; peat — 15 percent.

Transportation-intensive physical raw materials predominate in the composition of consumable means of production; they account for more than 70 percent of the total volume of natural resources put into production circulation. This is related not only to the growth in industrial refining of mineral products, but chiefly to the worsening quality of raw material being extracted. In 1980 ferrous metallurgy plants received 34 percent of commodity output from an extraction figure of about 500 million tons of raw iron ore, whereas in 1965 the figure was 40.8 percent. The iron content in commodity ore presented to transportation for shipping was 58.5 percent after enrichment. In 1980 24 percent of the coal mined at underground mines was worthless rock compared to 21 percent in 1965. The level of concentration of coal extracted in 1980 did not exceed 55 percent. Shipment of round timber over long distances from the North and East to the European part of the country for milling increases the volume of transportation work by 30-35 percent in comparison with shipping crosscut wood. A significant part of mineral building materials are not dressed in advance at the extraction point. This process has been transferred to the places where they are put to production use, and as a result the volume of transportation work and transportation costs increased more than 9-10 percent.

Shipment of raw material without preliminary processing requires additional means of transportation: railroad cars, ships, and motor vehicles. The rolling stock requirement of the railroads for shipping unprepared coal and ore increases 35-40 percent, while for round timber (instead of sawtimber) it is 30-35 percent higher, for unstacked scrap metal it is almost three times as high, and for simple superphosphate it more than doubles. This leads to an increase in both current operating costs of transportation and capital investment.

The material-intensity of production also influences the level of transportation costs. In recent years our country has stepped up the campaign for economical use of fuel-energy resources, metal, building materials, lumber, and products of the chemical industry. But expenditure of the principal types of primary materials and fuel in the USSR is still much higher than in the industrially developed capitalist countries. Calculations show that reducing the material-intensiveness of production and construction in our country to the level achieved by industrially developed foreign countries would have enabled us to reduce the volume of transportation work and transportation costs in 1980 by about 18-20 percent. Thus, improving the quality of materials and fuel being shipped by preparing them and reducing the material-intensiveness of production is an important way to reduce the transportation costs of the national economy.

Planning shipping and economic links and eliminating irrational shipping has a special role to play in reducing transportation costs. The questions of improving the planning of freight shipment must be resolved not as intrasectorial transportation problems, but as parts of the overall national economic problem. In this case planning national economic needs for shipping must be based on material-technical supply plans and delivery plans worked out by the appropriate agencies. In turn, material-technical supply agencies should have territorial balances of production and consumption whose development was contemplated by the July 1979 decree of the CPSU Central Committee and USSR Council of Ministers on improving the economic mechanism. But these balances are not being produced yet. Development of territorial balances of production and consumption is necessary not only to insure integrated development of transportation, but also for rational siting of productive forces in the country. The need for freight shipping should not be determined on the basis of the requests from freight shipping ministries and departments, as is the case today, but rather on the basis of a plan that assigns suppliers to customers. The time has come to assign material-technical supply and marketing agencies to present transportation ministries and their local organizations with freight shipping demands indicating the loading point (shipping station or port) and unloading point (destination station or port) with a distribution of shipments by shippers and receivers. On the basis of these papers the transportation ministries must compile plans for the freight to travel from the supplier to the consumer directly or in mixed transportation involving two or several types of transportation. The choice of the shipping plan should be based on minimum social transportation expenditures. Material-technical supply and marketing agencies must be materially accountable to transportation for performance of shipping demands, just as transportation must be responsible for delivery of freight at a certain time in the required volume.

Economic links for delivery of output are established by material-technical supply agencies, and transportation carries out delivery plans and carries freight to the consumers according to their schedule-orders. Therefore, shipping costs should be normed and planned by material-technical supply agencies, not by freight shippers or receivers. With the current system of franking (prepayment) of prices the freight receiver cannot influence the choice of supplier enterprise, type of transportation, and route of travel of the freight because this is the function of material-technical supply and marketing agencies. The freight receiver pays the actual transportation costs, whose level is determined depending on prepayment of prices by the freight shipper or by material-technical supply and marketing agencies. But material-technical supply agencies and freight shippers do not have an economic interest in cutting transportation costs because expenditures for shipping are fully repaid by the receiver of the shipment.

At the present time ministries do not plan and record transportation costs of production associations and organizations as an independent indicator. Under the current system of costing industrial output transportation expenditures for delivery of material resources are included in the cost of the raw and processed materials and fuel being purchased, while expenditures incident to the sale of the finished output are recorded in general marketing expenditures. This kind of planning and accounting makes it more difficult to monitor the use of resources for freight shipment and diminishes the possibility of analyzing, identifying, and using existing reserves to cut transportation costs. The present system does not allow us to determine the true magnitude and dynamics of aggregate transportation costs of the national economy.

In our opinion, it would be wise to single out transportation costs as an independent expenditure subheading in planning, accounting for, and reporting circulation costs. Norms should be established for them by production sectors. Appropriate changes must also be made in existing methodological instructions and basic statutes on planning and recording the prime cost of output. The methodological instructions must envision differentiation of transportation costs according to a number of characteristics, above all the economic characteristic. Material resources that are brought to the enterprise and sale of finished output (including all elements of expenditures related to delivering the freight from the supplier's warehouse to the consumer and with loading-unloading work) must be classified as circulation costs. In this case expenditures for internal industrial shipping should be put in a special sub-heading and related to production expenditures.

The level of national economic transportation expenditures is directly dependent on expenditure of material resources for shipping freight. In 1980 expenditures of material resources in general-use transportation were 55.2 percent of the prime cost of shipping freight (including depreciation deductions) in rail transportation, 84 percent in maritime, 62.3 percent in river, 49 percent in motor vehicle, and 80.9 percent in petroleum pipeline transportation. In view of the high proportion of resource expenditures for shipping freight, transportation management bodies face the problem of searching for ways and means of reducing expenditures of material resources as much as possible. This was contemplated by the 1980 decree of the CPSU Central Committee and USSR Council of Ministers entitled "Intensification of Work on Economic and Rational Use of Raw Material, Fuel-Energy, and Other Material Resources." This is even more essential because during the 10th Five-Year Plan the specific proportions of material expenditures in the prime cost of freight shipping grew.

The increase in expenditure of resources for shipping results above all from shortcomings in the work of transportation. On the railroads this is seen in poor organization of the shipping process, relaxation of production and labor discipline, poor monitoring of adherence to train traffic schedules, and the imprecise work of all elements of the railroad system. All these things have led to a significant decline in the principal indicators of use of rolling stock.

In 1980 the technical and sector speed of freight trains declined compared to the level attained in 1970, the daily run of freight cars decreased, and downtime increased. As a result, the turnaround time for a freight car increased 22 percent in the same 10 years. This is equivalent to a decrease of 725 billion ton-kilometers in the carrying capacity of the railroads, which is 21 percent of the volume of freight turnover performed in 1980. The freight capacity of the rolling stock is not being fully used either. According to figures from the All-Union Scientific Research Institute of Railroad Transportation, one-quarter of the cars were underloaded by an average of two tons. The degree of loading of rolling stock is an indicator of its use and influences the level of expenditures that make up both the prime cost of shipping and national economic transportation costs. Raising the use coefficient of the freight capacity of rolling stock reduces transportation costs. Under the existing car tariff system when loading is increased the tariff payment per ton of freight decreases. Underloading of rolling stock accounts for about 200 million rubles of additional national economic transportation costs a year.

The indicators of use of the resources of maritime and river transportation have also declined. Productivity per ton of load capacity per day of operation in ton-miles in 1980 was 24 percent lower than in 1970. This is related to an increase in unproductive downtime in ports, a decrease in ship sailing speeds, and incomplete use of their load capacities. The situation is similar in river and motor vehicle transportation. The productivity of traction vessels in river transportation declined by 24.6 percent between 1970 and 1980, while for trucks (per average vehicle) the figure was 7.3 percent. All these things had a negative effect on the indicator of efficiency of use of fixed production capital, above all rolling stock. As Table 2 below shows, during the Tenth Five-Year Plan the output-capital ratio compared to the Ninth Five-Year Plan declined for all forms of transportation except pipelines.

Table 2. Output-Capital Ratio in Freight Shipping (ton-kilometers per ruble, in comparable prices)

	1970	1975	1980	1975 as % of 1970	1980 as % of 1975
All General-Use Transportation*	72.94	73.76	64.62	101.1	87.6
Included in above					
Railroad	71.85	79.27	69.44	110.3	87.6
Water	121.41	95.06	72.02	78.3	75.8
Motor Vehicle*	21.18	22.10	21.96	104.3	99.4
Pipeline	60.04	64.25	64.60	107.0	100.5

* Without considering the cost of highways.

As the figures in the table show, water transportation has the highest output-capital ratio. This indicator for motor vehicle transportation is about one-third of the average value for the transportation system as a whole. The figures in Table 2 illustrate that the output-capital ratio rose for all forms of transportation except water transportation in the Ninth Five-Year Plan. In the Tenth Five-Year Plan the output-capital ratio dropped appreciably in rail and water transportation. In motor vehicle and pipeline transportation in 1980 this indicator remained at about the 1975 level. In connection with structural changes in the transportation system as a whole for freight shipping, the output-capital ratio declined 12.4 percent in the Tenth Five-Year Plan. The worsening technical condition of rolling stock and the fleet has a significant impact on the decline in output-capital ratio. During the Tenth Five-Year Plan the value of the inoperable fleet in railroad transportation increased 1.8 times, while in river transportation it increased 1.6 times. The worsening of these indicators is also linked to disproportions that have taken shape in the development of the material-technical base of transportation. The essential reinforcement of the capacities of the existing railroad system, which was working at great intensity, was not accomplished. During this time the introduction of double-track and electrified lines decreased. The use of means of transportation is also being held back by inadequate development of the network of railroad stations, maritime and river ports, vehicle roads, and the repair base.

The significant growth in the cost of transportati .1 facilities being built in the northern and eastern regions of the country, the rise in the capital-intensiveness of structures, and the increasingly rigid social and ecological requirements also have a significant influence on the output-capital ratio. In the Tenth Five-Year Plan capital investment per kilometer of new railroad line, second tracks, vehicle roads, and for construction of maritime and river ports and trunk pipelines was 1.3-1.6 times more than similar costs in the Ninth Five-Year Plan.

Table 3. Specific Capital Investment in Construction of Transportation Facilities

	1971-1975	1976-1980	Rate Change (%)
New Railroad Lines, rubles/km	433,100	686,000	158.4
Second Tracks, rubles/km	263,500	376,000	142.7
Electrification of Railroads, rubles/km	136,500	139,000	101.5
Transshipment Complexes at Seaports, rubles/run. m	66,600	101,400	152. 3
Docks at River Ports, rubles/run. m	43,500	7.600	163.5
Motor Vehicle Roads, rubles/km:			
National	430,000	560,000	130.2
Republic	163,000	212,000	130.1
Oblast and Local	70,000	107,000	152.9

In 1980 the cost of fixed productive capital (without rolling stock) per kilometer of length of the railroads increased 11.2 percent over 1975, while the specific cost of hard-surface vehicle roads rose 16 percent.

Important steps to reduce transportation costs are working out measures to improve the system of the shipping process and making better use of the fixed productive capital of transportation together with raising the efficiency of use of all its resources.

Economical use of fuel and energy resources is a critical issue. Transportation is a major consumer of these resources, accounting for about 10 percent of total consumption of energy resources in the country. Technical re-equipping of transportation, replacement of steam traction with diesel traction on railroads and in water transportation, and the development of motor vehicle transportation led to a sharp increase in the use of light petroleum products, from 35 million to 130 million tons or more than 3.7 times between 1960 and 1980. In the postwar five-year plans transportation has attained relatively high efficiency of fuel use. The specific expenditure of standard fuel in USSR railroad transportation is considerably lower than in the United States, West Germany, France, and other industrially developed countries. In 1980 this figure for USSR railroads was 8.55 kilograms of standard fuel per thousand gross ton-kilometers, compared to 11.5 in the United States and 15.1 in West Germany.

The shortcomings noted above in use of rolling stock caused a certain decline in the indicators of fuel use in the 10th Five-Year Plan compared to the Ninth Five-Year Plan. On the country's railroads the specific expenditure of energy resources for electric traction increased from 124.0 kilowatt-hours per 10^4 gross ton-kilometers in 1970 to 127.2 in 1980; the corresponding figures for diesel traction were 48.4 kilograms of standard fuel per 10^4 gross ton-kilometers in 1970 to 53 in 1980. For shipment by diesel freighters in river transportation the specific norm of expenditures of standard fuel rose from 9.8 kilograms in 1973 to 12.5 kilograms in 1980. Refining the operations systems and improving the indicators of use of rolling stock by reducing downtime are major reserves for lowering actual specific expenditures of fuel-energy resources by transportation. The use of diesel-powered motor vehicles is a major reserve for lowering consumption of petroleum products. Diesels with efficiency rates that reach 38 percent consume 35-40 percent less fuel than standard engines. Calculations show that gasoline consumption could be reduced to approximately 30 million tons by full use of diesel motor vehicle transportation.[4] Reducing consumption of liquid fuel and preservation of the ecological balance demand that we step up work on the development of electric vehicles and switch to the use of liquefied gas. A number of industrially developed capitalist countries are planning to move from experimental production to large-series production of electric vehicles for passengers and freight shipping.

Improving the technical condition of highways is a significant factor in cutting fuel consumption. At the end of 1980 only 37 percent of the total system of

---

[4]See N. A. Balychev, "Reserves for Reducing Consumption of Fuel-Energy Resources in Transportation," TRUDY IKTP, Vyp 82, 1980, p 29.

1,340,000 kilometers of motor vehicle roads had improved surfaces; this was 510,000 kilometers. The low technical level of the roads causes an increase in fuel expenditures and in specific transportation costs of the national economy. Shipping on highways with asphalt and concrete surfaces requires 20-30 percent less fuel than shipping on unimproved roads. The prime cost of freight shipping on roads with asphalt and concrete surfaces is just two-fifths of the figure for roads with rock surfaces, and expenditures for road repair and maintenance are barely one-sixth as much.

National economic transportation costs are high because of losses and spoilage of freight during the transportation process. This figure reaches an impressive size. For example, coal losses are almost three percent (equivalent to losses of 2 million tons of coal), while for glass it is 10 percent (23 million square meters of glass), for bricks 13 percent (more than 2.7 billion bricks), for ore up to four percent (15-16 million tons of ferrous and nonferrous metal), and so on. Because delivery time of freight to customers increased in 1980, there was a rise in frozen material resources. The rise in national economic costs for this reason is more than 4 billion rubles. Unrecorded transportation costs resulting from losses and spoilage of freight in the transportation process and the lowered delivery speed run into billions of rubles. But plans do not envision indicators of the quality of shipping and transportation work and no such indicators are considered in evaluating the activities of transportation enterprises.

Solving a number of methodological and organizational questions for improving transportation cost planning and accounting and achieving savings of material resource expenditures for freight shipment by transportation are very important to reduce specific transportation costs of the national economy.

11,176
CSO: 1829/203

END