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22 October 1984

# USSR Report

TRANSPORTATION

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## USSR REPORT TRANSPORTATION

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## MOTOR VEHICLES AND HIGHWAYS

### MOSCOW'S FIRST NATURAL GAS FILLING STATION

Moscow MOSKOVSKAYA PRAVDA in Russian 9 Jun 84 p 1

[Article by V. Nechayev: "Gas-Powered Vehicle"]

[Text] Fact: In the capital, construction has been completed on the first gas-filling compressor station for refueling vehicles with compressed natural gas.

Commentary: Gas fuel is perfectly normal for the capital's motor transporters. By the end of this year, more than 10 thousand Glavmosavtotrans vehicles will be operating on liquefied propane-butane. This is not the first year that an entire network of filling stations for refueling this equipment has been operational in Moscow. The gas powered vehicles have performed excellently not only on city highways, but also on the roads of outlying areas, where Moscow drivers worked during the vegetable harvest.

And natural gas is an inexpensive fuel, the production of which last year in our country reached hundreds of billions of cubic meters--how suitable is it as a motor vehicle fuel?

Scientists' projections have shown that compressed natural gas not only is completely suitable as a replacement for expensive gasoline, but that it surpasses traditional motor vehicle fuel in terms of a number of operational qualities. It is sufficient to say that when natural gas is used the life of a motor is increased 1.5-fold, the cost of transport will be less than half as high, and every cubic meter of gas fuel saves the national economy at least one liter of scarce gasoline. In addition, compressed natural gas lessens the harmful effect of motor vehicle transport on the environment, and the use of this "ecological" fuel permits a sharp reduction in the effluent of the harmful products of combustion into the atmosphere.

At the beginning of the current five-year plan, at ZIL [Moscow Motor Vehicle Plant imeni I.A. Likhachev] and the Gorky motor vehicle plant, an experimental lot of trucks was produced that operate on compressed natural gas. Operational testing of this equipment began 3 years ago at Mostorgtrans directorate's integrated vehicle works No 41. Experimental operation of the gas-powered vehicles on transport of commercial cargoes confirmed the calculations of the designers. Today such vehicles number over 200 at Glavmosavtotrans enterprises.

It is clear that for widespread use of the new equipment an entire network of specialized filling stations is required. The first of these has been put up at the intersection of Kashirskoe Shosse and the Moscow ring road.

The blue fuel comes to the station from the Moscow refinery. But before the natural gas is dispensed into vehicle gas tanks it is cleansed of mechanical impurities and fluids. Powerful piston compressors installed at AGNKS [Motor Vehicle Gas-Filling Compressor Station] raise its pressure to 250 atmospheres. A system of tanks secured beneath the body of the vehicle holds 80 cubic meters of gas. The vehicle can go 200-230 kilometers on this fuel supply. Working in 3 shifts, the AGNKS collective can refuel 500 vehicles in a 24-hour period.

According to the calculations of specialists, broadening the use of natural gas as a motor vehicle fuel will permit a reduction of the liquid fuel requirement by five million tons per year overall in the country. Eight more such stations will go into operation in the capital by 1990.

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## MOTOR VEHICLES AND HIGHWAYS

### CONVERSION OF GAS WELLS TO FILLING STATIONS PROPOSED

Kiev RABOCHAYA GAZETA in Russian 10 Jun 84 p 1

[Article by E. Alikhanyan, Ratau correspondent, in the column "Fact and Commentary": "Filling Stations at Wells"]

[Text] Kiev--Unprofitable wells may, it turns out, provide millions in profits if they are turned into... filling stations. That is what scientists at the AN USSR [Ukrainian SSR Academy of Sciences] Institute of Gas say. On their recommendation, the construction of the first such filling station has been begun on the outskirts of Poltava.

Motor vehicles without gasoline are no longer a novelty on the roads of our country. Natural gas, compressed in special tanks to 200 atmospheres, serves as motor fuel for them. Having begun lot production of vehicles with this type of engine, specialists are anticipating not only a large savings in gasoline and oil, which will reduce the cost of transport to one third of the current cost. The new fuel will increase the life of motors and improve their operational characteristics. The environment will improve as well, as automobile exhaust will become many times cleaner.

Before the end of the five-year plan a million economical trucks will reinforce the country's motor vehicle fleets. This will save one fifth of all the gasoline used now.

"However, the construction of filling stations is costing quite a bit so far," says A.I. Pyatnichko, candidate of technical sciences and head of the department of the institute. "The injection of methane into tanks requires a large expenditure of electrical energy, the use of expensive compressor equipment, a system for purifying and drying gas, and storage reservoirs where it is kept under pressure. While in natural reservoirs at a depth of up to 3 kilometers, ready-to-use gas, compressed by nature to 300 atmospheres, waits to be used.

"Leading to it are seemingly unprofitable wells, of which there are several hundred in the Ukraine alone. Many of these reservoirs are located in busy places, near highways. It would suffice to install some simple equipment and vehicles could be refueled directly from the depths of the earth.



"The construction of compressorless stations that operate on the energy of the formation will be a half million rubles cheaper," concludes the scientist. "If they service only 500 vehicles a year, it means a savings of ten trainloads of gasoline and ten million cubic meters of industrial gas."

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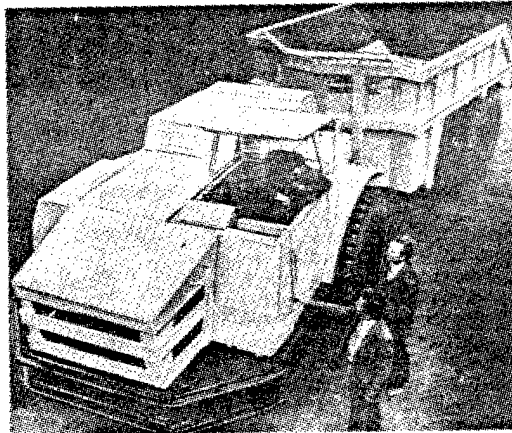
MOTOR VEHICLES AND HIGHWAYS

MOAZ-7405 DUMP TRUCK TRAIN PRODUCTION BEGINS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 8 Jul 84 p 1

[Text] Lot production of the MoAZ-7405 dump trailer truck has begun at the Mogilevskiy Motor Vehicle Plant imeni S.M. Kirov. It is designed for work in the mining industry and may be used in tunnel construction. The load capacity of the new vehicle is 22 tons. Its service life is increased by 1.5 thousand hours over its predecessor. The cabin has been improved significantly.

The trailer truck performed excellently during tests.



In the photograph: Engineers A. Palagin and V. Peklin, and chief of the design bureau, M. Mirkin. This is what the MoAZ-7405 looks like. Photo by S. Panov.

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## MOTOR VEHICLES AND HIGHWAYS

### FEATURES OF NEW MAZ-5432 TRUCK TRACTOR

Moscow ZA RULEM in Russian No 8, Aug 84 p 7

[Article: "Soviet Engineering: MAZ-5432 Truck Tractor"]

[Text] Two generations of trucks are now coming off assembly lines at the Minsk Motor Vehicle Factory. One generation consists of the MAZ-5335 side platform truck, the MAZ-5429 and MAZ-504V truck tractors, the MAZ-5549 dump truck and MAZ-509A timber truck. The second generation of truck tractors being produced simultaneously is made up of the three-axle MAZ-6422 and the two-axle MAZ-5432 (ZA RULEM, 1982, No 9).

The two new trucks reflect extensive standardization in their chassis, power trains and cabs. Their safety, comfort and productivity places them at the level of the best foreign models. Both vehicles satisfy All-Union and international standards. The new MAZ line features turbocharged YaMZ diesel engines. The MAZ-6422 is the first domestic vehicle to be equipped with a fairing placed on the cab roof for use with semitrailers.

The first lot of commercial MAZ-6422 trucks was produced in 1978 (ZA RULEM, 1979, No 4), while the first MAZ-5432s were built in 1982. Mass production of both versions began last year and thousands of this new line of MAZ over-the-road haulers are already in service.

The MAZ-5432's modern, turbocharged diesel engine and eight speed transmission with high gear overdrive (0.71:1 ratio) combine to increase average speed by 7 percent and reduce fuel consumption by 10 percent compared to the MAZ-504V. Radial tires also contribute to the increased economy of operation.

In the past, drivers have criticized the MAZ-504V's noise level and lack of comfort, especially on long hauls. These observations were carefully analyzed and studied during the design of the new truck line. The MAZ-5432 has a modern, comfortable cab and a curved windshield for outstanding visibility. Sound insulation has been markedly improved in the cab. The seats, with suspensions adjustable according to occupant weight, can be adjusted for height, backrest angle and distance from the dashboard.

Safety is greatly enhanced through the use of impact-absorbing materials on the instrument panel and internal cab components, a round rear-view mirror and safety steering column as well as state-of-the-art warning indicators and

highly effective, air-activated brakes. The braking system, produced under Westinghouse and Knorr licenses, has separate, independent circuits for the front and rear wheels.

The driver's job is made easier by a more effective power-steering unit, full synchromesh transmission, comfortable sleeping compartment and an improved cab heating/ventilation system.

Initial experience reports on the new trucks have validated the engineering solutions chosen and, at the same time, have pointed out isolated weaknesses. The factory was fully committed to solving these as rapidly as possible. In this spirit a series of measures have been adopted including improved wind-shield weatherstripping, a change in the way in which the final drive reduction gear housing is mounted on rear axle beam in order to eliminate lubricant leakage, a new means of machining the outer surfaces of the front brake drums, and fulltime monitoring of the action of the solenoid-operated air valve controlling the gearbox. This comprehensive fault-correction plan has been successful--at the end of 1983 the MAZ-5432 and MAZ-6422 were awarded the state Seal of Quality.

In the coming years the company will face the tasks of further improving the quality and durability of this new line as well as beginning the production of new models including a dump truck, timber hauler, stake-bodied truck, chassis for truck cranes, cement mixers, and other equipment, as well as truck tractors with YaMZ-236 engines. The Minsk Motor Vehicle Factory will fully change over to production of the new vehicle line at the beginning of the next 5-year plan.

Technical Specifications: MAZ-5432 tractor with MAZ-9397 semitrailer

#### General

Curb weight: (tractor) 7050 kg; (tractor/trailer combination) 13,750 kg  
Combination load capacity: 10,000 kg  
Tractor drive arrangement: 4x2  
Top speed: 88 km/h  
Fuel capacity: 250 liters  
Rated fuel economy at 60 km/h: 37.5 liters/100 km  
Service life prior to first major overhaul: 320,000 km  
Tires: 300-508R

#### Dimensions

Length: (tractor) 6050mm; (combination) 14,525 mm  
Width: 2500 mm  
Height: (tractor) 2970 mm; (combination) 3740 mm  
Wheelbase: (tractor) 3550 mm; (semitrailer) 7500 mm; (trailer bogie) 1540 mm  
Track: (front axle) 2002 mm; (rear axle) 1792 mm; (semitrailer axle) 1801 mm

## Engine

Type: YaMZ-238P

Number of cylinders: 8

Displacement: 14,860 cm<sup>3</sup>

Power: 280 HP (206 kW) at 2100 rpm

Maximum torque: 105 kgf-m at 1500 rpm

## Drive Train

Clutch: dual disc, dry-type

Number of gears: 8

Synchromesh: on all forward gears

Final drive: separated; central reduction unit with beveled pinions; planetary  
type wheel units

Final drive ratio: 6.33

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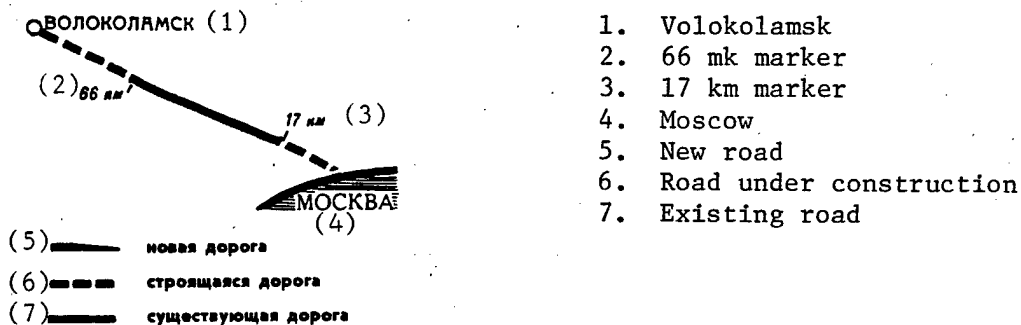
## MOTOR VEHICLES AND HIGHWAYS

### RECENT HIGHWAY, BRIDGE OPENINGS CHRONICLED

Moscow ZA RULEM in Russian No 8, Aug 84 p 17

[Excerpts from column "Highway Chronicle"]

[Excerpts] The builders of the new Moscow-Riga main highway have opened two contiguous segments with a total length of 17 kilometers. This construction project is unique in that work began in the middle of the route rather than at the first kilometer mark as is normal practice. This decision was made in order to speed relief of the heavily traveled Volokolamsk highway. At present the new highway is open for traffic between the 17th and 66th kilometer points.



In one of the most larger oblasts of the Nonchernozem region, the Vologda, a road has been opened between Vologda and Totma, connecting the remote farming rayons of Chekshino and Totma. Additionally, this road connects these areas to Vologda (since there already is a road between the oblast center and Chekshino). The result of the multiyear project carried out by the Vologodavtodor [Vologda Auto Highway] Construction Collective is a new route of 153 kilometers, including access roads to populated areas. This stretch will play an important role in the future economic and social development of these rayons.

Workers of the 18th Ulyanovsk Bridge Construction Authority gave residents of the isolated Mordovian ASSR agricultural rayon of Tengushevo a fine gift--a 300-meter steel and reinforced concrete highway bridge connecting the banks of the deep, unruly Moksha River. The new structure was erected to replace a temporary bridge which had to be dismantled during the bad road season. The new bridge will ensure year-round travel between the rayon, the capital of the republic, Saransk, other rayons and railway stations.



1. Velsk
2. Totma
3. Syamzha
4. Pogorelovo
5. Biryakovo
6. Chekshino
7. Kadnikovo
8. Vologda

In Dagestan, a 10-kilometer section of the road under construction between Kizlyar and Terekli-Mekteb was opened ahead of schedule. This route is especially important for the future development of the republic's animal husbandry.

The road connects Dagestan's third largest city, Kizlyar, with Terekli-Mekteb, a major center of the Nogaysk Rayon whose plains make up the winter pasture for most of the republic. In addition, once completed this road will provide easy access to the Astrakhan'-Kizlyar republic highway from isolated rayons in the region.



1. to Astrakhan
2. Tarumovka
3. Terekli-Mekteb
4. to Grozniy
5. Kizlyar
6. Kraynovka
7. Caspian Sea

Also in Dagestan, the 8th Rostov Bridge Construction Authority completed a large highway bridge across the Sulak River. The new structure, over 220 meters in length and with a width of 12 meters, is part of the Makhachkala-Glavsulak-Kislyar road, which in the near future will connect into the Baku-Makhachkala-Astrakhan national highway.

Preliminary calculations reveal that the opening of this new bridge will give the republic a daily savings of 150,000 rubles by shortening the distance between Makhachkala and Kizlyar by 50 kilometers. Prior to construction of this bridge, vehicles traveling between the Caspian area and northern Dagestan, at a rate exceeding 5000 per day, had to make a wide detour along the Rostov-Baku route in the Chechen-Ingush ASSR.

Construction of a large bridge crossing the Don River was completed in the city of Konstantinovsk, Rostov Oblast. This structure, part of a major integrated hydropower plan, significantly improves travel between the oblast's northern and southern rayons.

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## RAIL SYSTEMS

### RAILWAYS DEPUTY MINISTER ON USSR METRO SYSTEM PLANS

#### Upgrading Existing Systems

Moscow ZHELEZNODOROZHNYI TRANSPORT in Russian No 6, Jun 84 pp 43-48

[Article by V.P. Kalinichev: "Increasing Metro Efficiency"]

[Excerpt] The problem of mass passenger transport in large cities can be solved successfully only by the establishment of non-street transport--a metro, which is distinguished by a large capacity, high speed and regularity of movement, as well as a high level of reliability. In addition, a metro allows the proper development of a city and preservation of the environment, especially of the air. Soviet metros, with a high level of technical and architectural sophistication, satisfy aesthetic demands as well.

The length of domestic subway lines is continually growing. Metros have been built and are in operation in eight cities now: Moscow, Leningrad, Kiev, Tbilisi, Baku, Kharkov, Tashkent, and Yerevan.

The 1983 plan and the quotas for the three years of the 11th Five-Year Plan have been fulfilled ahead of schedule. More than 4 billion passengers have been transported in all, about 45 million over the plan. Labor productivity grew 3.5 percent and cost was reduced by 2.6 percent against the plan.

As a result of great constructive labor to fulfill the resolutions of the 26th party congress and subsequent plenums of the CPSU Central Committee, the operation of the Moscow, Kiev, Tbilisi, Baku, and Tashkent metros improved the mode and methods of work and strengthened labor and industrial discipline. The reliability of hardware components increased noticeably, primarily the power supply apparatus, track, tunnel structures, escalators, and other equipment. The Tashkent, Kharkov, Kiev, Tbilisi, and Baku metro collectives have been working for a long time without waste.

In taking on their socialist responsibilities for 1984, the metro collectives pledged to fulfill the annual plan for passenger transport and assimilation of capital investments ahead of schedule, on December 30, to raise labor productivity by 1 percent over the plan, and to lower the cost of transport by 0.5 percent. Developing businesslike creative cooperation with design, contract, and machine building organizations and enterprises, it has been decided to put

lines into operation ahead of schedule in Minsk, Kharkov, and Tashkent, as well as to ensure that sections in Moscow, Leningrad, and Kiev are opened early.

#### Development and Reconstruction of the Network

An analysis of the operation of metros indicates that there are various degrees of efficiency there. On individual lines in the Moscow, Leningrad, and Kiev metros the passenger traffic at rush hour is very heavy and close to the limiting values. The construction of new lines in Moscow, Leningrad, Kiev, Tbilisi, Baku, Kharkov, Tashkent, and Yerevan is continuing in order to increase the metro's share of urban mass transport and to improve services for the population in the 11th Five-Year Plan. Plans call for completing construction of starting sections in Minsk, Gorky, and Novosibirsk, work has been promoted on the construction of metros in Kuybyshev, Sverdlovsk, and Dnepropetrovsk. Information on the length of lines put into operation in the 11th Five-Year Plan is cited in table 1.

Table 1

City	Lines operational on 1 Jan 80		Opening planned	
	Length, km	No. of stations	Length, km	No. of stations
Moscow	189.9	115	30.0	17
Leningrad	68.7	39	21.7	10
Kiev	29.3	19	6.7	6
Tbilisi	18.8	16	4.2	2
Baku	18.5	12	6.7	4
Kharkov	18.5	13	7.4	5
Tashkent	16.3	12	5.5	5
Yerevan	-	-	11.5	9
Minsk	-	-	8.5	8
Gorky	-	-	8.0	6
Novosibirsk	-	-	8.3	5
Total	360.0	226	118.5	77

The extent of metro lines in the country is increasing at a rapid pace. In spite of the continuous growth and the pressure of quotas and the difficulties encountered that are unavoidable at such a rapid pace, the builders manage to over-fulfill the plan every year. In 1981 the construction quotas were 107.6 percent fulfilled, 101.5 percent in 1982, and 103.3 percent fulfilled in 1983.

Besides those metros that are operational, under construction, or planned, complex transport schemes recommend the construction of metros in a number of other cities. In addition to those mentioned above, metro construction is planned in Riga, Rostov-on-the-Don, Alma-Ata, Omsk, Chelyabinsk, Perm, Ufa, Odessa, Kazan, and Donetsk.

Side by side with the development of the network of operational metros, work is being conducted on their reconstruction, developing the repair-operation depot,

re-equipping, and increasing capacity, especially on the Moscow metro (Gor'kovsko-Zamoskvoret'skiy, Kaluzhsko-Rizh'skiy, and Kirovsko-Frunzenskiy lines). In order to complete part of the special jobs, the Ministry of Means of Transportation set up the Mosmetrorekonstruktsiya trust to aid Metrostroy. In December 1983 the trust had already completed 175,000 rubles worth of work, and in 1984 it is to organize more than 10 million rubles worth of work; these volumes will be continually increasing in the future.

In recent years the demands on underground main lines have increased significantly, the necessity has arisen to build additional entrances, to expand inclined escalator entrances and exits and transfers between stations, to reconstruct the power supply, STSB [Signalling, Centralization, and Blocking] equipment and communications, and to develop the operational base further.

The strenuous program of development and reconstruction of the metros calls for the realization of an entire complex of measures to improve construction organization; reduce the time and cost of construction, improve quality, raise the technical level of technical apparatus, designs, and equipment used on the metros. The operational reliability and longevity of a metro depends to a great extent on the quality of construction. Tunnel and station structures are built and used under complex geological and hydrogeological conditions, and are often situated in unstable floating earth, aggressive subsurface water, or seismic belts. At the same time the load carrying structures of the tunnels and stations are subject to dynamic loads from the moving trains. If one considers the responsibility of the structures, then those strict demands made on the quality of their construction by specification documents and the customer become completely obvious. However, the quality of construction still has not reached the required level in a number of cases.

It should be noted that the quality of metro construction depends on many ministries and authorities, but primarily on the customer, general contractor, and suppliers of construction designs and materials, as well as on the designers. The Ministry of Means of Transportation, jointly with the Ministry of Transport Construction, adopted a resolution for 1984-1985, to develop and consolidate the basic trends in subway planning for the long term. These materials should contain: a plan for the use in metro projects of modern scientific and technical achievements in the area of production technology; measures to ensure an increase in the level of planning; maximal use of standard plans for design treatments based on the unification of volume-planning, design, and technological treatments of assemblies, designs, and goods; and measures for the widespread adoption of networks and line production.

It is stipulated that the specific consumption of materials in construction be reduced in every way possible, that the factory readiness of constructions be continually improved, that mechanization and industrialization of construction be increased, that advanced technical treatments be widely adopted, that construction be better provided with mechanization, and that a complex program for the reduction of manual labor be developed.

The solution of metro development problems in large cities like Moscow requires a particular approach. We know that the limits of Moscow are constantly expanding, and now the necessity is being considered of building microrayons at a

significant distance from downtown and from the rayons where industrial and transport organizations are located. For this reason the proposals of a number of scientific-research institutes for the construction of special high-speed radii from the rayons of the suburban zone and from satellite cities are of special interest. High-speed lines will allow passengers to be delivered faster from the suburban zones, relieve the overloaded suburban railroad lines, and create favorable conditions in the operation of urban transport. The problems of building high-speed above and underground metro lines in large cities merit the greatest attention and study.

#### Improvement of Technology

The transport process on a metro is a complex system in which route and structure, rolling stock and turn-around devices, power supply and escalators, automation and communications systems, engineering-technical installations and other things are integrally linked in a single transport system.

It is enough to say that in this system more than 100 kilometers of escalator and thousands of cars are mobilized every day. The interval between trains during the rush hour is 80 seconds, which works out to 45 pairs of trains per hour. Such quantities of traffic are so far unknown in world experience.

A high level of metro operation depends on a correctly constructed and accurately functioning system of directing the transport process. Train traffic on metro lines is organized according to schedules developed in accordance with combined passenger flows. The schedule establishes the amount of traffic according to time of day, the interval between trains, and the most rational regime for train movements.

On-line control and control over train movements, operation of equipment and metro facilities is exercised from a central dispatching point by means of automation. In this, automation and telemetry resources acquire special significance. At the present time, on the basis of modern achievements in computer and micro-processor technology, automated systems for directing train traffic and technological processes are being developed which ensure the vital activity of the metro.

An important place in the complex of hardware components belongs to the devices that guarantee the regulation of the intervals of movement and its safety. A system of automatic locomotive signalling (ALS) of the frequency type with automatic speed regulation (ARS) is used to regulate movements on sections of track and in stations without route development. The system was developed by VNIIZHT [All-Union Scientific Research Institute for Railroad Transport], the Moscow metro, and the design bureau of the Chief Directorate of Signalling and Communications and has high technical and operational indicators. The capacity of lines equipped with the ALS and ARS systems increases by 20-25 percent in comparison with the automatic block system. The safety of movements increases as well.

Stations with route development are equipped with route-relay centralization with dispatching control by means of switches and signals. The control of

station objectives can, when necessary, be carried out from a local desk set up at the station. The centralized traffic control is supplemented with dispatching control facilities in order to control the state of the objectives managed and controlled as well as that of sections of track.

The use of ALS and ARS in a set with other hardware components makes it possible to obtain a calculated capacity of up to 48 pairs of trains per hour.

To ensure a high volume of traffic on the subway, a complex automated system for controlling train movements has been developed and set up. It exercises centralized automatic control over the movements of all the trains on the line and makes it possible to carry out schedules of train movements with increased accuracy, to free the operator from the monotonous, often repetitive operations of controlling the train, and to realize the most rational traffic regime.

The automated train traffic control system consists of two subsystems: traffic safety (ALS and ARS facilities) and automatic train control. All the train control functions that are carried out by the operator or his assistant in manual operation are automated here. Centralized train control is accomplished with the aid of a complex of facilities: a central control point and station, track, and train equipment. The central control point consists of a controlling computer complex (EVM) which, in accordance with the program given, transmits all the information necessary for controlling the trains on the line to the station facilities. The station facilities, on the basis of this information, formulate the appropriate commands for the control of the train and transmit them to the train's facilities.

The automation of train traffic control using ALS and ARS has made it possible to reduce the strength of a locomotive crew from two people to one. The operator retains control over the operation of the hardware components as well as the ability to intervene when unforeseen situations arise.

Metro specialists, in close cooperation with the scientists from VNIIZHT, MIIT [Moscow Institute of Railroad Transport Engineers], LIIZHT [Leningrad Institute of Railroad Transport Engineers], and with the participation of design organizations and specialized organizations, is continually improving the facilities for automation, telemetry, and communications, developing new systems for interval regulation that meet the growing operational demands.

#### Track and Track Maintenance

Track facilities occupy an important place in securing safe and uninterrupted traffic on the metro. At the present time the length of the main metro routes is about 800 kilometers. The density of traffic on a subway track is equivalent to main above-ground railroad tracks, and on certain lines exceeds 40 million ton-kilometer/kilometer gross per year. In connection with this, R65 type rails are laid. The construction of the foundation and the upper structure of the track is standardized. In tunnels a ballastless upper track structure is used, with wooden ties on a concrete foundation. On above-ground sections, track is laid primarily on reinforced concrete ties and crushed stone foundations. The rail track is unjointed, the lengths of rail are welded together from standard rails. They are secured to the ties by individual Metro type fasteners.

Metro operating conditions make extraordinarily high demands on the quality of maintenance and on the reliability of all track elements. A system of conducting track maintenance has been established on the metros which stipulates measures for routine maintenance and repairs using small-scale mechanization as well as special machines developed in conformity with metro conditions. In addition a complex of measures is being carried out for preventive examination and diagnostics using flaw detection trucks and track measuring and flaw detection cars. However, the peculiarities of a metro resulting from the restricted dimensions of the tunnel, construction features of the upper structure of the track, the presence of the third rail in close proximity to the track, and finally from the short duration of the technological "window", available only at night when the trains are not running, do not allow the full use of the rich experience and technology of track maintenance and repair used on main railroads with the complex of existing track machines.

The Chief Directorate of Metros, in close cooperation with scientists from VNIIZHT, specialists from the project-design bureau of the Chief Directorate of Track, subways, design organizations, and industrial plants, is continually working to improve the technology of routine track maintenance and repair, to develop specialized machines for the mechanization of routine track maintenance and repair, and finally, to improve the upper track structure in the metro. A set of rules for conducting scheduled preventive track maintenance has been worked out and put into effect in order to regulate the system of repairs. The first manual of technological procedures for metro track repair has been developed and published. At the present time the development of the second manual is being completed.

Since work on the track in the tunnel is carried out only at night and is connected with hard physical labor, the problem of raising the level of mechanization and reducing the expenditure of labor in the preventive maintenance system is not only a technical one, but a social one. In recent years various design organizations have developed and manufactured experimental models of a number of machines and mechanisms for the metros: a complex of machines for the replacement of ties, a device for replacing lengths of rail in the tunnel and on above-ground sections, a machine for repairing wooden ties in the tunnel, the VPRS-500 lining-straightening machine for above-ground lines on metro dimensions, and a high-speed track measuring car. Organizing lot production of all these machines and supplying them to the metros is currently one of the primary tasks of the Chief Directorate of Metros and Mintyazhmash industrial associations.

The problems of reducing the noise and vibration accompanying train movements acquires particular urgency in connection with the development of metro networks and the construction of shallow lines near housing developments. In order to solve this problem specialists from the Chief Directorate of Metros, VNIIZHT, and Glavtonnel'metrostroy have worked on developing new track designs with vibration-absorbing properties. The task that has been set before the scientists and designers is to come up with a track design with R65 rails and reliable, easily serviced fastenings, and to bring manufacturing and structural assembly closer to the industrial method of production. The design and laying of a section of noise-absorbing track on the recently opened Serpukhovskiy radius of the Moscow metro is a result of the latest developments. VNIIZHT's suggestions

for the modernization of this design are being examined now. At the same time, technical studies are being conducted on the development of a unified track design with noise-absorbing properties for operational lines.

The high volume of traffic on metros, increased demands on the reliability of the track, the potential for increasing the speed of newly developed rolling stock have advanced the task of developing special switching products for the metros. In a short period of time, designers at the Chief Directorate of Metros' PKB [project-design bureau] have developed R50, 1/5 mark type switches instead of R43, 1/5 mark for stock tracks and a potential R65, 2/9 mark access track. Changes have been made in the standard designs of R50 and R65, 1/9 mark switches for 1520 millimeter lines, taking into consideration the conditions of their use on the metro.

The complex solution of the problems of developing progressive track designs and developing and instituting technology based on the new generation of mechanization and changing over to the machine method of conducting work on the tracks will guarantee a high quality of subway track maintenance and its operational reliability.

#### Reliability of Rolling Stock

The significant volumes of train traffic make special demands on the design of the motor coach rolling stock, on increasing its reliability and on improving the system of servicing and repairing cars.

The development of type E cars at the end of the 50s could not completely satisfy the volume of transport; in connection with this, in 1977-1980 industry plants switched to the production of the faster and roomier 81-717 and 81-714 model cars, which now make up the basic rolling stock.

During the first years that these cars were used certain weak assemblies came to light. For this reason the problems of increasing the reliability of the cars were examined by a number of interested ministries and special measures were worked out for improving the design of the motor coach rolling stock and improving individual assemblies and parts on all versions of the cars. In the first place these measures were carried out on the Moscow metro, which, in comparison with the others, has the largest load and volume of work.

The measures were carried out at accelerated rates and were under the constant control of the Chief Directorate of Metros. By order of the ministry the system and norms were confirmed for scheduled preventive car service and maintenance, strengthening technological discipline, introducing advanced technology and scientific labor organization, increasing worker qualifications, complex mechanization and automation of production processes, and the widespread adoption of the up-to-date experience of the best enterprises in the field.

The work of the Central Laboratory for the Reliability and Diagnostics of Metro Motor Coach Rolling Stock was reviewed and ways were planned to further develop diagnostic resources to prevent defects from arising in the motor coach rolling stock.

The Central Laboratory conducted tests based on analysis of information on car breakdowns, and recommended improvement of certain assemblies. The design changes were incorporated by the manufacturing plants, raising the level of reliability considerably. These measures developed by the Central Laboratory met with approval: improving battery operation, increasing the reliable service life of electropneumatic contacts, recommendations for improving the operation of the tyres on wheel sets and increasing the reliability of draw-bar operation on trucks of the rolling stock, recommendations for modernizing the thyristor field regulators and individual assemblies of the trains' automatic drive, and for protecting the motor-compressor circuit, and other developments.

Measures directed toward improving metro car design and increasing the reliability of cars have already shown a positive effect. The number of breakdowns among 81-717 and 81-714 model cars went down 10 percent in 1983 in comparison with 1982. The reduction in the number of breakdowns of these cars came about basically owing to improved operation of mechanical equipment. The number of breakdowns of electrical equipment on all types of cars lessened insignificantly.

In order to further increase reliability on the metros, operational tests are being conducted on cars equipped with high-speed and differential protection, complete energy sources for their own needs with a frequency of 150 Hertz, and electrocontact boxes for the connection between cars made on the basis of the 7R-52 connector assembly. According to preliminary results of the testing, these improvements give a definite positive effect, and many of them will be incorporated by industry plants into the lot production of cars.

The continual growth of passenger traffic on the metros required that industry plants develop a faster, more economical, and roomier motor coach rolling stock. Right now on the Moscow metro they are testing 7 experimental type I cars, models 81-715 and 81-716, put out by the Mytishchinskiy machine building plant. The passenger capacity is increased on the new type of cars, owing to a change in the configuration of the body. The use of aluminum alloys in the construction of the body reduced the weight of the car by more than three tons. In order to improve the smoothness of the ride, the car is equipped with a central pneumatic spring suspension and thyristor-impulse regulation of the traction engines. Electrical energy will be saved on the new motor coach rolling stock thanks to regenerative rheostatic braking. In the near future type I cars should replace model 81-717 and 81-714 cars in lot production.

However, in using the type I cars a number of design defects showed up: individual assemblies of the central spring suspension broke down repeatedly, cases have been observed where the drive-coupling cam slipped, and the number of breakdowns of electrical equipment is still great. Modernization of the thyristor-impulse scheme, which should have greater operating reliability, was proposed in 1983 in order to accelerate the revision of these cars. In this scheme the number of contact elements is reduced more than two-fold, thyristors are used that industry makes in lot production, and high grade condensers are used. This way the mass of the electrical equipment set is reduced by approximately one ton. The modernized thyristor-impulse system from type I cars and separate units of its undercarriage will be installed on model 81-717 and 81-714 cars in 1984 in order to accumulate a great deal of operating experience.



In improving the design of a car a great deal of attention is given to improving working conditions for the operator. Over the years of lot production of 81-717 cars, changes were made in location of various buttons and switches, and additional switches were installed for the convenience of the operator. In the course of a number of years, the location of the windshield wipers for the side windows of the front part of the operator's cabin was improved on this model. Since 1983 they have been installing an improved system of forced ventilation in the operator's cabin on lead cars manufactured by the Mytishchinskiy machine building plant, and illumination of the route is improved thanks to the use of special headlights. The system of fixing the electrical circuits to the train's automated control and automated speed regulation is continually improved on model 81-717 cars in the process of their lot production. In place of the ZHR-3M radio sets they have begun to use the 42RTM type and the rod antenna that goes with it.

Improving the level of passenger service is one of the most important tasks before the designers of metro cars. Since 1982 all newly produced cars have been equipped with forced ventilation in the passenger compartment. Model 81-714 intermediate cars have increased seating capacity as the operator's cabin has been eliminated from its design. The public address system is being developed further. The passenger-operator communication equipment being installed in the motor coach rolling stock helps, in case of an accident, in making a good decision on the way out of whatever difficult circumstances arise.

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#### Future Systems Development

Moscow TRANSPORTNOYE STROITEL'STVO in Russian No 6, Jun 84 pp 15-17

[Article by V.P. Kalinichev, deputy minister of means of transport and candidate of technical sciences: "Metros: Potential and Problems"]

[Excerpts] An analysis of the operation of metros attests to the various degrees of efficiency in their operation. During rush hours, the passenger traffic on individual lines of the Moscow, Leningrad, and Kiev metros is close to the maximum and in some cases even exceeds it, which points to the too slow rate of network expansion in these cities at a time when the passenger traffic on Tashkent and Yerevan metro lines opened during the 11th Five-Year Plan is relatively low. In order to increase the metros' share of urban transport, to improve service for the population with comfortable non-street urban transport, and to increase the operational efficiency of metros in cities with a single working line, metro development continues in bringing the network up to two or three lines.

In all the cities where underground transport is already working, construction of new lines is continuing in the current five-year plan. Besides this, construction is scheduled to be completed on starting sections in Minsk, Gorky, and Novosibirsk, and plans are being developed for the construction of metros in Kuybyshev, Sverdlovsk, and Dniepropetrovsk. Information on the new lines opened in the 11th Five-Year Plan is cited in the table [not reproduced].

From 1981-1983 on the Moscow, Leningrad, Kiev, and Yerevan metros, sections were opened with a total length of almost 30 kilometers.

In Moscow, sections of the Serpukhovsko-Timiryazevskiy line (Yuzhnyy-Prazhskiy and Serpukhovskiy-Borovitskiy), the Gor'kovsko-Zamoskvoretskiy line (Kashirskiy-Orehovo and Orekhovo-Krasnogvardeyskiy), and the Kalininskiy line (Marksistskiy-Novokuznetskiy) will be put into operation before 1986, which will provide reliable high-speed transport for the southern and south-eastern rayons of the capital.

With the continually growing volumes of construction putting projects into operation in a timely manner is ensured, which shows the good rates and organization of construction and the great help that contract organizations get from city authorities in opening metros ahead of schedule. The builders are supplied with the necessary design-estimate documentation, finances, equipment and the customer's materials, and assembly-adjustment brigades made up of highly qualified workers from operational services and subdivisions. All this does not detract from the construction of other lines and projects that are not initial ones.

In spite of the continuous growth of and pressure from quotas and the accompanying difficulties, unavoidable at such high rates, the builders succeed in overfulfilling the plan every year. Hence, the construction quota was 107.6 percent fulfilled in 1981, 101.5 percent in 1982, and 103.3 percent in 1983.

Alongside the necessity of developing the network of metros in operation, a significant amount of work also needs to be carried out on developing their repair-operation base, reconstruction, re-equipping operational lines, and increasing their capacity, especially on the Moscow metro (Gor'kovsko-Zamoskvoretskiy, Kaluzhsko-Rizhskiy, and Kirovsko-Frunzenskiy lines). In December 1983 the Mosmetrorekonstruktsiya trust was created so that part of the special work could be carried out by the Ministry of Means of Transportation. In December 1983 the trust had already done 175,000 rubles worth of work, and this year it will assimilate more than 10 million rubles worth of capital investments. In the future these volumes will continually grow.

In 1985 the Moscow metro will be 50 years old. In this time the demands on metros increased significantly, the necessity arose of building additional entrances, expanding inclined escalator entrances, exits, and transfers between stations, reconstructing the power supply, STSB [Signalling, Centralization, and Blocking] equipment and communications, and further developing the operating base. These jobs are estimated at several hundred million rubles, and the construction organizations of Glavtonnel'metrostroy and Glavmetropoliten must reconstruct the sections in the shortest possible time.

Besides lines that are operational, under construction, and in the planning stages, complex transport schedules recommend metro construction in a number of other cities. In recent years the problem of building up construction base capacity and of the opportunity to obtain cast iron tubing, escalators, ventilators, cable, and other products became one of the decisive factors in determining the optimal variants and times for opening new line projects. It was necessary to make a plan of action for the long term.

Taking all this into consideration, in 1983, on the assignment of MPS [Ministry of Means of Transportation], Metrogiprotrans developed a "Scheme for the

development and placement of metros in the USSR for the period up to the year 2000" in which recommendations are worked out for the optimal development of the branch, coordinating them with appropriated capital investments, taking into consideration the availability of materials and designs, and also with the object of liquidating delays in the development of a number of working metros and their repair-operating base. The problems of building and developing metros in 24 cities are examined in the scheme: Moscow, Leningrad, Kiev, Tbilisi, Baku, Kharkov, Tashkent, Yerevan, Minsk, Gorky, Novosibirsk, Kuybyshev, Sverdlovsk, Dnepropetrovsk, Riga, Alma-Ata, Rostov-on-the-Don, Omsk, Chelyabinsk, Ufa, Perm, Odessa, Kazan, and Donetsk. Background materials are compiled on every city.

Suggestions contained in the Scheme are being examined by MPS and Mintransstroy at the present time. Undoubtedly changes are possible in the times for beginning construction and opening sections, especially in cities where the work is to be done from the beginning. However, these plans correctly reflect the general trend in the development of Soviet metros and the bases for their construction.

The relative unevenness of the opening of new lines in individual cities is explained by the extended period of construction for new lines (7-8 years) and the various amounts of time required to conduct preparatory and preliminary work.

In 1986-1990 it is planned to continue work on the reconstruction of the Moscow metro's Gor'kovsko-Zamoskvoretzkiy line, to complete a significant amount of the reconstruction of the automation equipment on the Kaluzhsko-Rizhskiy line, begin construction of a production-operating base for a metro in Borisovo, continue the reconstruction of the experimental electromechanical plant and get its repair capabilities up to 120 escalators per year, and conduct reconstruction of the motor coach rolling stock. Construction of an escalator repair enterprise in Leningrad, associated workshops in Kiev, and a car repair enterprise in Tashkent is planned for these same years.

The strict program of metro development requires the realization of an entire complex of measures for strengthening construction organizations, reducing the time and cost of construction, improving its quality, and raising the technical level of technical apparatus, designs, and equipment used on metros.

Precast reinforced concrete designs have recently been developed and are widely used in metro construction: all-section linings for span tunnels of the open method of work (their use reduces labor expenditure two-fold in comparison to linings of the usual blocks); span tunnel linings compressed into the rock; standard extended unified designs for span tunnels and tunnel and station structures of the open method of work (which reduces the number of assembly units by 40 percent); antiseismic designs for shallow stations and span tunnels for rays where the seismicity is higher than 7; and designs for deep single-vaulted stations. Progressive designs are being instituted for shallow single-vaulted stations of massive reinforced concrete and for deep columned and column-pylon stations.

However, the problem of the quality manufacturing of precast reinforced concrete linings that meet waterproofing standards has still not been completely solved. Considering the extreme limitedness of cast iron tubing being supplied for metro

construction and the demand for it that is constantly growing in connection with increasing rates of metro construction, great significance is attached to the introduction of facilitated lining designs from high-strength iron. These designs have been developed, but production of them has so far not been organized.

A method of tunnel construction from massive molded linings has been instituted, in connection with which the consumption of steel is reduced as are cost and labor input. The introduction of technology for the construction of tunnels in water saturated ground using freezing and lowering of the water level, which allows the passage to be cleared using compressed air, has great significance.

However, in spite of the widespread use of the leading technology, the amount of manual labor in metro construction is still intolerably large. In the area of architectural design of stations, Soviet metro construction occupies the leading positions in the world, however architectural-finishing jobs are poorly mechanized. With the object of mechanizing them and saving materials that are in short supply, the necessity is imminent of developing and using large-dimension variously colored panels on an artificial base, including refractory plastic materials.

The operational reliability and longevity of a metro depend to a great extent on the quality of construction. Tunnel and station structures are built and operated under very complex geological and hydrogeological conditions, and are often situated in unstable floating earth, aggressive subsurface water, or seismic belts. At the same time the load-carrying structures of the tunnels and stations are subject to dynamic loads from the moving trains. If one considers the responsibility of the structures, then those strict demands made on the quality of their construction by specification documents and the customer become completely obvious. However, the quality of construction still has not reached the required level in a number of cases.

An increase in the demands made on completed projects by inspection personnel and state and workers commissions, more thorough control over the construction process by the management and specialists of metro building directorates, and strengthened supervision by the design institutes allow incidents of poor quality work and of the use of tubing made by plants that lag behind in norms and standards to be brought to light in a timely manner. Cases of reduction in construction quality rightly alarm MPS and Mintransstroy.

The first all-union conference on increasing construction quality at metro projects was conducted by Glavmetropoliten and Glavtonnel'metrostroy in May 1983. Problems of organizing high quality work were critically examined at the conference in a businesslike way. Specific measures were developed pertaining to all the problems of increasing construction quality, and control was instituted over their fulfillment. And nevertheless it is still too early to talk about the complete resolution of this problem. On the Leningrad, Yerevan, and certain other metros the proper conclusions have still not been drawn.

It should be noted that the problem of metro construction quality is a multi-branch one; it depends on many ministries and authorities, but primarily on the customer, the general contractor, and the suppliers of building designs and materials.

There is much criticism, for example, of the cast iron tubing from the Lentrublīt plant. One would think that it would be possible to manufacture a large expensive element of tunnel lining well, however a large quantity of that enterprise's tubing delivered to the construction sites does not meet the demands made on it and deviates seriously from GOSTs [State All-Union Standards] and the norms. According to the requirements of the customer's technical supervision and the contracting organization's technical control, tubing with pits, flaws, or deviations in geometrical dimensions is rejected and returned to the plant. However, improvements in the quality of the goods being delivered to the construction sites have not been observed so far. That is the way things stand with many reinforced concrete structures. All this is seriously reflected in the quality of the structure.

Much work on this problem needs to be done by the builder himself. In the past year, because of unsatisfactorily completed construction-assembly work, the customer did not pay for this work; on the Moscow metro the sum was 3.2 million rubles, on the Leningrad metro it was 480,000 rubles, and on the Kiev metro it was 200,000 rubles.

In order to improve the quality of metro planning and construction, departments of planning and estimating expertise have been organized on the boards of directors, a directorate of capital construction and reconstruction of metros has been established in the Chief Directorate of Metros as well as the position of chief inspector of construction-assembly work quality, and a laboratory has been organized, the chief task of which is developing measures to increase the reliability of structures.

MPS and Mintransstroy together also adopted a resolution to develop and approve, in 1984-1985, the basic directions for metro planning in 1986-1990. These materials should contain tasks for the use in metro plans of modern scientific and technical achievements in the area of the technology of production, and measures for ensuring an increase in the level of planning; they should stipulate maximum standardization of planning decisions on the basis of unification of volume-planning, design, and technological treatments of assemblies, designs, and goods as well as improve the role and quality of construction organization plans by instituting networks and line production.

It is stipulated that the specific construction of materials in construction be reduced in every way possible, that the factory readiness of structures be continually improved, that the mechanization and industrialization of construction be increased, that advanced technical treatments directed at the improvement of construction quality be widely adopted, that a complex program be developed to reduce manual labor, that stock industrial temporary buildings and structures be used more widely, and that concreting, installation of reinforcement, and finishing work be improved. The successful completion of these tasks will allow metro development to be realized in the volumes recommended by the Scheme for development.

At the same time, in the solution of these problems of fulfilling metro construction and reconstruction quotas there are definite difficulties in the problems of material and technical supply. Fans for the main ventilation system, traction

electric motors, and spare parts for metro cars are apportioned in insufficient quantity, the hauling chains are extremely unsatisfactorily supplied, and electro-mechanical and other equipment used only on the metros and not in other branches of the national economy is not centrally manufactured. The demand for spare parts for tunnel escalators is being only 10-15 percent satisfied by industry.

The directorates of the metros under construction arrange directly with various industrial enterprises (with various production technologies) of other ministries and authorities for the production of this critical equipment, which has a negative affect on the quality and delivery time of this equipment; the transfer of a large quantity of assembly equipment and parts to the customer is required as well. In connection with the significant growth of metro construction and the necessity of increasing the quality of electrotechnical products, the need has apparently arisen to centralize their manufacturing with inclusion in the production plans of the corresponding industrial ministries.

Solving the problem of the direction of metro building development in city-giants like Moscow also requires a particular approach. As we know, it has become necessary to build microrayons of the capital at a significant distance from downtown and from the rayons where industrial and transport organizations are located. Therefore the suggestion of a number of scientific-research institutes for the construction of special high-speed radii from suburban zones and satellite cities is of legitimate interest. High-speed lines will permit the delivery of passengers from suburban zones to be accelerated, it will relieve the overworked suburban railroad lines, and create beneficial conditions in the operation of urban transport.

The new high-speed lines should have an average speed between stops of 120-130 kilometers per hour, which requires special studies and further study of the problem of high-speed traffic on metros. Many problems having to do with the development of new upper track structure elements and new, more perfect high-speed cars will have to be solved. The problems of building above and underground metro lines in city-giants deserve the greatest attention and study.

There are a number of other problems as well in metro development and metro building, the solution of which demands a great deal of attention from many ministries and authorities.

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## RAIL SYSTEMS

### CAPABILITIES OF NEW VL85 ELECTRIC LOCOMOTIVE

Moscow ELEKTRICHESKAYA I TEPLOVOZNAYA TYAGA in Russian No 5, May 84 pp 32-33

[Article entitled "VL85 Electric Locomotive" by V. Ya. Sverdlov, deputy director, All-Union Scientific Research Institute of Electric Locomotive Building, and Z. M. Dubrovskiy, chief expert, Technology Center--Ministry of Railroads, in the column "New Technology."]

[Text] In 1983, upon a technical assignment from the Ministry of Railroads and in accordance with the approved standardization of a main-line electric locomotive, the Novocherkassk Electric Locomotive Plant produced two test prototypes of the VL85 12-axle, dual-section, alternating-current freight locomotive.

The new locomotive has a tractive force and power 1.5 times greater than the standard VL80S and VL80R eight-axle, electric freight locomotives. This is the first locomotive with such characteristics to appear on the world scene. It can develop a continuous power output of 10,000 kW and a 72 ton tractive effort at speeds of up to 50 km/h.

The locomotive is equipped with regenerative electrical braking and has an automatic unit to control both the propulsion and regeneration modes. It is designed with the capability of being used in multi-locomotive arrangements consisting of three locomotives and three sections.

The locomotive's operating economy has been improved significantly by lowering energy consumption for internal needs and raising the overall effective operation factor.

The amount of high-tension equipment and control devices has been significantly reduced in comparison to VL80S locomotives which operate in a three-section configuration. This allows a reduction in operating costs for repair and maintenance. Thus, maintenance and service are reduced by 2000 man-hours per repair unit.

The material requirement for this locomotive is 18 tons less than that of the three-section VL80S. The amount of electrical conductors (wires and bars) is reduced by 15-20 percent and the amount of installation and assembly work is reduced by 10-12 percent.

The new locomotive is designed and constructed in full compliance with health and safety standards concerning the size of the operator's cab and the width of passages between equipment. A transverse layout is used for the VL85's power equipment blocks, allowing a rational arrangement of the high-voltage compartment and facilitating access to components for repair and servicing.

Crew comfort has been considered: cabin size has been increased by 25 percent, its modern instrument panel has logically arranged instruments and vibration-damping seats are provided for the engineer and assistant. Additional features include an improved wall finish, increased sound/heat insulation and provision for air conditioning.

The locomotive consists of two uniform six-axle sections. Most of the equipment has been designed to function at ambient temperatures of  $-60^{\circ}\text{C}$ . Future locomotives will be produced for UKhL [not further identified] climatic conditions, allowing their use on the Baikal-Amur Main Line.

The running gear of each section comprises 3 two-axle bogies with jawless journal boxes. The traction motors are mounted in the axles, however, the locomotive's design allows the possibility of future frame-mounted drive.

Each section's body is semistreamlined and has a single cab. The body is connected to the bogies by means of flexible damping units. A special method was used to attach the center bogie. In comparison to the earlier VL60, VL80 and VL10 locomotives, the VL85 has a strengthened body frame and has been designed for higher tension and compression forces (300 ton-force instead of 250).

Tractive and braking forces are transmitted from the bogies to the body via a slanted linkage, allowing the usable coupled weight coefficient to be raised to 0.94. This tractive effort can be maintained on a continuous basis.

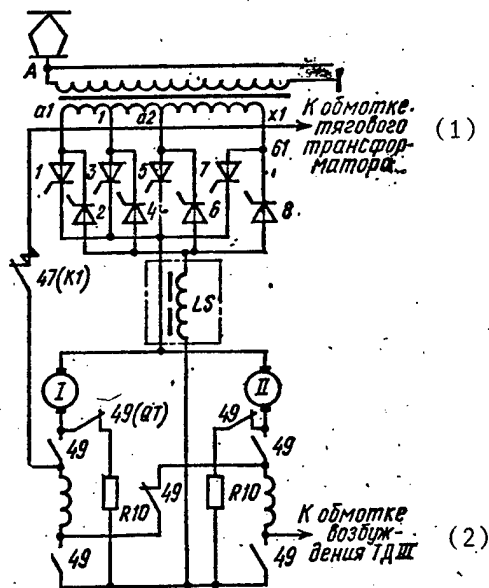
Natural and assisted ventilation of the cab and body are provided on the locomotive. In winter, a semi-closed ventilation plan can be used, with the electrical components being cooled by a partly recirculated air flow.

Air quality has also been improved with the air intake louvers being raised as high as possible for this purpose.

The electrical layout of the locomotive's power circuits is similar to that of the VL80R. Alternating current from the contact network to feed the traction motors during propulsion is rectified by the power transformer and rectifier/inverter units, each of which is connected to one power transformer traction winding.

Each section has one power transformer and three rectifier/inverter units (one for each pair of bogie-mounted traction motors) (see the figure). A rectifier/inverter unit consists of two parallel bridges. T-353-800 Class 28-32 thyristors and an OA-036 cooling unit are used.





(1) To traction transformer winding

(2) To Traction Motor 3 excitation winding

Continuously regulated traction motor voltage is obtained by changing the thyristor firing angle. The locomotive's circuitry design provides four-zone regulation. Three degrees of motor excitation reduction are provided to expand the travel speed variation ranges.

High- and medium-speed regenerative braking current regulation is effected by continuous variation of excitation current, while low-speed current is regulated by continuous variation of motor counter-electromotive forces.

The rectifier/inverter units are regulated by control units similar to the BUVIP-113 control units used on the latest VL80R locomotives. Future locomotives will be fitted with BUVIP-133 devices containing microcircuits.

During propulsion the locomotive's control system continuously regulates the rectified voltage flowing to the traction motors. Further, the system establishes the regulation angle, smooths changes in tractive force upon moving from one regulating range to another and prevents sharp surges in current and tractive effort.

During regenerative braking the locomotive's control system assures continuous regulation of counter-electromotive force at the power transformer secondary windings as well as smooth regulation of braking effort upon moving from one range to another. Additionally, it automatically maintains a permanent reserve angle and balances the traction motors in the first regulation zone. Under automatic control in the propulsion mode, the locomotive accelerates until a set speed is reached with a determined traction motor current. Subsequently, this speed is maintained continuously.

During regenerative braking the automatic mode provides preliminary light braking, maintains a set effort when braking to a stop and holds a determined speed when descending grades. Specially developed, highly reliable ANE-225 auxiliary three-phase asynchronous motors are used in this locomotive. They are

powered from the power transformer's special equipment windings via an asynchronous phase expander. The same electric motor with capacitor starting and without preliminary loading from the single-phase current network is used as the expander.

Dash-mounted instruments monitor maximum motor armature current, excitation current of the series-connected excitation windings, contact network voltage and preset speed value.

Electrical equipment in locomotives connected in a multiple arrangement is monitored by means of cumulative indication on a decoding annunciator panel.

A special unit supplying regulated direct-current voltage powers the low-voltage control circuits in each section. An alkaline battery also serves as a power supply.

The VL85 test locomotives are fitted with a great deal of equipment well suited for use on mass produced alternating current locomotives. At this time the prototypes are undergoing extensive testing.

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## MARITIME AND RIVER FLEETS

### CHIEF ON RIVER FLEET OPERATIONS IN BSSR

Minsk SEL'SKAYA GAZETA in Russian 14 Aug 84 p 2

[Article by L. I. Kozak, chief of the Economic Planning Department of the Main Administration of the River Fleet of the BSSR Council of Ministers: "An Important Contribution by the Rivermen"]

[Text] The river fleet is a mighty transport power. L. I. Kozak, chief of the Economic Planning Department of the Main Administration of the River Fleet of the BSSR Council of Ministers, describes what Belorussian rivermen are engaged in and how they participate in the affairs of the republic's agro-industrial complex.

Our republic has 878 rivers with an overall length of 33,770 km. But not all of them are navigable. No more than two dozens are of transport significance. Among the main water routes, of course, are the Dnepr, Sozh, Berezina and Zapadnaya Dvina. But of greatest significance for the fleet are the marshy woodlands beauty Pripyat and the Dnepr-Bug Channel, which link major industrial centers--Brest, Pinsk and Mozyr. Our vessels also travel via them to the Ukraine. It is difficult to respond in a few words to the question as to what is being hauled by the river transport of Belorussia. I will name only the most basic: iron ore, coal, quartzites, quartz sand, granulated slag, timber and production of enterprises of the agro-industrial complex. However, most often we have to deal with construction cargo, particularly with the cargo which is intended for agricultural needs, construction of necessary projects and laying of roads.

The volume of shipments conducted on orders of ministries and departments of the agro-industrial complex is constantly increasing. Compared with 1980 it has increased by 220,900 t. And if we take, for example, the hauling of grain cargo, then nearly 28,000 t of it was transported by water routes last year. Here it is necessary to remind of one not unimportant aspect of our activity. It is known that the load of the railroad is very great. Therefore, associates of the Main Administration of the River Fleet [Glavrechflot] are exerting every effort in order to bring to light such agricultural cargo which can be hauled by water routes and to "take" it over for themselves.

It is not easy to be a rivermen. Members of ship crews perform their work at times under incredibly difficult conditions caused by an arid summer-autumn

period and early light frosts. But along the way they are helped by the lofty feeling of responsibility for the assigned work and the good traditions of our transport fleet, which are created and multiplied by such most conscientious people as, for example, captains V. Kupriyanov, V. Sugakov, N. Pyshkin, F. Kniga and A. Prikhod'ko who are well known throughout the republic. Many supervisors of crews and mentors of youths are, as a rule, originally from rural areas themselves. They understand perfectly well the great responsibility entrusted to them, and know that the cargo placed in their care is being expected with impatience somewhere.

Not only members of ship crews but collectives of industrial enterprises of the BSSR Main Administration of the River Fleet are actively participating in the fulfillment of the Food Program. They produce many goods for rural workers. During the past 3 years, 10 ferries were built for crossings. Good things are also being said about the barge of project 619A, which is intended for hauling grain. Its basic advantage is an ability to operate on the relatively shallow Belorussian rivers. This floating assistant of farmers was developed by specialists of the sector's planning and design buro, and will receive its start in life at the Petrikovskiy Shipbuilding and Ship Repair Plant. Working on developing it with the use of KTU\* are best collectives of the enterprise: the brigades headed by S. Yevelkin, A. Zhogol' and V. Zhevnerchuk. Eight such barges will be turned out by the end of the 11th Five-Year Plan. Construction of a shallow-draft pusher tug of project 730 for hauling agricultural products in the upper reaches of rivers has also been mastered.

Participation by rivermen in fulfilling the Food Program is not limited only to the basic, production activity. The sector has three subsidiary farms: one for fattening pigs and two for raising cattle on the basis of the Mozyr, Gomel and Pinsk river centers. In 1983 alone, the Mozyr farm has sold 11.7 t of meat. Moreover, rivermen work in kolkhozes sponsored by them every year, with which they have established durable, businesslike and really comradely relations.

One cannot speak of the links of Belorussia's river transport with its agro-industrial complex without mentioning passenger transportation. This year, our motorships will transport 1,050 people to their destination. For this purpose the arsenal of the Main Administration of the River Fleet has 35 special vessels, 16 of which are hydrofoils. In the current navigation season there are 25 passenger routes in operation, including five interrepublic transit transportation routes. During the past few years, suburban passenger transportation has been broadly developed in connection with the growth of orchard and vegetable garden associations in the areas along rivers.

We are doing very much so that passengers would be always satisfied with their trip, show concern for their good frame of mind and spare no strength and means for this purpose. A comfortable river station, which was put into operation in Mozyr 2 years ago and now functions successfully, is designed for serving 200 people a day and has everything that is necessary: a snack bar, a restaurant, a recreation room and even a barbershop. The new passenger motorship "Poles'ye" is being built at the Gomel Shipbuilding and Ship Repair Plant imeni 50th Anniversary of the Belorussian SSR. It has a spacious lounge, comfortable soft armchairs and high speed...

\* Coefficient of Labor Participation

Incidentally, I think that readers will be interested to know that we have wonderful tourist and excursion routes. Taking advantage of this opportunity, I would like to invite them to an interesting outing on the river.

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## MARITIME AND RIVER FLEETS

### WORK AT MARITIME FLEET MINISTRY'S MAIN COMPUTER CENTER

Moscow VODNYI TRANSPORT in Russian 21 Jun 84 p 4

[Article by Ye.Mukhina: "The Electronic Computer and the Sea"]

[Text] Close by the busy Dzerzhinskiy Square spills its flood of people and cars into Prospekt Marksa, but here, behind a double wall of glass, instruments are quietly plotting temperature and humidity curves, air conditioners are creating a microclimate, numerous lights are flashing, green lines on display screens are aglow. Working tirelessly in these halls, filling it with a ceaseless monotonous hum are the electronic computers that are the heart and soul of the Maritime Fleet Ministry's Main Computer Center (MCC).

The MCC collective is young - the staff's average age is close to thirty. Most of them have a higher or secondary technical education. Eighteen years ago when this new subdivision of the ministry came into being all the center's employees had at their disposal was a few score calculators.

Today there are two main machine rooms, four large and several smaller electronic computers.

From the very first day of its establishment one of the center's basic tasks was to control the safety of navigation, the work of the ships and the ports. The center works round the clock, there are no weekends or holidays. Stored in the memory block of the machine today is a breakdown on all the ships of the cargo and passenger fleets, the Academy of Sciences and the Meteorological Service. The work of the fleet, the ports and the ship-repair yards is under supervision at all times.

The center is linked by invisible threads with all the country's shipping companies, it receives up-to-date info on ship deployment no matter where they are. The machine can dispense over 300 kinds of information on the work of the Ministry of the Maritime Fleet.

Several years ago a new department was organized based on the MCC's complex of electronic computers. Its function is the rescue of

ships and planes in danger at sea or in the air with the aid of an international satellite system known as KOSPAS (Cosmic System for Location of Stricken Ships and Planes).

The Soviet Union now has three stations on its territory that pick up information from satellites.

Time elapsed between the despatch of the SOS and its processing for search and salvage agencies will not exceed two hours.

Today the MCC is the chief general client for all projects aimed at improving the industry's performance by way of computer technology. Created in the framework of this program were the automated control systems "Port" and "Shipping Company". To achieve more effective control over fleet performance the traditional post-voyage reports by shipmasters were replaced by a new unified system of ships' accountability.

But time does not stand still. In the past 20 years maritime traffic and freight turnover have increased dramatically, the speed and tonnage of the ships have grown too and the process has begun of equipping them with the most sophisticated mechanisms and devices. At the same time there has been a sharp rise in losses from disasters at sea because these losses now stem not only from the value of the stricken ship, but likewise on the extent of the damage suffered by the environment.

All this leads to but one conclusion: no crew today can hope to resolve quickly and efficiently the problems of operating a modern vessel if it does not resort to computer technology.

"Beginning with 1986," says deputy chief of the center S.Pavlov, "the ships will be equipped with microcomputers. The new program is called automated control system "Ship". These will enable the crew to work even more efficiently. Of course, the first to be so re-equipped will be ships with sound economic results, specialized craft such as bulkers, container ships and passenger liners.

There are a number of difficulties involved too. The fact is that computer hardware is very sensitive to weather conditions, and at sea they are bound to face tossing and pitching, high humidity and significant temperature fluctuations. Consequently, the ship-board computers must of necessity be endowed with a very high degree of reliability.

How specifically will the automated control system "Ship" benefit the seamen? It will enable ships to cut down on their mileage and sailing time, increase carrying capacity through more rational cargo stowage based on the sequence of its loading and unloading

in ports. In case of an accident the microcomputer can determine the durability factor and the buoyancy of the ship with several compartments flooded, the time remaining before it goes under, the stability of the vessel if any cargo is displaced, and much more.

Every year new automated control systems will be developed. Computer technology will make the transition from shore to ship, nearer to those whose far from easy toil it is called upon to control and alleviate.

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## MARITIME AND RIVER FLEETS

### NUCLEAR-POWERED LIGHTHOUSE INSTALLED IN LATVIA

Moscow KOMSOMOL'SKAYA PRAVDA in Russian 5 Aug 84 p 1

[Article by SOVETSKAYA MOLODEZH' correspondent A. Mirlin and staff correspondent V. Zaytsev: "A Lighthouse Operates in the Baltic"]

[Text] A new nuclear-powered lighthouse has begun operations in the Irbenskiy Strait.

It is only 200 miles from the Tallinn port water area, where the lighthouse came off the building slip, to the Mikhaylovskaya shoal where it was to be placed in the soil. But a convoy needed nearly 3 days to cover this distance. The octahedral reinforced concrete "iceberg"--the lighthouse foundation is 26 m in diameter on which a tower is installed--has an 8.5 m draft afloat. Therefore, it was towed at a speed of only 3 knots.

We proceeded on an accompanying hydrographic vessel. Its navigator Leonid Kozlov gets his bearings among shoals and sandbanks of the strait like in his own cabin. Therefore, he was entrusted to fulfill the role of a harbor pilot--to pave the way for the new lighthouse. The convoy had once almost reached its destination, but the rough sea made it impossible to begin work. So the expedition spent several days at an anchorage waiting for a change of weather. Finally an "all right" was received for going out. The icebreaker "Purga" and the seagoing rescue vessel "Loksa" again began guiding the lighthouse to the Irbenskiy Strait.

The remaining fleet was approaching here, to the point which is marked on navigational maps as a place that is dangerous for navigation. Our "hydrographer" stands on the very shoal, marking it. One can see from its bridge how two port tugs and a diver boat are maneuvering along the right side. A floating workshop is approaching from the northwest. A fire launch has arrived exactly on time and is already anchored, waiting for work...

Everything is also ready on the sea bottom for installing the lighthouse. Some 40,000 t of crushed rock has already been poured here--divers have leveled this mountain into a circle that is 90 m in diameter. Then steel beams were laid in its center, and the soil between them was thoroughly leveled for a long time. The surface of the underwater foundation must be perfectly level: plus-minus 3 cm.

Yu. V. Sidorov, a representative of the hydrographic service, said while standing on the bridge:

"Do you see those barrels, standing on anchors? The lighthouse will moor to them. The most important is to position it precisely over the center of the 'bed'."

Work moved into high gear on the lighthouse. The crew headed by I. O. Alekseyev, designer of the floating island, was here during the entire crossing. For the first time in our country the lighthouse was built on the coast and towed by sea to a permanent place already in a completed form.

Now only sinking it here remains to be done. Divers go under water to make the last check. The fire launch begins its work. Its powerful hydraulic giants convey hundreds of cubic meters of water into compartments of the reinforced concrete mass. These compartments together with a special pontoon have held the lighthouse afloat.

After taking on 4,000 "cubic meters" of water, the lighthouse smoothly stops on the bottom. Floating cranes and the motorship "Volgo-Balt" are approaching. Several thousand tons of crushed rock will be unloaded from its holds into the foundation compartments, then the lighthouse will be additionally strengthened by 30 t slabs.

But there is no lighthouse without light. The nuclear "heart" of the lighthouse is covered with tarpaulin on the deck of our hydrographic vessel. Two power units in bright yellow containers are ready for operation when the time comes. They will be able to maintain the light of the lighthouse for 10 years.

The Irbenskiy lighthouse operates in a self-contained mode. A tower with a helicopter pad rises 36 m high. Navigators who pass here can get their bearings from the light house: two dots, dash, two dots--the letter IR of the Morse telegraph code. The new lighthouse on the Baltic identifies itself in this manner.

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## MARITIME AND RIVER FLEETS

### LARGE BLACK SEA SHIP USED ON ARCTIC ROUTES

Moscow IZVESTIYA in Russian 28 Jul 84 p 1

[Article by A. Knop and V. Shmyganovskiy: "Giants Proceeding to Transpolar Area"]

[Text] One of the largest vessels of the Black Sea Shipping Company will be used on the northern sea routes, doing so for the first time in the practice of the country's maritime fleet. The "Izgutty Aytykov" has become the pioneer of transpolar shipping of oceangoing heavy cargo carriers. The motorship has arrived in Murmansk to the starting line of the Northern Sea Route.

Many places have been visited during their generally brief life by these motorships bearing the names of Komsomol heroes on their side, which take on thousands of tons of cargo--in Japan and near the coasts of America, Africa and West Europe. But such giants (length--215, width--32 m) have not been seen so far in the Transpolar area. In the holds and on the deck of the "Aytykov" there are large diameter pipes, which were purchased in Italy and are intended for the construction of the Urengoy-Center gas pipeline. After a brief layover, the vessel will begin its high-latitude voyage to the coast of the Gulf of Ob, to the Novyy port.

From here it is only a stone's throw away from main gas pipeline construction sites. Such quantity of pipes--for 35 km of the pipeline all at once--was never delivered so fast to the construction area. Vessels of the Baltic and Murmansk shipping companies, which made voyages to the Transpolar area so far, usually took on 2,000 to 3,000 t of pipes each. There is now a possibility of transporting sevenfold-tenfold more pipes on a single voyage. This is what determines the main advantage.

During these days, en route from Japan via Asia and Europe, there are two more motorships of the "Komsomol" flotilla heading north--"Parfentiy Grechanyy" and "Zoya Kosmodem'yanskaya"--with a total of... 70 km of the gas pipeline aboard.

The Black Sea seamen will share with Novyy port dockers their experience of rapid unloading, which was perfected to the smallest detail in Ilichevsk.

Small depths and difficulties in handling vessels on the roadstead await the seamen in the Transpolar area. The southerners are opening a new page in the history of Arctic development.

V. Zbarashchenko, chief of the Transportation and Operation of the Fleet and Ports Main Administration [Glavflot], comments:

"The purpose of the experiment is to use our large-capacity fleet more fully, especially in the directions which formerly appeared to be inaccessible. For example, the silhouette of the 'one hundred thousanders' 'Marshal Budenny' has generally become customary in Leningrad. This oil and ore carrier, as it is said in jest on the berths, covers 'half' of the port with its hull, and part of the cargo is unloaded at the Kronshtadt roadstead when it approaches the port."

Equipment and skill of the people are being used more fully. During Arctic navigation, the Black Sea seamen will have to manifest a maximum of shrewdness and ability.

The advantages of the direct method of delivering pipes without transshipment are obvious. Formerly the motorships unloaded their cargo in the Ilichevsk port where it was accepted by the railway. So it happened quite often that owing to overloading of the steel tracks and a shortage of railcars the imported pipes moved on slowly. Expenditures for chartering foreign tonnage are also sharply reduced, and currency is saved for the state.

K. Chubakov, chief of administration of the Northern Sea Route, said:

"Of course, such navigation became possible as a result of good ice conditions at present in the western Arctic region. The Gulf of Ob and the southern part of the Kara Sea are practically clear, so the Black Sea seamen will travel in clear water. Naturally, the icebreaker fleet will ensure their safety if the weather deteriorates. But then no heavy ice pileup is expected: unlike the eastern Arctic, this region is shielded by islands from the invasion of old ice from the polar regions. But the vessels are in a hurry in order to get through within the summer navigation periods: all the same they are not adapted for navigation in ice."

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## MARITIME AND RIVER FLEETS

### LIGHTER CARRIER 'ALEKSEY KOSYGIN' OPERATING IN FAR EAST

Moscow PRAVDA in Russian 11 Jul 84 p 6

[Article by correspondent N.Bratchikov: "A Caravan On Board Ship"]

[Text] The voyage has begun from Vladivostok to the northern regions of the lighter carrier "Aleksey Kosygin", the first such ship to be built in our country.

The seamen of the Far East are not easily impressed by ocean vessels, but this giant motorship now blocking entry into the Zolotoy Rog Bay attracts attention not only for her size. On board is an entire flotilla - 82 lighters or, in other words, spacious "floating containers" stacked one atop the other in six rows. Moving from the superstructure to the cantilever-rimmed stern over this pyramid of red metallic boxes is a bridge crane which picks up the lighter next in line, hoists it and sets it down on the water. Here the lighter is forthwith snatched up by a tugboat that tows it away to a special collector wharf where dozens of other boxes are tied up board to board looking much like a honeycomb.

"The lighter carrier "Aleksey Kosygin", recounts chief of the Far East Shipping Company's Lighter and Container Shipments administration V.Cherepanov, "was built by the shipyard workers of Kherson. Before coming to the Pacific it did a good job of work in the West hauling grain and piping and arrived here in its home port with 20 thousand tons of miscellaneous cargoes...

We are standing on the upper deck of the ship and figuring its productivity with the aid of a pocket calculator, and what it shows is that the deck cargo delivered by this vessel in just one trip to Vladivostok is the equivalent of 10 railroad trains of 60 cars each.

The tugboat is now hauling two lighters at a go with a freight-carrying capacity comparable to that of 70 heavy-duty trucks. The seamen cite an even more graphic example: one lighter carrier on Far Eastern lines will replace six freighters of 14 thousand tons deadweight each.

Work aboard the ship is in full swing, but the men doing it seem uninvolved. Seamen pace the deck with little walkie-talkies in

hand - without these no two-way conversation is possible aboard this quarter-kilometer-long leviathan. The loading is done by mechanisms and electronics. Walking up to the cantilevers that do the work, we ask seaman V.Sidorovich about the nature of his duties. It turns out he is not a "docker", but an electrician. Together with crane operator V.Chekhov they take 500 tons of cargo off the ship every 20 minutes.

The lighter carrier's long-range assignment is to service the not easily accessible and and poorly equipped coastline of Magadan oblast, Kamchatka and Chukotka. The arrival of the "Aleksey Kosygin" in the Far East heralds the establishment in the country of a new lighter-carrying system. It is not simply a freight line. A component part will be a far-flung network of ports, including Magadan, Petropavlovsk-Kamchatskiy, Ust'-Kamchatsk, Beringov, Egvekinot, Pevek, Zelenyy Mys. As a rule, though, at points with no port facilities the mother ship will ride at anchor on the roadstead, haulage of goods up and down the coast will be by tug and lighter.

Plans for the winter envisage voyages by the "Aleksey Kosygin" to southern latitudes with cargoes for Vietnam, Campuchea and other South East Asia countries. Be that as it may, but for such a costly ship not to stay idle, two more sets of lighters are being built at Ministry of the Maritime Fleet ship-repair yards. Disencumbering itself of one load and taking aboard 82 new lighters, the ship will head back to its starting point. It is on shuttle trips like these that the lighter carrier will sail the high seas.

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