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for Transmashholding Partners

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Happy Journey!

Modern tramcar to undergo tests

The state-of-the-art 71–911 tramcar with a fully low floor is undergoing certification tests. The tramcar was designed by PK Transport Systems. The first tramcar was built this May by Tver Carriage Works (TVZ), a member of Transmashholding. In June-July, the tramcar successfully passed dynamic tests held in Moscow. Its certification tests will take two months.

Model 71–911 features a single-unit fully low-floor design and has no equals in the world. More than 80% of tramcar components are manufactured in Russia. Due to its modular design, the tramcar can be produced in different versions depending on the capacity and waggonage requirements to fit lines with any traffic and length, including commuter traffic. The tramcar design features unique patented flexible low-floor swivel bogies ensuring smooth movement and full compatibility of the tramcar with Russian urban infrastructure. The tramcar boasts an innovative diagnostic and control system and two independent climate control systems — one for the driver's cab and one for the passenger compartment.

The new tramcars are expected to appear on Russian streets as early as next year.

Recognition

3ES4K locomotive gets a certificate

Novocherkassk Electric Locomotive Plant (NEVZ, a member of Transmashholding) obtained a certificate of compliance with the federal railway transport standards for the commercial production of the Donchak 3ES4K locomotive. 3ES4K is based on Donchak 2ES4K, a freight DC commutator motor locomotive. Many mechanical units of Donchak are standardized with AC locomotive Ermak 2ES5K. A distinctive feature of 3ES4K versus the two-section model is a two-section booster (intermediate) unit that increases its power 1.5-fold and its hauling ability up to 6,000 tonnes. Employment of locomotives will allow for heavier train loads and higher delivery speeds along with lower car turnover and rolling stock maintenance costs.

Benefits of the new locomotive versus 2ES4K include motor axial roller bearings for increased mileage between scheduled maintenance and a pass-through between sections for easier shunting operations and maintenance.

The certificate is effective through July 2017. 3ES4K commercial production will be launched in 2015.

Modernization

New Penza turbo compressors

Designers and engineers of Penzadieselmash (PDM, a member of Transmashholding Group) have completed motorless tests of two pilot models of the new 25-series turbochargers to be used to upgrade basic medium-speed and high-speed diesel engines.

The new 25-series turbochargers are designed under the Federal Target Program "Industrialization of New-Generation Diesel Engines and Their Components in the Russian Federation". Higher efficiency of the new turbochargers will improve engine-operating economy. The TK25 series includes turbochargers both for medium-speed (TK2502) and high-speed (TK2503) diesel engines. Following the tests, optimization and gas dynamic calculations were made and design documents were refined.

The basic version of the TK2502 turbocharger is suitable for medium-speed diesel locomotive engines 8ChN26/26. New turbochargers will replace the outdated 14TK model installed on remotorized shunting diesel locomotives. The key feature of TK2502 is solid tired turbine wheels that enhance its reliability and efficiency. The expected turbocharger efficiency is 7–10% higher versus its equals. Service tests of TK25-series turbochargers are scheduled for 2015.

Production

DMZ presents a special-purpose EMU

Demikhovo Machinebuilding Plant (DMZ, a member of Transmashholding Group) obtained a compliance certificate with Federal Railway Transport Certification Registry for the commercial production of a new rolling stock, a special AC EMU EDS1R.

The special EMU to transport maintenance crews to RZD's infrastructure facilities will be placed into service for the first time ever. It includes two cars, one for work team needs, and one for equipment storage and transportation. It was built with working conditions in mind. The passenger compartment meets all modern sanitary, ergonomic and safety standards and is equipped with an HVAC system and an eco-friendly lavatory that can be used along the entire route, including in sanitary protection zones. The car is fitted with 2- and 6-seat couches with tables between them and has a kitchenette with a serving table, wash sink, dish dryer, cabinets, refrigerator, microwave oven, and electric kettle.

The new special-purpose EMU is designed on a standard ED EMU basis and incorporates proven solutions, standardized underframe and car body equipment for lower operating and maintenance costs.

Hitting the target

Reliable electronic equipment is vital for safe and efficient operation of rolling stock. Therefore, Transmashholding seeks to develop and expand its R&D units. One of them is Locomotive Electronic Systems (LES), a producer of electronic train control systems. This September, LES celebrates its 10th anniversary.

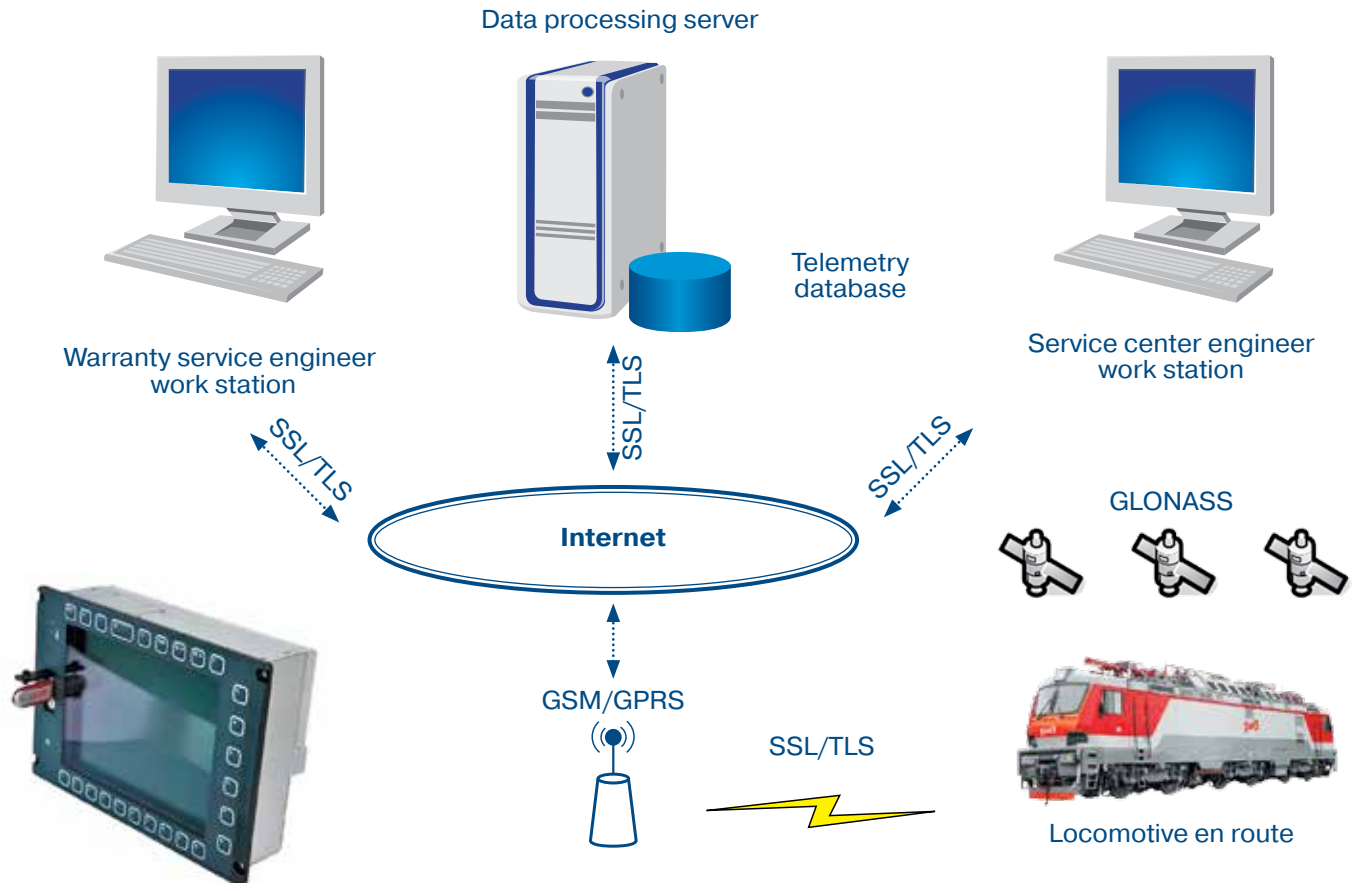


Figure 1. Remote monitoring system

The Company has had a long and fruitful history. Today, it manufactures the electronic 'core' of rolling stock management systems and test equipment, develops design documentation and software for locomotive control systems.

Additionally, LES develops new equipment, updates design documentation and software, and offers warranty and aftersales service.

Its major clients include PK NEVZ, Kolomensky Zavod (Kolomna Plant), and Luganskteplovoz.

OUR TEAM

A company's success always depends on its close-knit and dedicated team. Currently, LES's headcount is 94 people.

LES operates five business units: design unit, production unit, software unit, quality unit, and setup and warranty service unit.

35 electrical engineers qualified to grades from 4 to 6 with a vast experience in electronic equipment installation make up the backbone of the production unit. Average age of a specialist is 40 years.

CURRENTLY, MORE THAN 1,850 LOCOMOTIVES ACROSS RUSSIAN REGIONS AND CIS COUNTRIES ARE EQUIPPED WITH LES CONTROL SYSTEMS

Setup and warranty services are provided by 8 engineers with higher education and extensive work experience. LES representatives work at each depot that operates warranty locomotives ensuring prompt control system troubleshooting.

22 engineers are engaged in development and upgrade of electronic equipment. Qualified specialists, some with a degree in science, devise current activity and strategic development plans.

BACKGROUND

The Company started its operations in late 2004 with the production of pilot models of the MSUD-N control system for AC passenger locomotives EP1. At the time, the system was launched into commercial production and installed on electric locomotives EP1M, EP1P, 2ES5K, 3ES5K, E5K and 2EL5.

Introduction

In 2005, the Company's engineers jointly with All-Russian Scientific Research and Design-Engineering Institute of Electric Locomotive Construction (VEINII) embarked on the development of design documentation and software for control systems:

ALEKSEY IVANOV, DIRECTOR GENERAL, LES:

"The cutting-edge concept of designing rolling stock control systems is based on a modular principle. Each module is an independent subsystem with an integrated control and diagnostic system and standardized interface links to other subsystems. All rolling stock systems should incorporate maintenance-free and low-maintenance equipment and energy-efficient solutions.

To reduce the costs and time required for rolling stock building, the technical solution design phase should include development of a standardized base platform for modular rolling stock control and diagnostic systems that can be used, like bricks, to construct a control system for any type of rolling stock. Standardization ratio of such control systems should be at least 85%."

MSUD-001 (for freight DC locomotives 2ES4K, MSUD-K (for the upgrade of freight AC locomotives VL80TM/SM for Kazakhstan Railways), and MSUD-R (for pilot locomotive 3ES5K with enhanced package of features).

From 2005 to 2007, the Company manufactured and tested several system samples and began preproduction. At the same time, the Company launched commercial production of MSUD-007 control systems for PJSC "Kolomensky Zavod."

In 2008, batch deliveries of control systems for freight DC locomotives 2ES4K began.

In 2008-2010, control systems MSUD-N and MPSU-007 underwent a complete hardware and software upgrade, enabling the production according to own design documentation adjusted to operation experience and tailored to client needs.

In 2011, the Company's experts designed BRPD-004, a data recording and transmission tool that is integrated into locomotive positioning systems and transmits measurements to the server in real time. Since 2012 the unit has been supplied to PK NEVZ.

In late 2012, LES launched commercial production of equipment for control systems of the EP20 dual voltage locomotive and started deliveries to PK NEVZ.

Additionally, in 2011-2013, LES developed design documentation for a pilot sample of microprocessor control system MSU-013 to be employed in diesel locomotive TEP70BS. It was manufactured and successfully passed bench tests.

In 2013-2014, LES engineers and VEINII specialists designed documentation and software for microprocessor control system MSUD-015 for the 2ES5K class locomotives (3ES5K, 4ES5K) with enhanced diagnostic functions and individual axis control, as well as designed control system MSUD-001-01 for the booster section of the 3ES4K locomotive.

The systems were successfully tested and installed on the 3ES5K and 3ES4K pilot locomotives.

FOCUS ON QUALITY

One of LES's top priorities is a product quality control. The Company has introduced and certified a quality management system (QMS) integrated into its overall management system. QMS focuses on continuous operating improvement with regard to the needs of all interested parties, primarily the consumer.

Striving for continuous quality improvement, higher reliability and competitive edge of LES products, and aspiring to boost business profitability in 2015, the Company is planning on adoption of the International Railway Industry Standard (IRIS).

LOCOMOTIVE ELECTRONIC SYSTEMS (LES) WAS INCORPORATED ON SEPTEMBER 23, 2004 AS AN ENGINEERING COMPANY INVOLVED IN DESIGNING AND COMMERCIAL PRODUCTION OF CONTROL AND DIAGNOSTIC SYSTEMS FOR LOCOMOTIVES MANUFACTURED BY NOVOCHERKASSK ELECTRIC LOCOMOTIVE PLANT AND KOLOMENSKY ZAVOD (KOLOMNA PLANT)

Figure 2. Operating geography of locomotives utilizing LES systems

The Company's efforts in the field were awarded with 10th Anniversary European Quality Gold Medal.

THERE IS NO END TO PERFECTION

LES does not only design new systems, but upgrades the existing ones as well. Diagnostic and measurement recording software monitors equipment en route on an ongoing basis and displays error messages in case of emergency. Malfunction analysis helps improve the system's efficiency.

INTO THE FUTURE WITH CONFIDENCE

After 10 successful years of significant achievements, the Company looks into the future with confidence. LES engineers stay current with global trends in control unit and system design and manufacture and tailor their systems employed in rolling stock to customer needs.

The Company is committed to personnel development and training in advanced electronic equipment production technologies.

LES works in close cooperation with locomotive building plants, best designers and manufacturers of electronic equipment, and research institutes.

During these past ten years, the high scientific and technical potential of LES has earned the Company the position of Transmashholding's leading enterprise in the field of electronic devices.

Sergei Perov: "New metro cars to become safer and more spacious"

In many Russian cities the metro has always been the most popular and democratic public transport. It is no wonder that designers and developers seek to create the most up-to-date and comfortable rolling stock models.

SERGEI PEROV, HEAD OF TRANSMASHHOLDING'S PRODUCT DEVELOPMENT DEPARTMENT, SPEAKS ABOUT THE MOST PROMISING PRODUCTS

— Sergei Victorovich, the new law on technical regulations affects metro car manufacturers. What changes could this entail for rolling stock manufacturers and passengers?

— Passengers, who ride Transmashholding cars, will not notice any changes. The new regulations do not imply a review of the existing standards. In fact, the new regulations make the existing standards mandatory for all manufacturers. We will still have to meet the mandatory durability requirements, sanitary and fire standards. From now on, structural changes in new car models will be governed by the law and not by technical documents alone. This means that all manufactures will have to obtain certificates for each product. Until now it was voluntary. The new law makes it mandatory for all manufacturers regardless of their wishes.

Additionally, the new law provides for higher liability limits on the part of manufacturers and will make passengers confident that the new rolling stock fully meets safety requirements.

— The recent tragedy on the Moscow metro calls for a question as to how robust and safe modern metro cars are and what can be done to

minimize passenger risks in case of emergency?

— Today, over 6 thousand cars manufactured throughout these years by Metrowagonmash carry more than 15 million passengers in 19 cities of 11 countries worldwide.

However, traffic safety is basically a matter of efficient traffic management. Notably, the subway is least prone to accidents among all ground transport. As far as the design features of cars are concerned, I would like to underline that in Russia we maintain a much higher passenger safety level than in many other countries. Our metro trains stop automatically at red light or, for example, if the driver loses conscience, which is an extraordinary event. Speaking about durability, our car bodies are made of stainless steel. Aluminum is, of course, lighter, and aluminum car bodies are more cost-efficient. However, it is less durable and can even inflame in some situations.

A number of tests conducted in Russia proved that in the event of thermal action (for example, when the undercar electric equipment ignites) the aluminum car quickly loses its form and breaks down. This involves a greater risk for passengers inside the car and makes evacuation of the damaged train from the tunnel very difficult. Nevertheless, in some countries aluminum is still used for metro car production for economic reasons. In Russia, steel is the prime material.

I would like to stress that Russian standards prescribe much stricter requirements to passenger and rolling stock safety than anywhere else in the world. The same is true for sanitary standards to ensure comfortable environment in the passenger compartment and the driver's cabin, and requirements to car interior. Fire safety is also a priority — potential fire points are equipped both with automatic fire alarm and automatic fire fighting systems; fire-resistant materials are used in the car interior finishing. Therefore, even serious metro accidents have never led to car inflammation.

THE DESIGN FEATURES OF OUR TRAINS DELIVER A MUCH HIGHER LEVEL OF SAFETY FOR PASSENGERS THAN IN MANY OTHER COUNTRIES

Additionally, it is worth mentioning that very few metro cars across the globe are equipped with video-surveillance systems or emergency communication lines either with the driver or, like our cars, with a dedicated situation center that monitors the entire Moscow metro.

Our developers integrate innovative solutions into new model designs. For example, today, the cabin's front walls are equipped with ramp doors so that in case of emergency passengers can escape not only through the 'regular door', but through the exits along the train as well.

— Apart from reliability and safety, there are certain expectations in terms of comfort. Even during peak hours passengers do not want to arrive at their destination totally exhausted…

— Unfortunately, optimization of peak-hour passenger traffic and train schedule are outside of our area of competence. Our responsibility is to ensure most comfortable conditions for passengers inside the car. We never stop working — even at the launch of commercial production of a new model we keep searching for more efficient solutions. For example, in Moscow and some other cities there are passenger cars with wider doors for easier entrance and exit. Starting next year, we plan to manufacture cars with even wider doors. In line with our new barrier-free design concept, new cars will have a special platform for comfortable transportation of handicapped passengers (on wheelchairs) or baby carriages.

The car interior layout has been improved significantly for easier entrance and movement around the car. There is more standing room; handrails are installed in a more convenient location for easier access by standees. New models will have more visible and simple warning lights (to consider the needs of poor-sighted people).

Meanwhile, safety and comfort to a large extent depend on passengers themselves. Therefore, passengers are frequently warned through the public-address system that the metro is a high-risk mode of transport. Designers take every effort to minimize the risks. For example, currently, there is less chance of a passenger or clothing getting trapped between doors. Doors in new cars are equipped with so-called trapping sensors. If doors are not tightly closed, automatic devices get activated and the train won't start until the driver makes sure it is safe.

— Recently, the world has seen new models of metro rolling stock, differing by a streamlined and, in a manner of speaking, futuristic form. Is this a matter of improved aerodynamic performance?

— Honestly speaking, this is done for aesthetic reasons. The way of life is changing, and people want to see stylish trains. For a train moving like a piston in an enclosed space of a tunnel, the form and streamlined front do not play a significant role in aerodynamic performance. So, it is a matter of aesthetic appeal. On the other hand, it is important, since we are not living in the 1930s when the first metro lines were launched.

— What is, in your opinion, the basic difference between Russian and foreign-made metro cars?

— It lies in operating conditions of a city or country and infrastructure properties. For example, London's underground is one of the world's oldest, with small-size tunnels. Sometimes it is impossible to install air conditioning systems in cars

because there is not enough space. The widest cars run in Oslo, in tunnels cut in the rock. They are even wider than our customary commuter trains. In Paris, RER lines operate double-decker trains. Much depends on a given metro's infrastructure capacities, including the train size and equipment. Our cars are designed for very heavy loads. On the Moscow metro, an average number of passengers departing from and arriving at a station is larger than anywhere else in the world. Modern Russian cars are fully consistent with the Russian underground railway conditions, and this is how they differ from others.

OUR CARS ARE DESIGNED FOR VERY HEAVY LOADS, AND IN TERMS OF THEIR TECHNICAL LEVEL THEY ARE ON A PAR WITH THE WORLD'S BEST ANALOGS

As for everything else, just like almost all modern electric trains, Russian metro trains are equipped with electronic public-address and warning systems, air conditioning, airtight and soundproof doors. There is only one difference between our trains and many foreign-made trains — we did not have a pass-through along the entire length of the train that could help passengers move between more and less crowded cars. However, such trains are soon to come. The Mytishchi plant has already manufactured pilot models.

Speaking about the metro in general, comfortable trips are not only a matter of good cars, but efficient traffic management as well. Despite some drawbacks that are unavoidable in operating such a big facility, it is notable that Russia is the best-performing operator globally in terms of traffic intensity: during peak hours trains arrive every minute and a half. Smooth traffic and accident-free operation in such conditions are a difficult task that is successfully solved by the Metro personnel and car manufacturers. In the future, through a well-coordinated technical policy of national metro-car manufacturers adjusted to the Moscow metro plans, we are going to deliver cars with even better performance that, we hope, will match the growing demands of our passengers.

The 2ES5 locomotive, 25 kV DC 50 Hz, is designed for hauling freight trains on 1520 mm track gauge.

2ES5: DESIGN OUTPUTS AND PROSPECTS

THE FIRST RUSSIAN MAINLINE FREIGHT ELECTRIC LOCOMOTIVE WITH ASYNCHRONOUS TRACTION ENGINES WAS DEVELOPED BY TRANSMASHHOLDING JOINTLY WITH ALSTOM, A FRENCH MACHINE-BUILDING GIANT, BASED ON TRTRANS, A RUSSIAN ENGINEERING CENTER. WHAT SORT OF A LOCOMOTIVE DID THEY DEVELOP? YOU CAN READ ABOUT IT IN THIS ARTICLE.

Most of the innovative ideas implemented in the 2ES5 locomotive design were developed as early as the 1990s and are based on the extensive experience of operating VL80 class locomotives. However, the ideas could only be implemented when the market offered affordable cutting-edge electronic components, control, management and protection devices, traffic-safety management systems, information and data exchange and transmission technologies.

ERMAK'S POWER

In mid 2000s, a number of performance properties of RZD's freight locomotives were improved when the new generation locomotives 2ES5K ('Ermak') joined the fleet. However, the loco's power (6,200 kW) was not sufficient for hauling heavy trains (over 5,000 t). A booster section was designed for heavy trains, which is as powerful as one section of 2ES5K. The model was entitled 3ES5K. The first 3ES5K running results displayed an enhanced traction performance. However, regular operation of three traction modules for lighter train hauling decreased the locomotive's energy efficiency. There remained a need for a freight two-section AC locomotive for trains with a load rate exceeding 6,000 t. Analysis of traction and power properties of a prospective mainline locomotive showed that hauling of freight trains would require a locomotive with a continuous running duty over 8,000 kW. It excluded the possibility of a traditional design solution - the commutator traction motor.

NEW HERCULES

This inspired design engineers to design a conceptually new electric locomotive capable of performing according to the required freight traffic parameters and featuring commutatorless asynchronous traction motors. The locomotive's design utilizes dozens of state-of-the-art engineering solutions focused on improved work environment for drivers and maintenance personnel, enhanced reliability and increased time between repairs. The locomotive is highly compatible with the existing infrastructure.

GEOGRAPHICAL VASTNESS OF RUSSIA

Quality improvement of the rail freight traffic is impossible without timely re-equipment of the available fleet of electrically propelled vehicles and enhancement of its technical level. A persisting demand for international transportation services, intensification of overland traffic along the South-East Asia-Europe transportation corridor and, in this context, good chances for the Trans-Siberian line to become an important transportation link between the countries of Euro-Asian regions make re-equipment of the existing electric rolling stock a vital problem for railroad transportation companies.

Taking into account difficult operating conditions on the railroads of Siberian and Far-Eastern regions and pending annual freight traffic growth, locomotives equipped with asynchronous traction motors could become a promising type of locos suitable for those conditions. For the first time ever, domestic manufacturers embraced the production technology of

2ES5 key performance parameters

Purpose	Freight carriage
Design speed, km/h	120
Nominal overhead system voltage, kV	25
Wheel arrangement	2 x (2o – 2o)
Service weight at 2/3 sand capacity, t	200
Continuous shaft rating, kW	8,400
Starting rail tractive effort, kN, min	784
Efficiency rate in continuous operation, %, min	86

Below are only some advantages of the 2ES5 loco versus the previous-generation VL80 and 2ES5K locomotives:

Improved traction properties due to new traction drive control algorithms:

- individual axis control;
- adaptive slippage and skidding protection;
- rigid traction motor characteristics;
- higher adhesive weight utilization factor due to the design of bogie-to-body tractive effort transmission unit, and lower center of gravity due to traction transformer location under body

Lower traction power consumption:

- maximum efficiency in load range from 0.5 to nominal;
- power factor at 0.99 in load range from 0.25 to nominal;
- lower resistance to motion;
- lower auxiliary power consumption;
- power efficient control algorithm in automatic piloting mode;
- automated use of regenerative brake instead of pressure brake

Improved long-train traffic safety:

- automated control of a locomotive operating in distributed traction mode;
- automatic reduction of axial dynamic force in long and heavy freight trains and double trains; reduction of axial dynamic force due to appropriate substitution of electric brake with pressure brake

Adaptation to operation in insufficient power supply conditions:

- increased nominal power utilization range in overhead system voltage from 21 kV to 29 kV.

One-man operation option for the driver:

- extensive implementation of remote operating systems;
- enhanced diagnostic systems;
- high degree of control automation;
- engine-room video monitoring

Increased service life:

- use of low-maintenance equipment (traction motor, traction reducer, traction transformer, oil-free main compressor, driver's brake valve);
- body: 45 years;
- bogie frame, traction transformer: 40 years;
- electrical equipment: 20 years;
- traction tooth-gear transmission: 2 M km;
- bogie wheel: up to 1 M km;
- axle box bearing: 3 M km;
- rotor bearing: 2 M km;
- motor-axial bearings: 5 M km

Design features:

- two-axle bogie (welded, Flexicoil springs, cartridge axle box bearings with transmission of traction (brake) effort through slant thrust);
- 1 grade rod gear;
- traction drive with asynchronous motor and individual voltage inverter (axis control); auxiliary power consumption converter with automatic performance regulation and smooth air fan and compressor start;
- microprocessor control and diagnostic system;
- oil-free piston-type compressor with air drying and cleaning option;
- distributed ventilation system with regulated performance;
- energy absorbing devices for locomotive crew impact safety; modular pneumatic installation of stainless pipes and electrical installation by using spring clamps;
- equipment arranged in the body with pass-through along taxis

such electric locomotives, the 2ES5 being the first loco with this design.

World experience speaks in favor of such possibility, since the development of asynchronous traction motor locomotives is given priority across the globe. Owing to the low specific consumption of active materials, asynchronous traction motors as compared with commutator motors possess better mass and dimensions parameters and require lower maintenance costs. Moreover, the rigidity of mechanical/electrical characteristics provide for high values of coefficient of traction. A combination of these factors allows an increase of the locomotive's axial thrust to provide better traction performance, reduce maintenance costs and enjoy a number of other significant operating advantages.

Nevertheless, the acquisition cost of the electric rolling stock with asynchronous motor drives is by far higher (up to several times) than the cost of the electric rolling stock with similar axial thrust of constant-current commutator (intermittent-current)

THE LOCOMOTIVE DESIGN UTILIZES HUNDREDS OF STATE-OF-THE-ART ENGINEERING SOLUTIONS FEATURING IMPROVED WORK ENVIRONMENT FOR DRIVERS AND MAINTENANCE PERSONNEL, ENHANCED RELIABILITY AND INCREASED TIME BETWEEN REPAIRS

motors. This factor by no means decreases the competitive edge of the electric rolling stock with asynchronous motor drives and does not pose an obstacle to their purchase for re-equipment of the existing electric rolling stock, taking into account the lifecycle cost of various types of the new (fifth) generation locos and that of previous generations. A solution to this seeming problem can be reduction of the lifecycle cost with simultaneous reduction of the acquisition cost of the electric locomotive with asynchronous traction motors.

THE RUGGED WORKHORSE LOCOMOTIVE

The 2ES5 electric locomotive boasts high cost-performance ratios. These characteristics were not simply proposed by the electric locomotive designers, but they were a result of strict observance of technical specifications for development of the electric locomotive, which had been prepared by the customer – Russian Railways.

The parameters indicated in the design specification of the 2ES5 locomotive were formulated based on the Company's plans to handle freight traffic in the years to come in the context of annual freight traffic growth and critical operation territories. As to some characteristics of onboard information systems of the 2ES5 locomotive, a number of requirements were included in the requirements specification. They require that the information systems be equipped with cutting-edge devices based on the latest global achievements in the field of electronics, mechanical engineering and other high-tech industries.

Their design allows for longer runs between repairs as opposed to those of the previous-generation locomotives. This entails a considerable reduction of locomotive maintenance

A COMBINATION OF TECHNOLOGICAL FACTORS ALLOWS AN INCREASE OF THE LOCOMOTIVE POWER PER AXLE TO PROVIDE BETTER TRACTION PERFORMANCE, REDUCE MAINTENANCE COSTS AND ENJOY A NUMBER OF OTHER SIGNIFICANT OPERATING ADVANTAGES

costs and substantial improvement of the management of the Company's fleet.

The first-class mechanical suspension rod makes it possible to reduce dynamic loads both on the railway track and all units and parts of the electric locomotive.

The brake-track master system allows for reduction of the length of brake path in unfavorable weather conditions and at high running speed and wheel wear.

Tread-free (one-piece-rolled) wheels with service life of one million kilometers enable an increase of mileage between major repairs.

A modular operator's cab with automatic climate control meeting all modern sanitary, ergonomic and safety requirements allows for reduction of the locomotive's assembly cycle time.

A new fully integrated microprocessor-based control and fault detection

TREAD-FREE (ONE-PIECE ROLLED) WHEELS WITH SERVICE LIFE OF ONE MILLION KILOMETERS ENABLE AN INCREASE OF MILEAGE BETWEEN MAJOR REPAIRS

system is employed in the locomotive. The 2ES5 electric locomotive surpasses Ermak in terms of traction and output performance, which makes it possible to use the 2ES5 electric locomotive (twin-unit loco) instead of the triple traction unit of the 3ES5K locomotive in some operation territories. The 2ES5 electric loco is capable of operating in any point of traction area being limited by adhesion and maximum power of traction motors.

With a view to secure operation in different climatic zones of the Russian Federation, a number of efforts were made to adapt electronic components to winter conditions.

The used system architecture of the 2ES5 locomotive features a high speed of data exchange between control devices and reliability.

Among other enhancements, modeling of thermal processes of the operator's cab and the body under different ambient temperatures was performed, complex body strength analysis was conducted.

Modeling of thermal processes made it possible to assess the operability of equipment in the body without transporting the locomotive to the test area with extreme ambient temperatures. At the same time, it saved time for engineering and excluded possible design shortcomings.

Calculation of the body strength facilitated optimization of the design of the body's load-bearing elements, prevented unnecessary material consumption and retained the required safety margins of the construction.

The said works contributed to comprehensive designing of the locomotive.

UNDER THE AGREEMENT SIGNED JSC RZD WILL PURCHASE 200 LOCOMOTIVES 2ES5 BY 2020

IN EARNEST AND FOR LONG

The 2ES5 electric locomotive incorporated latest innovations of the global mechanical engineering industry and information technologies with regard to engineering and styling design, energy saving and information technologies in the area of transport.

The 2ES5 new-generation electric locomotive developed by PK NEVZ is capable of satisfying the growing demand of Russian Railways in the segment of AC freight transportation.

Outside-air filtering system, solid-state relays in low-voltage circuits, electric apparatuses for protection and control, new technologies to control thrust and auxiliary electric motor drive were among technical solutions and devices that ensure efficient operation of the loco's equipment.

Localization of production of import parts in the vicinity of the main assembly plant will provide for substantial reduction of the locomotive cost at serial production.

Additionally, the competitive edge of the 2ES5 may be increased through a leasing system if it is purchased by railway companies.

On June 28, a meeting of the interagency panel at Novocherkassk Electric Locomotive Plant (NEVZ is a part of Transmashholding) that considered the commissioning of the 2ES5 AC freight locomotive with asynchronous traction motor. The panel ascertained that the 2ES5 locomotive meets all requirements of the requirements specification and complies with all railroad transport safety regulations.

A certificate for production of the pilot batch consisting of 35 electric locomotives was obtained.

In total, five electric locomotives will be manufactured this year. According to an approved supply schedule, electric locomotives will be manufactured and delivered to RZD on a monthly basis starting in 2015. Development of a service base for maintenance of electric locomotives in turnover areas is soon to be completed.

In accordance with the agreement signed RZD will purchase 200 electric locomotives by 2020.

Locomotive Ermak: on th

THE 2ES5K AND 3ES5K ELECTRIC LOCOMOTIVES ARE THE MOST MASS PRODUCED LOCOS IN RUSSIA TODAY. HIGH DEGREE OF RELIABILITY, EASE OF OPERATION, HIGH-POWER CAPACITY AND COST EFFECTIVENESS — THESE ARE BUT A FEW ADVANTAGES OF ERMAK LOCOMOTIVES, WHICH ARE CONTINUOUSLY IMPROVED AND UPDATED BY ITS DESIGNERS. THE OPERATION EXPERIENCE ACCUMULATED OVER THE PAST 10 YEARS IS ALSO OF GREAT SIGNIFICANCE. GIVEN BELOW IS OUR STORY OF HOW IT HELPS DEVELOP AND IMPROVE THE ERMAK PROJECT.

e way toward perfection

Sergei Mitin, Head of Quality Management and Operation Analysis, Technical Department of CJSC Transmashholding, shares about his company efforts

TWENTY-FOUR-HOUR CONTROL

Vast experience in employment of twin-unit and triple-unit Ermak locomotives is at the core of the integrated system of performance reliability control, which helped significantly reduce the number of defects and the downtime of locomotives.

"Provided that approximately one fourth of all manufactured locomotives undergo warranty maintenance at our premises, a decision to establish such a system was quite logical," says Sergei. "Currently, 731 locomotives are assigned to six depots — Vikhorevka and Irkutsk-Sortirovochnoye (East-Siberian Railway), Amurskoye and Mogocha (Transbaikal Railway), Smolyaninovo and Khabarovsk-2 (Far-Eastern Railway)."

Warranty warehouses were set up in Vikhorevka, Mogocha, Smolyaninovo, Khabarovsk-2 and Amurskoye depots to maintain stocks of materials and spare parts to be used for eliminating the most common defects. This allowed us to reduce maintenance downtime during unscheduled warranty repairs and increase an inherent availability ratio. Readiness for repairs without additional time expenditure is only one of the measures taken. Routine maintenance is of great significance as well, let alone continuous efforts aimed at the improvement of the design of locomotives and the enhancement of reliability of their units and assemblies.

This is why a great deal of attention is paid to the analysis of causes of failures and their prevention in the future. Therefore, there are technical representatives of PK NEVZ (Novocherkassk Electric Locomotive Plant) at each depot who are always ready to render hands-on assistance to depot employees and a service company, where warranty locomotives are parked. At the same time, technical knowledge of locomotive crews, repairmen of repair depots and employees of the service company is very important to maintaining locomotives in serviceable condition. For a few years, PK NEVZ has been providing employees of JSC RZD and the service company with mechanical training both at the plant's training center and at the depot. Such training brings positive results.

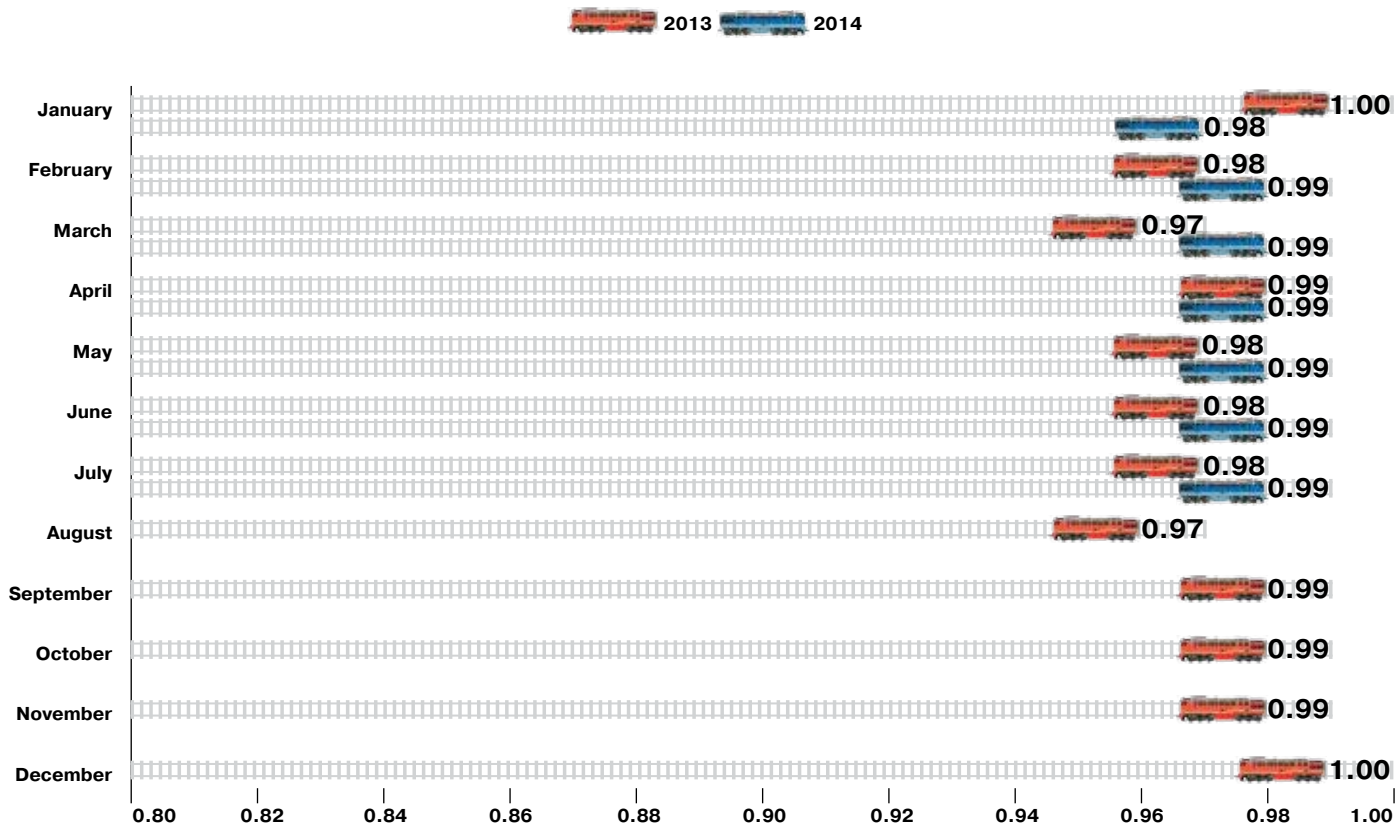
"A transfer of locomotives, full maintenance and, as first practical experience, organization of full maintenance at the Vikhorevka locomotive repair depot became another important phase of the program launched after the establishment of TMH-Service, LLC," says Sergei Mitin. "It means that under the warranty service we are able not only to monitor the locomotives status, but at any time to carry out full maintenance and repair right after detection of failure as well. This experiment proved to be a success and was extended to other depots, where Ermak series locomotives undergo maintenance.

ONE STEP FROM PROPOSAL TO IMPLEMENTATION

July of this year saw the Company's new approach to a feedback between the locomotive manufacturer (PK NEVZ) and its operators. An extended session of JSC RZD and PK NEVZ representatives was held in Rostov-on-Don. Representatives of the Far East and

AT EACH DEPOT, WHERE WARRANTY LOCOMOTIVES ARE PARKED, THERE ARE TECHNICAL REPRESENTATIVES OF PK NEVZ WHO ARE ALWAYS READY TO RENDER CONSULTING AND HANDS-ON ASSISTANCE TO DEPOT EMPLOYEES AND THE SERVICE COMPANY

Inherent availability ratio values of warranty fleet of the 2,3ES5K locomotives broken down by months of 2013—2014



Transbaikal locomotive depots took part in this video conference session. Specialists who are directly involved in maintenance and operation of Ermak series locomotives put forward their observations and suggestions, which were incorporated in the basis of specific technical solutions, which are currently developed at PK NEVZ.

A result of this dialogue was not slow to arrive. For instance, the inherent availability ratio, indicating the locomotive status, amounted to 0.99 compared to the normative value of 0.97. It means that 99 out of 100 locomotives are in a state of instant readiness for operation.

The locomotives upgrading program implemented in 2010–2013 serves as an example of how observations and suggestions of specialists of locomotive depots and the service company made it possible to improve useful qualities of the locomotive.

> INTERNAL AVAILABILITY RATIO INDICATING THE LOCOMOTIVE STATE MADE 0,99, WITH THE NORM OF 0,97. THIS MEANS THAT 99 OF 100 LOCOMOTIVES ARE ALWAYS READY FOR OPERATION

For instance, throughout these years, thanks to the cooperation with depot specialists, PK NEVZ specialists introduced more than 100 significant changes to the locomotive design, such as locomotive cabin windows, configuration and geometrical dimensions of the spokes of driving-wheel sets, software, NVA-55 hardware, casing for gear and a host of other items.

All of that made the locomotive operation easier. According to the feedback of our colleagues, this loco became one of the most comfortable and reliable locomotives as compared to other models.

COMPARED WITH THE LAST YEAR, ELECTRIC MACHINE FAILURES WENT DOWN DUE TO COOPERATION BETWEEN OPERATORS AND DESIGNERS

CLOSE COOPERATION WITH MANUFACTURERS

However, apart from the improvement of the organizational management at locomotive depots, numerous innovations were introduced in the manufacturing process. The enterprise erected what is known as locomotive quality boards. These boards carry information relating to the frequency and causes of locomotive breakdowns. Having received information from a depot about locomotive failure, quality assurance directors and managers of the quality control department hold workshop staff meetings to investigate reasons for the breakdown. If their root causes are in the manufacturing process, they will be eliminated in order to prevent breakdowns in the future. If the main cause is the misuse of equipment, appropriate recommendations will be given to drivers and maintenance staff.

As a result of all these efforts, reliability parameters meet requirements of technical specifications.

"This is another confirmation of the improved quality of our products.

To obtain performance records of the plants and verify whether locomotives' reliability meets technical specifications, Quality Day meetings are held on a regular basis. They are attended by heads of appropriate departments and directorates of JSC RZD and TMH-Service, LLC. Based on the results of the meetings, protocols are drawn up to offer a job list aimed at administrative and technical measures to improve the locomotive design. Such recommendations were taken into account at the manufacturing of the latest Ermak locomotive. The other day, PK NEVZ completed development of a more powerful model of the 4ES5K loco, capable of carrying cargoes of up to 7.1 K tonnes.

The state-of-the-art 4ES5K boasts an unprecedented capacity of 13,120 kW (one-hour efficiency) and enables operating heavy-tonnage trains in the eastern operation territory of RZD under complex terrain conditions. The 4ES5K locomotive is standardized with the serial Ermak family of locomotives of Novocherkassk Electric Locomotive Plant. Special attention is paid to the labor conditions of locomotive crews. The electric locomotive provides comfortable environment for locomotive crews — 'B' units are equipped with a lavatory and a lounge for locomotive crews, which satisfy all current sanitary, ergonomic and safety standards.

Establishment of situation centers is the next stage of development of the locomotive operation control system. Today, these centers operate not only at Novocherkassk Electric Locomotive Plant, but at Bryansk and Kolomna plants as well. The Company's specialists rely on these centers for online monitoring of the operation of all locomotives fitted with telecommunication systems. This resulted in manyfold decrease of the equipment breakdown response time.

A FEW WORDS ABOUT PROSPECTS

The accumulated experience in operation of Ermak locomotives and some well-

known events resulted in the guaranteed manufacturing quality and technical maintenance of locomotives and active development by the Company of cooperation with various equipment suppliers. Specifically, a plant has 2–3 potential suppliers for each type of products. There are domestic manufacturers who are also ready to supply components and parts that are now imported.

"We pay special attention to the quality of each unit and assembly used in the manufacturing process. Therefore, a possibility to perform a complete audit of their manufacturing process is one of the requirements to our suppliers," says Sergei Mitin. "Overall, I can point out that today there is an alternative to any supplier, and we are in a position where we can choose the best one."

SET-UP SITUATIONAL CENTERS MARKED ANOTHER STAGE OF THE ELECTRIC LOCOMOTIVE MONITORING SYSTEM DEVELOPMENT. IN THESE CENTERS THE COMPANY SPECIALISTS MONITOR OPERATION OF ALL THE ELECTRIC LOCOMOTIVES EQUIPPED WITH THE REMOTE DATA TRANSMISSION FACILITIES. THIS ALLOWED TO DRASTICALLY REDUCE THE TIME OF RESPONSE TO EQUIPMENT FAILURES

Kolomna plant "Kolom

1000th machine-gun cart

IN THE BEGINNING OF 20TH CENTURY KOLOMENSKY ZAVOD (KZ) ESTABLISHED IN KOLOMNA DISTRICT IN 1863 WAS ALREADY AMONG THE INDUSTRIAL LEADERS OF RUSSIA.

During World War I Kolomensky Zavod took an active part in supplying the Russian Army with arms and providing aid to the wounded. Its workers made charitable contributions and more than 2,000 plant workers were drafted.

Kolomensky Zavod with its vast experience in building narrow-gauge railroad equipment was the biggest supplier of steam locomotives and trolleys of different types for military purposes.

BY LAND

On December 6 of 1916, Kolomensky Zavod took part in festivities marking the 5,000th steam locomotive commissioning, which had been built by the order of the War Ministry and sent to the front line. The Kolomna plant was the first in Russia to achieve the number of 5,000 steam locomotives produced. To commemorate the merits of the enterprise, His Imperial Majesty's Edict allowed the steam locomotive to be decorated with a monogram of Emperor Nicholas II of Russia. Decorated with a laureate wreath and palm trees, the steam locomotive was triumphantly handed over to representatives of the Main Military Engineering Office. The best workers were awarded commemorative gold and silver badges with an engraved steam locomotive.

BY SEA

World War I spurred sales of diesel engines for Navy and Military Departments as well as defense industries. Kolomna diesel engines were installed on military ships and civil vessels. The 'Bars' submarines manufactured by Kolomensky Zavod were the first in the Imperial Russian Navy to be equipped with diesel engines. As early as 1910, Kolomna diesels were installed on the world's first riverine warfare craft — Shkval gunboats. In the summer of 1916, the Kolomna plant's new marine diesels were installed on the gunboats of the Amur flotilla.

Kolomensky Zavod fulfilled orders of the Navy for big steel casting parts of military ships: battleships Empress Maria, Alexander II, Ekaterina II, torpedo boats, armored cruisers Izmail, Kinburn, Borodino, Navarin, etc. All castings ordered by the Navy and parts processing were under constant personal supervision of marine mechanical engineers.

BY AIR

During World War I, the plant fulfilled military orders for development of new items, namely, manufacturing of fuses, French and government-issue grenades, machine tooling units designed for automatic production of barbed wire, machine-gun carts, field kitchens, wagon train hubs, and water boilers. In March of 1915, the Bochmanovsky plant of Emil Lipgard & Co partnership became an ammunition division of Kolomensky Zavod. It started manufacturing fuses, three-inch cast-iron bombs, primer cartridges and machine-tooling units for production of barbed wire. The plant continued mass production of machine-gun carts, with the first order received as far back as 1910. To fulfill the order, a machine-gun workshop with a floor space of more than 2,000 square meters was built. During the war, 350 handworkers were involved in that process, which enabled the plant to produce ten machine-gun carts daily.

ensky zavod" and war

EVERYONE TO THE FRONT

During the war, 2,376 men working at Kolomensky Zavod were drafted. It was impossible to replace them with experienced adult workers and the plant had to employ women and teenagers.

Servicemen' families were rendered substantial financial aid: every month single men who had been drafted received 1/3 of their wage, married men and those with families of less than four children — 1/2 of their pay, and families with four and more children — full pay. An ad-hoc Committee of Representatives composed of handworkers and employees was set up to help families whose men had been drafted. The plant's handworkers and employees contributed money to the Committee on a monthly basis, with monthly deductions from the salaries — from 1 up to 3%, and equivalent sums added to those deductions by the plant administration. There were 1,620 families in care of the Committee.

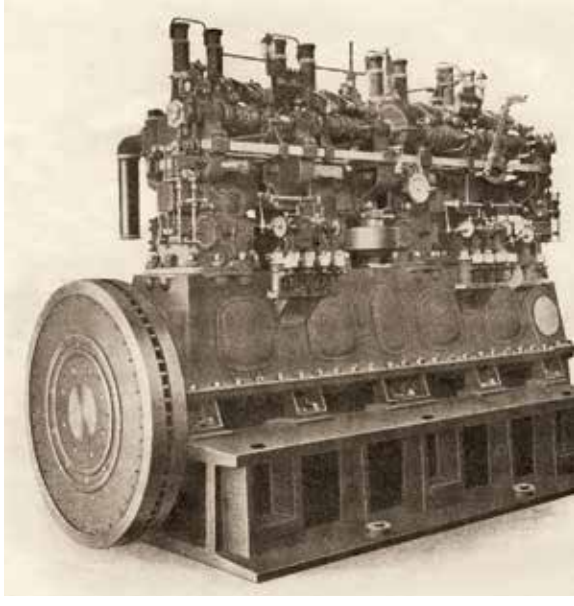
Due to the increased cost of basic necessities, war-time raises were granted to all handworkers and workers, as well as to employees whose salary was less than 150 rubles a month: the first raise was effective on April 1, 1915, the second one — on January 1, 1916.

Irrespective of the monetary allowances, Kolomensky Zavod started selling basic necessities at reduced prices beginning from June 1, 1915: rye-bread or rye flour, sifted flour bread, or first-grade flour, or coarse-granular flour, groats or millet, sunflower oil, salt, tea, sugar, and soap.

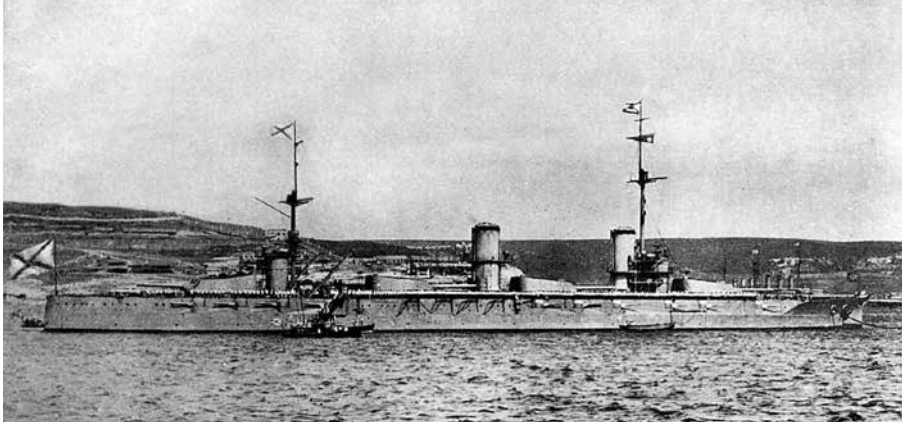
A total value of allowances, food benefits and other benefits to workers and employees of Kolomensky Zavod initiated by the plant administration from the beginning of the war until January 1, 1916 amounted to 562,818 rubles. Starting from 1916, after a nine percent raise in pay, the size of allowance was equal to almost 130,000 rubles every month.

To offer medical treatment to wounded soldiers, the plant administration provided 105 beds: 15 — in the plant's hospital, 83 — in the small hospital for employees and handworkers of Kolomensky Zavod and Consumer Society, 7 — in a private hospital. The plant's doctors worked for free in those hospitals. The plant's director organized in his own home a small hospital for employees and handworkers, and some wounded lived in employees' homes. To maintain the small hospital, all employees and handworkers volunteered to contribute each month from j up to S of their pay. The plant's X-ray room provided free services to all small hospitals of Kolomna District and some neighboring small hospitals in Ryazan Province. More than 1,000 wounded soldiers underwent treatment in those small hospitals.

Today, there are many representatives of the labor dynasties of Kolomensky Zavod whose ancestors worked for the plant 150 years ago and during World War I. The plant's employees continue the great traditions of valiant service to their Motherland.



The EDS-4H65 diesel for Amur flotilla. 1908–1915



Battleship Empress Catherine the Great. 1915

Ekaterina Bychkova

TRANSMASHHOLDING

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- mainline and electric industrial locomotives;
- mainline and shunting locomotives;
- freight and passenger cars;
- electric train and subway cars;
- rail buses and diesel trains;
- car casting;
- diesel locomotive engines and marine diesels;
- diesel generators and turbochargers;
- transport components;
- spare parts;
- repair and service maintenance.

OVER THE PAST FIVE YEARS, THE COMPANY HAS PRODUCED:

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over **4000** passenger cars

over **3000** electric train cars

over **230** rail bus cars

over **1500** subway cars

over **2700** diesels

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- Transmashholding is among WORLD'S TOP TEN LEADING MANUFACTURERS of railway equipment

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