MAGAZINE FOR PARTNERS OF
Transmashholding
№ 3 09/2013

TRP: Next-Generation Dining Cars

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Transmashholding

Contents

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A Magazine
for Transmashholding Partners

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Let's roll!

Tver Railcar Plant has handed over the first train of double-deck railcars to Federal Passenger Company. The train includes 15 railcars: 12 compartment cars, train master's car, a first-class sleeper car, and a dining car.

Double-Deck Railcars Delivered to Federal Passenger Company

Toward the end of 2013, Tver Railcar Plant (TVZ) is expected to assemble 50 double-deck railcars to be operated on Russian railways: three whole trains and replacement railcars.

Double-deck railcars represent a completely new form of rolling stock for Russia. They are meant to increase the passenger flow and make railway transportation more cost effective.

All railcars are designed with the use of energy-saving technologies. Centralized power supply reduces energy costs by 35 to 40%.

Double-deck railcars ensure significant maintenance cost savings compared to ordinary railcars.

Cooperation

New Maintenance Contract Signed

Metrowagonmash plant has signed a contract with the Moscow Metro for maintenance of 248 subway cars of the 81-760/761 series.

Under the contract, Metrowagonmash guarantees the daily availability of 29 trains (232 railcars) in a fully operational state. The plant is contractually obligated to perform all scheduled preventative maintenance and repairs.

Metrowagonmash has been entrusted with maintenance of the Novogireyevo electric train depot fleet that serves the Kalininskaya line of the Moscow Metro.

This is the first time that the Moscow Metro has signed a rolling stock maintenance contract that covers the entire lifecycle of railcars. As the contracted service company, Metrowagonmash will be responsible for the technical condition of railcars for 30 years.

The lifecycle contract is expected to help the Moscow Metro to reduce direct costs of railcar maintenance and repairs, phase out non-core operations, and increase the technical availability ratio of its fleet. The subway railcar producer's constant involvement in maintenance and repairs will make it possible to effectively implement the modifications aimed at improving overall passenger comfort and safety.

The Moscow Metro has been using Series 81-760/761 railcars since 2012.

Figures

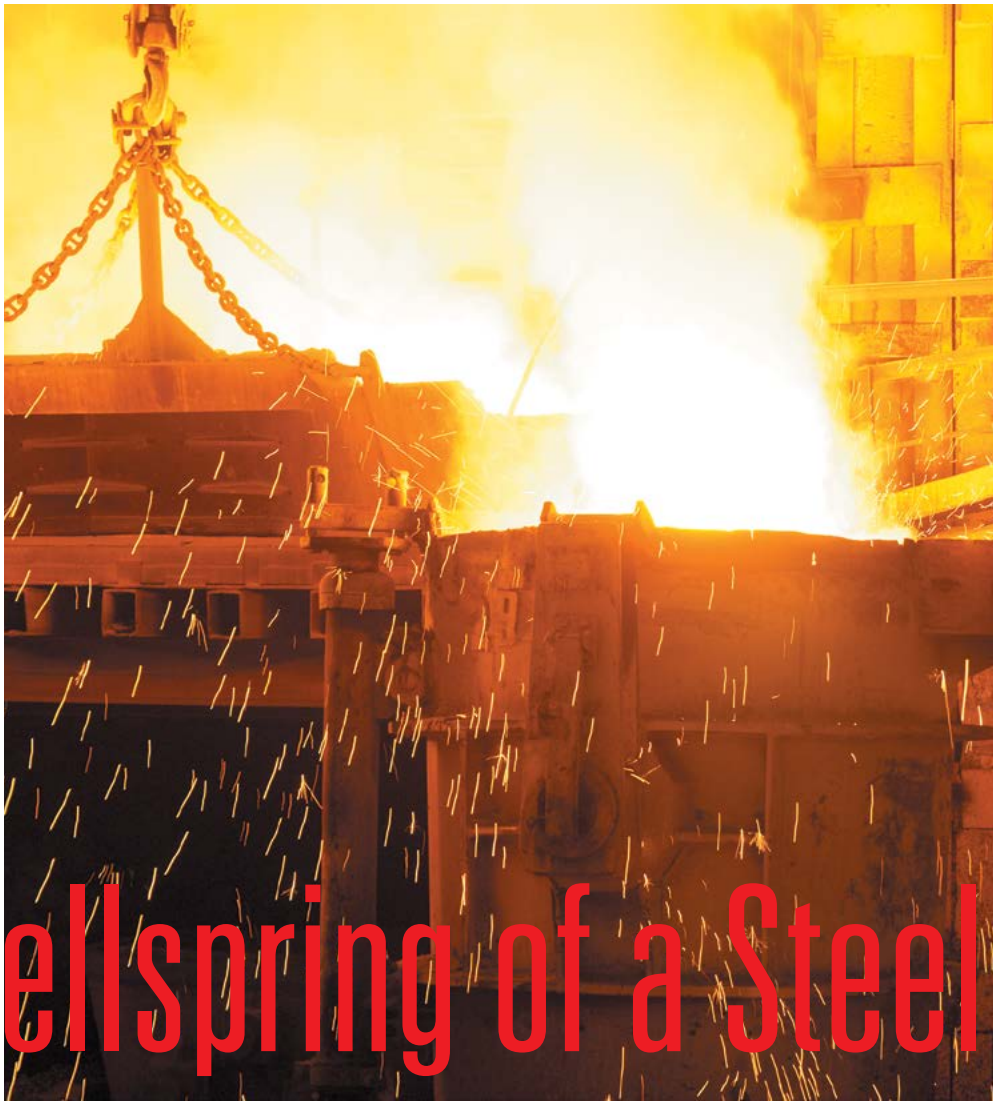
Sales of Transmashholding products and services are up **35%** in the first half of 2013 year-on-year to exceed **RUB 70 billion.**

Growth has been recorded in the key segments:

- Sales of mainline electric freight electric locomotives are **up 28% (249 sections vs. 195 sections)**;
- Sales of mainline electric passenger locomotives are **up 24% (from 41 to 57 units)** ;
- The output of shunting locomotives has increased twofold **(from 51 to 102 units)**;
- Sales of mainline diesel freight locomotives are **up 65% (from 68 to 112 sections)**;
- Sales of subway railcars are **up 71% (from 137 to 234 railcars)**.

Bezhitskiy Steel Mill takes pride in its glorious history and looks into the future with confidence. Since its inception in 1935 to this day, the plant has manufactured 6,354,000 tonnes of steel castings. It employs a staff of more than 4,000.

THE STEEL MILL SUPPLIES 36% OF THE RUSSIAN MARKET AND 18% OF THE CIS MARKET FOR RAILCAR CASTINGS.



At the Wellspring of a Steel

STEEL CASTING GIANT IN THE TOWN OF BEZHITSA

Bezhitskiy Steel Mill was established in 1935 in the town of Bezhitsa outside Bryansk. After World War II, Bezhitsa became of the districts in Bryansk as the city expanded. In those days, the steel mill's chief mission was to supply steel castings to railcar plants. Bezhitskiy Steel Mill, commonly known by its Russian abbreviation BSZ, had no equals not just in the USSR, but in all of Europe. The mill boasted an advanced product range and equipment that was unmatched at the time.

The first 20-tonne heat was produced on September 28, 1935, in the mill's only open-heath furnace. This day is considered the birthday of Bezhitskiy Steel Mill. Already in the latter half of the 1930s it evolved into one of the largest and most advanced enterprises in the Soviet heavy mechanical engineering industry.

The mill experienced its fair share of hardships. During World War II, BSZ staff had to be evacuated to Nizhniy Tagil. Yet it was here that BSZ employees joined Uralwagonzavod in manufacturing the famous T-34 tanks, thereby speeding up our WWII victory. On returning to Bryansk, the employees of Bezhitskiy Steel Mill rebuilt the destroyed plant and cast the first post-war steel in 1946.

The enterprise expanded with each passing year. In 1954, BSZ started manufacturing new axle boxes for railcars, both passenger and freight. In the 1950s, it added a shop that manufactured heavy T-180 tractors.

Eventually, Bryansk Automobile Plant was established on BSZ premises. Powerful T-180 tractors performed successfully in various climatic environments: in the Far North and in the sweltering south. Suffice it to mention as the Aswan Dam construction project in Egypt and road construction in the Crimea.

In the 1960s, the plant mastered the production of valves for petroleum

Steel production in an open-heath furnace

River

BSZ CEO V. Voronin, Bryansk Region Governor N. Denin, Deputy Governor K. Simonov, and TMX CEO A. Andreyev (left to right) launch the new automatic molding line

Andrei Andreyev addresses a meeting

pipelines and nuclear power plants. In 1985, BSZ was awarded the Order of the Red Banner of Labor in recognition of its achievements.

LIKE A PHOENIX FROM THE ASHES

A third rebirth of the steel mill began in 2002 when it joined Transmashholding (TMX).

Today BSZ is one of the few enterprises manufacturing virtually the entire range of castings for freight cars. Its products undergo constant design enhancements as the manufacturing technology and quality of steel castings are improved.

Bezhitskiy Steel Mill is a well-known trademark. The plant has a quality management system compliant with GOST ISO 9001–2011. Management is developing and preparing for certification of a business management system compliant with the requirements of the IRIS International Railway Industry Standard. In addition to improved product quality, this will streamline the plant's processes and enable it to meet customer needs more fully.

LAUNCH OF THE AUTOMATIC MOLDING LINE

A festive opening ceremony for the new line in July 2013 was attended by Transmashholding CEO Andrei Andreyev, Bryansk Region Governor Nikolai Denin, Russian Railways Vice President Anatoliy Meshcheryakov, BSZ director Valeriy Voronin, and many other guests of honor.

In his welcoming speech, Nikolai Denin said: "The enterprise has seen some dramatic changes in recent years. We have transformed and taken our grown to a new level. The retrofit project is a significant step forward taken by Transmashholding".

The governor made a point of saying that Bezhitskiy Steel Mill ranks first among the region's mechanical engineering plants in terms of tax

Production of rods using a Laempe rod machine

Bogie bolster

Bogie frame

revenue, accounting for almost 40% of the total.

TMX CEO Andrei Andreyev discussed the project and thanked Governor Denin for his assistance.

BSZ values its staff as a key asset. Management promotes social, art, and sports club activities and circles.

BETTER SOCIAL PACKAGE AND AMENITIES

Transmashholding and BSZ management goes to great lengths to improve the social package available to staff. The collective bargaining agreement for 2013–2015 further expands on certain vital points for employees, such as wage indexing, clearly defined work and leisure time, and occupational safety clauses. The existing social programs also provide for trips to health resorts for the children of staff members and financial aid to families with three or more children. The agreement makes a lot of provisions for the youth policy. It includes a detailed list of all the existing benefits, down to free lunches for the so-called List No. 1 workers, free health resort vouchers, and much more. Last year's spending on health resort trips amounted to RUB 1,200,000, or the average equivalent of 60–65 vouchers with 18 days of stay per trip.

In 2012, the plant spent RUB 750,000 on health resort trips and summer recreation for the children of staff members.

For women with children under three years of age, the work day has been reduced by 1 hour with pay.

Female workers with two children under 14 years of age have three extra vacation days with pay.

A great deal has been done to improve amenities for workers. The plant has commissioned two new administrative buildings for major casting shops, a canteen seating 150 for workers of Casting Shop 1, a canteen for workers of Casting Shops 2 and 3, complete with state-of-the-art cooking equipment and furniture.

Repairs are underway at the Sports Center, the campus for male workers, and amenity premises of plant shops. Major repairs at the Community Center are nearing completion.

YOUNG PEOPLE ARE THE PLANT'S FUTURE

The plant's Youth Council was established in 2008 at the CEO's initiative. BSZ is the first enterprise in the region to have organized an informal youth organization — a move that has already yielded results.

The plant's youth policy is aimed at improving the working conditions, helping to accomplish production targets, promoting creative initiative, shaping professional and business qualities in young employees, providing orientation for young workers and retaining them, and getting young people actively involved in cultural and mass activities.

Youth Council representatives contribute to social undertakings of the plant, helping to shape the social offering for young people. Thanks to the Youth Council, young plant workers are able to participate in various cultural, entertainment, and sporting events. Young workers get actively involved in activities organized by the Youth Committee at Bryansk City Hall, such as gala nights devoted to Fatherland Defender's Day, International Women's Day, all sorts of competitions, sporting events, and New Year's parties. A Physical Health Day with a picnic is now a well-kept tradition at the plant. The Youth Council administers the annual competition for best New Year's poster and much more.

The occupational profile of young people at the plant: engineers and technicians — 196, workers — 790. More than 100 workers are part-time students at various universities. The plant is sponsoring five students. Most importantly, all initiatives originate from young people themselves instead of coming from the top down.

In supporting the youth initiatives, plant management and the trade union

Casting molds produced on the automatic molding line

committee are want the young workers to pursue an active lifestyle and develop loyalty to their plant and occupation.

ENVIRONMENTALLY MINDED

Needless to say, steel making leaves a big environmental footprint, which calls for a responsible approach from management to environmental protection.

The overriding goal of Transmashholding's environmental policy is protecting public health and minimizing the adverse environmental impact of operations. To this end, the plant has an environmental protection office, an in-house production monitoring service, and an industrial health laboratory that constantly monitors the parameters of the ambient environment. All production process factors in the workplace area also thoroughly monitored.

BSZ uses various dust and gas trapping systems to reduce pollution. A new gas cleaning system that absorbs harmful emissions has been installed at the plant. It is a sophisticated array of engineering structures and processes that performs advanced treatment and disposal of waste, thereby protecting air against pollution with harmful substances. The nominal volume of gas cleaned by the system is 240,000 cubic meters. Residual concentrations of solid particles in the purified air do not exceed 10 mg/m^3. This is basically the same quality of air that we inhale while outdoors.

This approach produces exemplary results: an audit performed by Rosprirodnadzor and Rospotrebnadzor agencies in 2012 showed a significant improvement in the environmental status of the plant. The officials also praised the higher effectiveness of nature conservation efforts and other measures aimed at minimizing harmful impacts in the workplace.

A FOREMAN AS A KEY PERSON IN PRODUCTION

The first councils of foremen were created at Soviet enterprises back in the 1960s. They proved to be quite effective. In the tumultuous 1990s, the BSZ Council of Foremen sank into oblivion only to be revived in 2013.

The effectiveness of production mainly depends on human resources: the level of orderliness, team discipline, management of work processes on the scale of individual workers, crews, shifts, and stations. In all of this, the key role belongs to the foreman. Only the foreman knows best the potential of a process station, the capacity of equipment, and the skills of a worker. The foreman is the key person in production, and accomplishment of production targets greatly depends on his performance. The foreman must be a highly-qualified production man, a skilled organizer of work processes, and economist, a teacher, and a psychologist. He must be familiar with the capabilities of a process station, safety rules, occupational laws, and aspects of remuneration and on-the-job performance standards.

What are the most important traits for a foreman in a production facility? Professionalism, expertise, responsibility, and ability to organize work processes.

The Council of Foremen pursues several lines of endeavor: raising the educational and professional level of foremen; forming a close-knit team committed to delivering a quality product; raising the accountability of foremen and workers; improving labor discipline; improving working conditions and amenities; organizing cultural and mass activities; knowledge and experience sharing among foremen.

TRAINING CENTER

Plant management has been toying with the idea of setting up a training center for a long time. At many meetings the CEO was heard saying that today's worker needs comprehensive training, and that investment in education is the best kind there is.

Now that the Administration and Service Building of Casting Shop 1 has entered service, the first step in this direction has been already made. The plant has appropriate premises for the new training center available, complete with furniture, training equipment, test benches, and study manuals. The company has also purchased multimedia equipment for e-learning, thereby reducing the cost of training substantially. Now an instructor can conduct classes even from a different city. On-the-job training will take place directly at production sites under the supervision of experienced mentors with many years of experience.

The list of occupations in which training will be available at the plant's training center is currently close to 30.

The future of Bezhitskiy Steel Mill is

RAIL TRANSPORT IS VITAL TO RUSSIA'S ECONOMIC DEVELOPMENT, WITH THE RAILWAYS ACCOUNTING FOR MORE THAN 85% OF THE NATION'S FREIGHT FLOWS.

Meanwhile, economic growth calls for even faster expansion of the transport infrastructure and significant replenishment of the existing rolling stock fleet. Bezhitskiy Steel Mill is doing its fair share in helping the "locomotive of Russian Railways" pick up steam. The steel mill is run by CEO Valeriy Voronin.

Mr. Voronin, what does Transmashholding mean to your plant?

— Without a doubt, the steel mill would not have survived without Transmashholding...

The Ministry of Heavy and Transport Mechanical Engineering, a powerful and respected ministry to which our plant belonged, was disbanded in the late 1990s. Lead specialists, including four out of six deputy directors, abandoned the plant. The situation was dire. Production shrunk from 100,000 to 30,000 tonnes of steel castings. The plant was offered various solutions to survive, all the way to producing ferromanganese alloys. Pilot heats showed that while ferromanganese could be obtained in electric arc furnaces, the quantities would be insufficient even to cover the plant's own needs.

Fortunately, the plant joined the Transmashholding group.

New management helped with the financial rehabilitation of the steel mill and put in place clearly defined commercial mechanisms. All of this made our production process cost-efficient. To give you an example, during the first year of operation as part of the group, BSZ saw its output of steel castings rise by 45%.

We are stepping up production with each passing year. While in 2000 we made 30,475 tonnes of steel castings, 2012 output came to 57,253 tonnes. TMX is now successfully upgrading and expanding BSZ production facilities as part of a grand retrofit project. This is especially vital to the plant's future.

— Would you describe the BSZ retrofit project in more detail?

— Stage 1 of the retrofit project involved the launch in 2010 of a station for low-volume production of castings in molds from quick-hardening mixtures. It is equipped with a modern automatic boxless molding line by FTL (UK) that can produce six molds per hour. The plant has now mastered the production of over 100 steel castings, including such complex products as wheel bosses.

A comprehensive retrofit of Casting Shop No. 3 started in late 2010. The grand scale of this project is noteworthy. It costs RUB 6 billion! This is unprecedented in the history of the plant. We have renovated the existing buildings, built a number of new infrastructure buildings, installed three DPS-15 electric arc furnaces, finished assembling the Kunkel-Wagner automatic molding line, fuel supply and automation systems, mixture prepara-

in new technologies and equipment!

Profile

Valeriy VORONIN

Born in 1956 in Novocherkassk, Rostov Region. Started his career at Novocherkassk Electric Locomotive Engineering Plant (NEVZ), advancing from rank-and-file worker to Deputy CEO of NEVZ.

In 2005, got appointed as CEO of Bezhitskiy Steel Mill (BSZ) — a major producer of components and spare parts for freight and passenger railcars.

Over the many years, the plant has mastered production of various types of castings. BSZ produces the full range of products for a railcar assembly set, including the following assemblies: automatic couplers, energy absorbers, coupler yoke, and much more. The quality and reliability of products made by steel casters of Bezhitsa is known to be one of the best among similar products made by Russian enterprises.

DC electric arc steel furnace with 15 tonnes capacity

NEVER STAND STILL

IN 2012, BEZHITSKIY STEEL MILL INCREASED ITS OUTPUT

by **6%** year-on-year

to reach **57,253** tonnes

Solebar output increased by **14.7%**

Bogie bolsters up **1.5%**

Automatic couplers up **3%**

PMKP110 energy absorbers up by **18.6%**

tion and molding equipment, automatic rod machines and other equipment.

The Kunkel-Wagner automatic molding line entered service on July 27, 2013. We are now configuring it and perfecting the process of producing steel castings.

— What do you expect to achieve with the modern automatic molding line?

— This will mainly enable us to increase the precision class of castings, stabilize the quality of molds and steel castings, and eliminate manual labor almost entirely.

— And what do you expect from the retrofit project in general?

— The retrofit project will help us to create new jobs, reinforce our positions in the railway products market, and boost sales in the general market segment. The retrofit will also solve an array of problems: minimize the influence of human error on the production process, lower production costs, increase product quality and cost-effectiveness, and make our products more viable in the face of tough competition. It will also enable BSZ to maintain and reinforce its leading position as one of the primary producers of high-quality castings for rail transport.

— How do you manage your energy needs in light of the production retrofit project?

— Energy consumption by the plant will increase following the retrofit of Casting Shop 3. For this reason we are also upgrading the energy infrastructure that will use new energy-saving technologies and a modern shop heating system. We are finishing construction of a high-pressure gas pipeline to deliver additional gas quantities to the plant. The main 110 kV to 6 kV step-down substation is being retrofitted. There are no major or strategic complications; we only face multiple tactical difficulties in solving construction-related problems.

— Bezhitskiy Steel Mill products are known to offer one of the best quality of their kind. How have you managed to achieve this?

— We achieve this mainly by strictly observing all process requirements across all production cycle stages: from incoming inspections of materials and components to deliveries to consumers.

Modern requirements for the quality of castings and rolling stock safety impose stringent requirements on real-time analytical monitoring of the casting process and finished product quality. This is done by plant laboratories.

The Quality Control Department and plant laboratories monitor product quality at every stage. We are constantly developing and implementing measures to improve product quality.

In addition to the now traditional Quality Days, our departments have implemented computer-aided product accounting and analysis. Our database provides the complete product information, making it possible to measure its quality parameters at any stage of production.

— Does your plant develop new types of products?

— The plant, much like mankind, cannot exist without evolution. Over the many years we have successfully mastered production of various types of steel castings for rail transport, which enables us to manufacture products that stand up to the latest quality standards.

We produce the full range of steel castings for freight and passenger railcars, numbering over 100 articles. BSZ has successfully launched production of the SA3 1835.01.000 automatic coupler, and the PMKP110 energy absorber that uses a set of resilient polymer blocks instead of a spring set.

In 2012, we started producing castings for subway railcars. Next in line are castings for the wide range of locomotives produced by TMX.

Our experts are working hard to enhance the casting production technology and improve the mechanical properties of steel.

All of this explains why the quality and reliability standards of BSZ products are among the highest of similar products made by Russian enterprises.

— What else are you working on? For the long run, so to speak.

THE QUALITY CONTROL DEPARTMENT AND PLANT LABORATORIES MONITOR PRODUCT QUALITY AT EVERY STAGE

— We do not intend to rest on our laurels. We must make progress, constantly improving the quality and reducing production costs. To this end, we have signed a memorandum on strategic partnership with the United Railcar Company and a license agreement for the manufacture of large railcar castings for Barber S-2-R bogies. Under this agreement, we have received the full set of design documents for producing railcar castings for the bogies.

— Why have you selected the Barber S2R bogie in particular?

— The railcars currently operated in Russia use 18-100 bogies designed by Khanin. This design is over 50 years old. Despite constant upgrades, these bogies are becoming obsolete. Their base mean time between repairs is 110,000 km on average. Their service life is close to 20 years. Load per axle is 23.5 tonnes. The special design of the Barber S2R bogie developed for the Russian market incorporates the many years of experience in using these models. They are actively used in North America. The design of the Barber S2R bogie implements technologies that are new for Russia, which make it possible to build railcar undercarriages with safety, reliability, and lifecycle cost parameters that are unmatched in the Russian Federation and CIS member states. This project could not come at a better time. Unfortunately, rolling stock derailing incidents are happening in Russia due to breakages of the 18-100 bogie bolster. That's why we always instruct our workers to thoroughly observe the process requirements, as the life and health of passengers and attendant personnel ultimately depend on our products. We have signed this license agreement with a clear understanding that product upgrades are long overdue. We see this not just as an opportunity to expand our product range, but mainly as a way to create an innovative product that is sorely needed by the country and Russian Railways. The major advantages of the new bogie include the longer mean time between repairs (up to 500,000 km), load per axle of up to 25 tonnes, life span of wear-resistant components of up to 1 mln km, maintenance costs reduced by 50%, maximum speed of empty rolling stock increased to 120 km/h, and a stability safety factor higher by up to 30%, all of which translates into substantial cost savings.

This product is fully aligned with the strategic R&D plans of Russian Railways, making it possible to increase the load capacity of railcars, speed and safety of freight trains, and minimize impacts to tracks and infrastructure.

Our plant has the capability to start manufacturing the new Barber S-2-R bogie as soon as possible after certification testing. We have everything that is needed for this: vast technology expertise and a professional team. After all, the plant is not all about buildings and machines. First and foremost, it is defined by people, the dynasties of workers loyal to the plant. It is about experience transfer across generations. We were never in the middle league. We have always been one of the industry's best enterprises, and we intend to not only maintain this bar, but also raise it.

In addition to the restaurant section with tables, the dining car has a convenient bar with stools

Not a Railcar,

In 2003, the TRP team started designing a dining car. At the time, they were tasked with designing the car body alone. It was then that they designed the Model 61-4189 dining car that was included in the train of the famous Neva Express. One of those dining cars is running between Moscow and St. Petersburg to this day.

Tver Railcar Plant started manufacturing entire dining cars in

NOWADAYS, ALMOST EVERY TRAIN INCLUDES A DINING CAR WHERE PASSENGERS CAN PASS THE TIME OVER A MEAL. EVEN THOUGH IT STARTED MANUFACTURING DINING CARS ONLY 10 YEARS AGO, TVER RAILCAR PLANT (TRP) HAS ALREADY MADE GREAT PROGRESS IN THIS AREA.

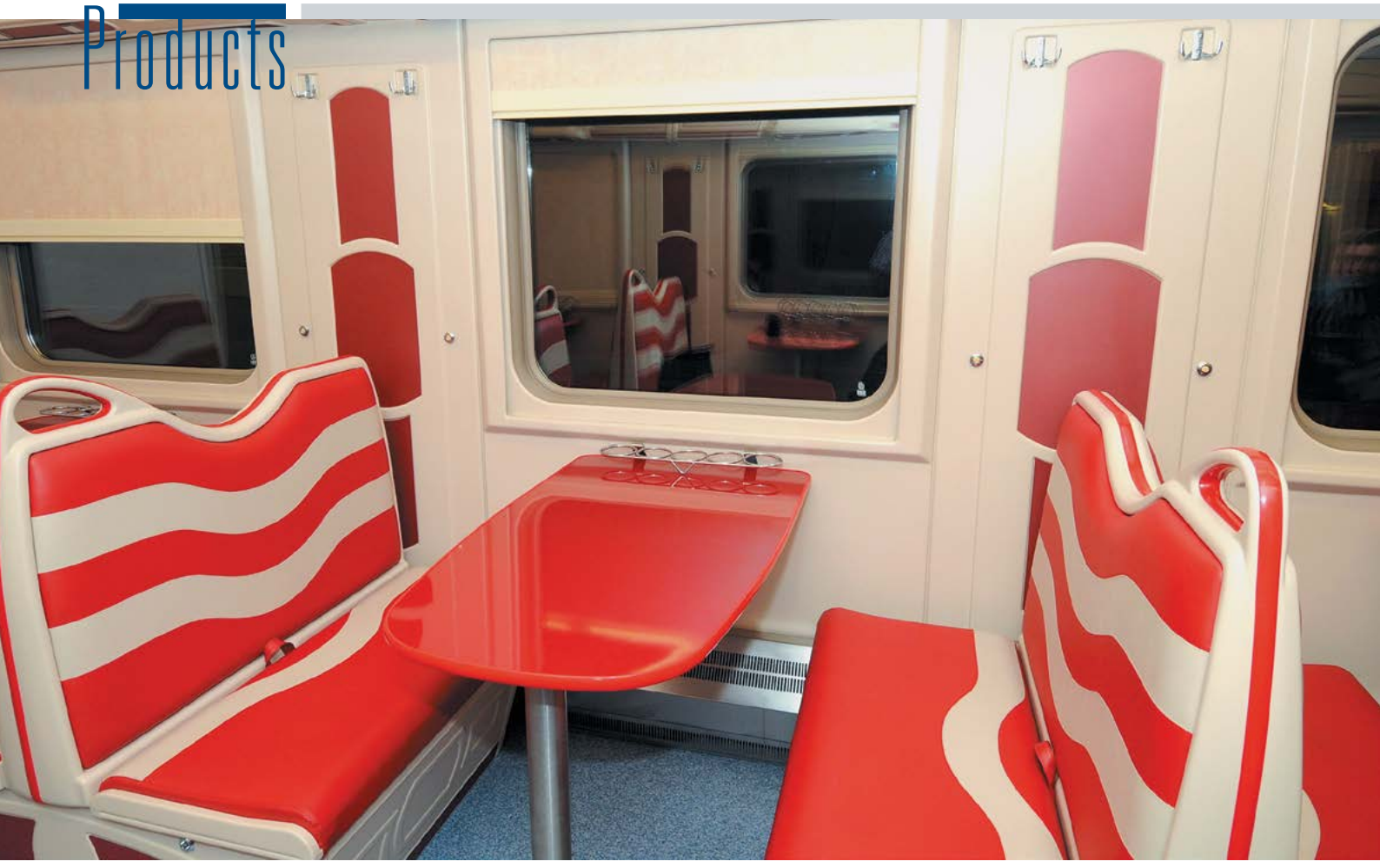
but a Restaurant

2008, when it designed models for the Red Arrow (connecting Moscow and St. Petersburg) and the Burevestnik (linking Moscow and Nizhniy Novgorod).

However, in 2010 a need arose to design new dining cars. This was mainly due to the fact that the rolling stock fleet of Russian Railways was depreciated by about 90%. Most of the rolling stock consisted of obsolete 30-year-old railcars.

Tver Railcar Plant designed and engineered the Model 61-4460 dining car having a new body with flat-corrugated plating of the exterior side walls and flat plating of end walls made from corrosion-proof steel. This model combines the best assets of other railcars of the same family.

It was later upgraded into Model 61-4464.



WHAT'S NEW?

The railcar is fitted with its own generator and an extra fuel tank so food can be prepared even when the train is parked or running at low speeds.

The arrangement of interior spaces in the railcar has changed compared to the old models. Now the restaurant section is separated from the bar by a kitchen space. This arrangement is

Model 61-4460 dining car

widely used in Europe. This is done to separate the flow of passengers into those who specifically come to the bar and those who visit the dining car to pass a longer period of time over a meal.

The new dining cars are designed to supply hot meals to both restaurant patrons and other train passengers who prefer not to leave their compartment for a long time. The dining car has large cold-storage spaces and purpose-built convection heaters for warming up food. Trays with prepared meals are passed into the aisle via a specially equipped hatch.

The advantages of the dining car will be fully utilized in trains formed using next-generation railcars because their monitoring, diagnostics, and control systems are compatible with those of the dining car.

Model 61-4464 railcar

TEAM AS THE BIGGEST ASSET

Tver Railcar Plant manages to keep up with the times and implement the latest designs thanks to a team of professionals who design and engineer the new dining car models. The design team includes many plant units: Chief Designer's Office, Chief Process Engineer's Office, and CAD Systems Office. They unite numerous units of various specializations that design the principal parts and systems of the railcar.

It is owing to the professionals in the design team that the plant is able to meet customer needs and create new railcars.

The restaurant will satisfy the most exacting patrons

Product Quality Must be Unconditional

Transmashholding is implementing modern failure mode and effects analysis (FMEA) methods. **TRANSMASHHOLDING QUALITY DEPARTMENT DIRECTOR VALOGI SUKHININ DISCUSSES ITS FEATURES.**

In recent years Transmashholding has been paying close attention to methods of ensuring consistently high product quality. Product sophistication and involvement of thousands of workers and hundreds of various resources makes this a far from trivial task that calls for substantial theoretical grounding.

An important aspect of the efforts aimed at increasing new product quality and a vital part of the Production Development Roadmap used by Transmashholding is the special requirement that FMEA, a tool for analyzing documented failures of products, be used as a risk analysis tool in developing new key components.

FMEA implementation at Transmashholding enterprises is still at its early stage. Nonetheless, it is already used in analyzing the experience of operating several select key components developed at Novocherkassk Electric Locomotive Engineering Plant (NEVZ), KMT production company, and Tver Railcar Plant (TVZ). Over the last three years, more than 100 technical professionals and engineers employed by Transmashholding plants have completed training in using this tool.

It is expected that as FMEA is gradually implemented, the structures and components that pass through FMEA will demonstrate higher reliability and strength after entering service.

WHAT IS FAILURE MODE AND EFFECTS ANALYSIS?

Failure mode and effects analysis, or FMEA, is a systemic method of analyzing the risk of failures. It is designed to identify the potential types of product and process failures, assess the risk associated with the particular type of failures, rank problems by severity, and determine and implement corrective action to resolve the most severe issues.

FMEA is an inductive method (direct logic) of failure analysis. It is a key aspect of reliability, safety, and quality engineering. Successful FMEA helps to identify potential types of failures based on existing experience using similar products or processes or proceeding from the common physics of failure logic. FMEA is widely used in manufacturing industries at various stages of the product life cycle.

There are four primary types of FMEA: System FMEA, design FMEA, process FMEA, and equipment FMEA.

System FMEA is used to analyze systems and subsystems at the early stages: concept and design. It mainly focuses on the types of potential system function failures caused the design. Design FMEA is used to analyze a product before it is put into production. Process FMEA is used to analyze production processes. Equipment FMEA focuses on the types of in-process equipment failures.

There are many industry standards providing guidance for FMEA application, such as GOST R 51814.2 — 2001, GOST R 51901.12 — 2007, SAE J 1739, and AIAG FMEA4.

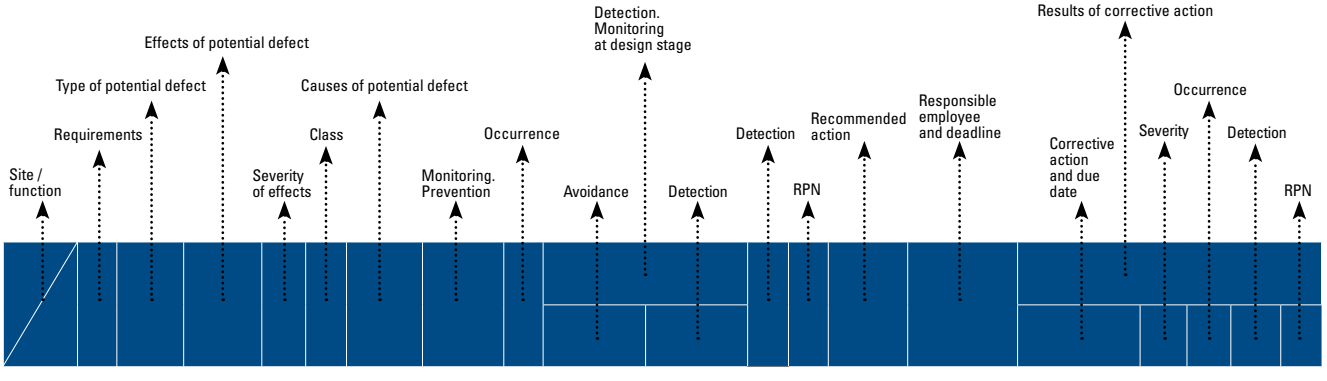
The following table, Analysis of types and effects of potential design defects, is a common example of a FMEA format

Analysis of types and effects of potential design defects

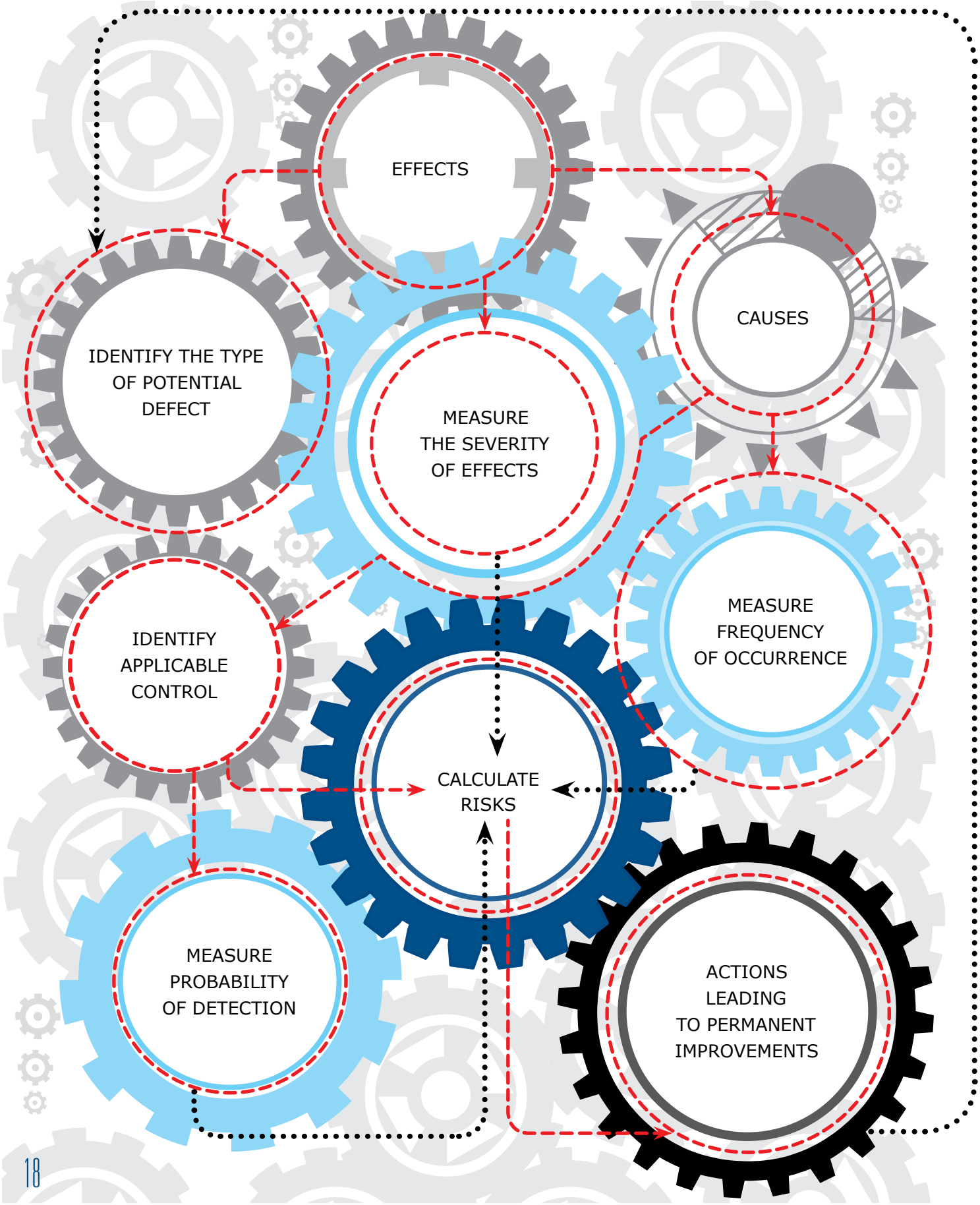
_____ System
_____ Subsystem
_____ Part _____
Model, year of manufacture (program) ____
Project team _____

Person responsible for design _____
Primary timeframe _____

FMEA number _____
Pages _____ of _____
Prepared by _____
FMEA date _____



Sequence of FMEA Process Operations



SEQUENCE OF FMEA PROCESS OPERATIONS

Simply put, FMEA uses a structured approach to predicting and preventing failures in design, production, and other functional areas where defects occur. It identifies those methods whereby a design or process can fall short of the customer's critical requirements by assessing the severity of defects and detecting them as they occur. There is a set of standard severity, detection, and occurrence scales and ratings based on which the priority score of a risk is determined. The priority score of a risk is then used to determine the first-priority measures that need to be implemented to improve the design or process.

For FMEA to succeed, the analyst must factor in all important types of failures affecting each element or system part. FMEA procedures can be implemented at system, subsystem, assembly, sub-assembly, or part level.

There are three primary cases for which the FMEA process must be developed, each case having its own scope and goal.

Case 1: New product, new technology, or new process. The scope of FMEA fully encompasses the entire design, technology, or process.

Case 2: Modification of an existing design or process. FMEA should focus on the modification of a design or process, the possible interactions as a result of the modification, and the documented history.

Case 3: Usage of an existing design or process in a new environment, site, in a new application or usage schedule. FMEA should focus on the impact of the new environment, site or application on the existing product or process.

In case of design FMEA, analysis should be planned and implemented concurrently with product design. If performed in a timely fashion, FMEA can help with the choice of design solutions. The benefits of FMEA as a design tool and a decision-making aid depends on the effectiveness and timeliness of detection of problems in the design.

Even though FMEA can identify all types of failures in parts, its major advantage is early detection of those types of subsystem and system failures that are critical and catastrophic, so as to eliminate or minimize them through design or process modifications when FMEA is used at the initial stage of development.

ADVANTAGES OF FMEA

Failure mode and effects analysis offers a documented method of choosing a design, production process or equipment with a high probability of success.

FMEA is a unified documented method of assessing the mechanisms of potential failures, types of failures, and their effect on system performance. It produces a list of types of failures ranked by severity of their impact on the system and probability of occurrence.

The FMEA tool is an effective method of assessing the effects of the proposed modifications on a design or production process. It acts as an important criterion in the planning of tests and inspections at the early stages of work on a product.

As a result, FMEA can help achieve a number of positive results at once: a more advanced design, high product reliability, higher safety, higher customer satisfaction, and reduction in overall costs that would have been otherwise spent on manufacturing a low-quality product.

The joint pavilion of Transmashholding and Alstom was one of the biggest and eye-catching

Alstom Transport President Henri Poupart-Lafarge was one of the keynote speakers at a railway mechanical engineering conference held as part of the exhibition

The highlight of the first day was the unveiling of the ultra-modern 2ES5 electric locomotive (shown in the photo is Novocherkassk Electric Locomotive Engineering Plant (NEVZ) CEO Sergei Podust welcoming a Russian Railways management delegation)

For the First Time in Russia

Transmashholding Draws Biggest Crowd at EXPO 1520

On September 11–14, 2013, the All-Russia Railway Research Institute (VNIIZhT) in Scherbinka hosted the EXPO 1520 Fourth International Show of Railway Equipment and Technologies. The exhibition drew several hundred companies and organizations that manufacturer products or provide services related to rail transport in one way or another. Exhibition participants represented not only Russia, but also CIS member states and overseas nations.

Transmashholding staged the largest pavilion featuring a total of 16 exhibits, many of which had not been previously showcased. This year company staged the largest display of its products of all the years that it has been participating.

Russian Railways President Vladimir Yakunin and Transmashholding CEO Andrei Andreyev inside the modern modular diesel train

Over two dozen EP20 dual-system electric passenger locomotives have rolled off assembly lines

The KZ8A electric locomotive is a joint project of Transmashholding, Alstom Transport, and Kazakhstan Railways

The latest Vityaz modification now features an MTU diesel engine

Interior of the modern electric locomotive: light, comfortable, and safe

The console of a modern locomotive comes straight from a sci-fi space ship

TE33A locomotives are manufactured in Kazakhstan under a General Electric license

Transmashholding is the co-owner of the plant manufacturing TE33A locomotives

2ES5. Presentations today; heavy-weight trains on the Trans-Siberian Railroad tomorrow

The exhibition featured several modern and promising locomotives manufactured by Transmashholding plants and overseas joint ventures in which TMX has a shareholding. Besides the two electric locomotives based on the ultra-modern platform (EP20 and 2ES5), visitors saw a new modification of the Vityaz locomotive with a diesel engine made by Germany's MTU (2TE25AM), two modifications of Lugansk-made 2TE116U locomotive (triple-section 3TE116U locomotive and 2TE116UD locomotive with a General Electric diesel motor), as well as two locomotives made for Kazakhstan Railways — KZ8A and TE33A.

TEM19 is a new type of locomotive on our railways

Modern shunting locomotives have light and comfortable cabs

The fuel tank is a distinctive feature of the gas-powered locomotive

TEM LTKh is the only four-axle model in the lineup of Transmashholding shunting locomotives

TEM18V is a time-tested locomotive with a new traction unit

Design team leader Vladimir Chernyshev presented the new locomotives at the exhibition

TEM33 and TEM35 locomotives are highly unified with interchangeable modules

Transmashholding has presented five new shunting locomotives to suite any taste. Transmashholding designers have engineered a number of locomotives that have no equivalents in the Russian mechanical engineering industry: the TEM19 gas-powered locomotive, the TEM33 locomotive with two diesel engines, and the TEM35 hybrid locomotive. Also unveiled were the locomotive TEM18V (with a diesel engine made by Finland's Wartsila) and the locomotive TEM LTH — a joint project with colleagues in the Czech Republic and Lithuania.

As part of its expanding diesel train production, Stadler is planning to start making traction modules in Russia

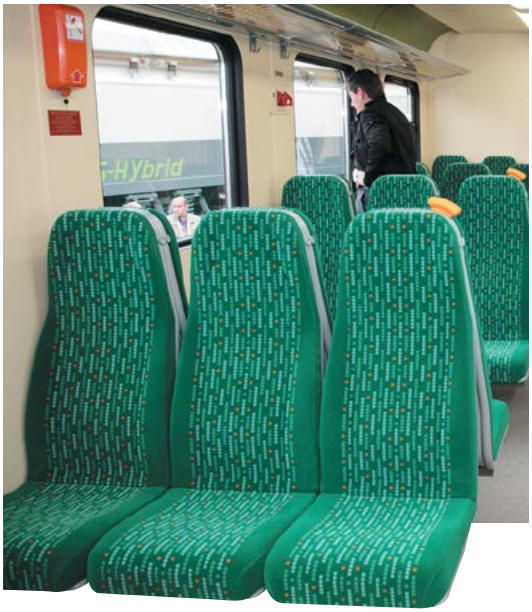
The train was presented to the accompaniment of an orchestra with lady drummers

The train features a modern convenient console

Train design really stands out on our railways. The DPM will turn heads at any railway station

The centerpiece on the “passenger” side of the exhibition was the ultra-modern modular diesel train, known by its Russian abbreviation DPM, developed by Metrowagonmash specialists jointly with Switzerland’s Stadler. It is the first train with a traction module in the history of Russian transport mechanical engineering: the primary equipment has been removed from the space under the railcar and moved to a dedicated module installed between railcars. Operating equipment inside the module does not create discomfort for passengers, produces less noise and vibration.

Seats with an eye-pleasing greenish trim in the passenger cabin. Seats of virtually any shape and color can be used



This is the second time for the ED4M-500 electric train at the exhibition

The ED4M-500 cab offers a comfortable working environment for the locomotive crew

IN SEPTEMBER 2013, KOLOMNA LOCOMOTIVE PLANT (KOLOMNA PLANT OJSC SINCE 1994) MARKED ITS 150TH ANNIVERSARY. IT HAS BEEN PART OF TRANSMASHHOLDING SINCE 2005.

Technical Director Viacheslav Shelemetyev discusses the recent achievements of Kolomna Plant.

Kolomna Locomotive Plant: 150 Years Serving Russia

EP2K: MISSION POSSIBLE!

Kolomna Locomotive Plant was established in 1863. At the turn of the 20th century, it was confidently positioned as the leader of the Russian steam and diesel locomotive engineering industry. The plant currently ranks among the flagship Russian plants in such areas as design and production of locomotives and diesel motors for railway rolling stock, shipbuilding, thermal and nuclear power plants.

— In April 2008, Kolomna Locomotive Plant delivered the first shipment of six new EP2K mainline DC electric passenger locomotives to the Barabinsk depot of the West-Siberian Railway. Meanwhile, over 200 electric locomotives of this model were in operation by August 2013.

EP2K was designed by Kolomna Locomotive Plant on a commission from Russian Railways to phase out the obsolete Czech-made ChS2 electric locomotives, becoming the first Russian-made DC electric passenger locomotive.

— EP2K is successfully fulfilling the mission of phasing out old electric traction stock. The principle of modular arrangement of equipment, developed by Kolomna Locomotive Plant designers, have been further perfected in the locomotive. The electric locomotive has a design speed of 160 km/h and power output (1-hour rating) of 4,800 kW, or 14% more than the ChS2 locomotive. Meanwhile, the traction force has been increased by 20%!

Thanks to the designers' consistent efforts in improving their design, the EP2K electric locomotive has achieved the parameters declared in the technical specs and for two years now has been consistently topping the ratings of new Russian-made locomotives. The factor of technical availability of EP2K electric locomotives currently in operation is 0.98 to 0.99 versus the factor of 0.97 declared in the technical specs. The parameters of the Type 1 and Type 3 failure flow are also in line with the technical specs.

— Assisted by the plant, the home depots of Barabinsk and St. Petersburg have implemented an effective infrastructure that enables the service company to perform timely and quality maintenance and repairs on the electric locomotives. — During the four years that they have been in operation, the cumulative distance traveled by the EP2K locomotives is nearing 80 million kilometers.

TEP70BS: COMFORT MEETS RELIABILITY

— In the early 2000s, the chief objective of locomotive engineers at Kolomna Locomotive Plant was to design a passenger locomotive with a system providing centralized power supply to train cars. A locomotive like this — TEP70BS (the “BS” index commemorates Boris Salambekov, Hero of the Soviet Union and director of the October Railway, for his meritorious service during World War II) — was designed by plant engineers. The first unit was built at the plant in 2002.

Milestone anniversary

Among the specific constructional features and new solutions used in TEP70BS, it stands to mention the highly efficient 2A-9DG-01 diesel generator, the system supplying power to the train cars, and the MSU-TE microprocessor-based control and diagnostics system. It is also worth mentioning the highly efficient cooler fan, a new operator console with improved ergonomics and a screen showing the operational parameters of the locomotive. It also includes the KLUB-U integrated locomotive safety device, an air conditioner in the driver's cab, high-strength electrically heated windshields and side windows, pantograph-type windshield wipers with electric motor drives, and much more.

— Mass production of TEP70BS started in 2006. More than 210 locomotives of this series left the assembly line by the end of August 2013. TEP70BS can be used in virtually all climatic regions of Russia and have been exported to the Baltic nations, Belarus, and Uzbekistan. They have proven to be very reliable thanks to time-tested systems and assemblies.

STRIVING FOR PERFECTION

Seeking to offer products that meet contemporary international requirements, Kolomna Locomotive Plant annually directors 15 to 25 million roubles of net profit to research aimed at further improving its locomotives and diesel engines.

— This research is underway at the plant year in and year out. The latest technology breakthroughs and solutions are introduced into product design in a phased process in line with customer preferences.

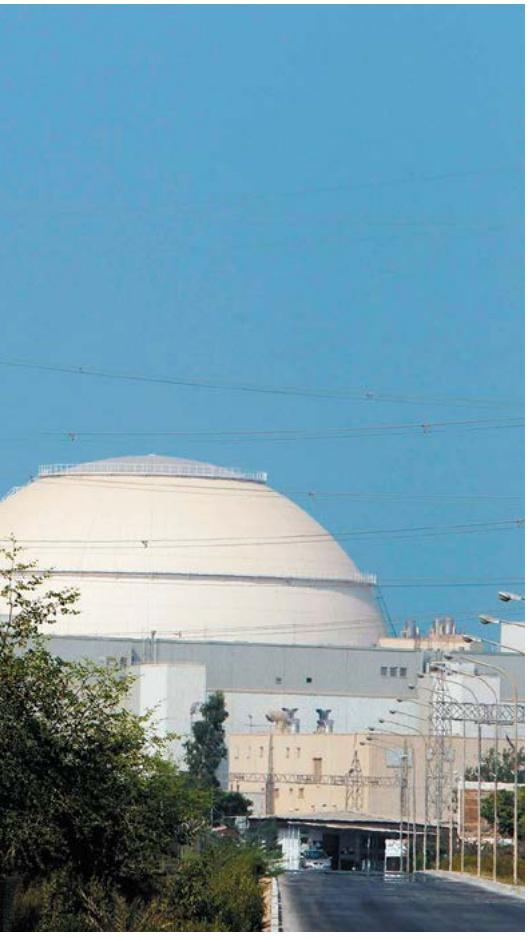
Kolomna Locomotive Plant has not been conducting fundamental development of locomotives in recent years, because Transmashholding decided to set up a locomotive engineering competency center in Novocherkassk. Two primary enterprises have been designated as new equipment designers: Bryansk Machine Building Plant and Novocherkassk Electric Locomotive Engineering Plant.

— Still, the plant has celebrated its 150th anniversary by ushering in a new stage in locomotive engineering: Kolomna Plant engineers have designed a modification of the TEP70BS locomotive with a traction unit based on the 2-9DG-03 diesel generator equipped with an electronic fuel feed control system. This will make the locomotive even more economical and reliable. In August 2013, the first specimen of the 2-9DG-03 diesel generator successfully passed inter-agency testing.

DEVELOPMENT OF DIESEL MOTOR ENGINEERING

Kolomna Locomotive Plant has been making a hefty contribution to the Russian diesel motor engineering industry. Besides the traditional application of diesel engines as traction units for railway rolling stock, the plant has succeeded in designing and manufacturing diesel engines used in nuclear power engineering. In 2003-2005, the plant shipped diesel generator sets to provide backup power supply for the Busher nuclear power plant (Iran). In 2012, the plant delivered diesel generator sets for the fourth power unit of Russia's first fast-neutron reactor power plant in Beloyarsk.

— Distinctive features of Kolomna-made diesel generator sets for nuclear power plants include their efficiency and reliability demonstrated in actual and simulated (including emergency) backup power supply tasks at nuclear power plants. Assemblies and parts of diesel generator sets, the diesel motors proper, and ancillary equipment have been designed and manufactured by Kolomna Locomotive Plant according



IN 2003—2005, KOLOMNA LOCOMOTIVE PLANT SHIPPED DIESEL GENERATOR SETS FOR BACKUP POWER SUPPLY OF THE BUSHER NUCLEAR POWER PLANT (IRAN)

to individual quality plans, and have been accepted by competent specialists of Rostekhnadzor and Rosatom.

Kolomna Locomotive Plant maintains and reinforces its leading positions in the Russian market and a number of overseas markets through its participation in the National Technology Base Federal Targeted Program in the category of Setting up and Manging the Production of Next-Generation Motors and Components in the Russian Federation in 2011–2015.

— As part of this program and contracts signed with the Russian Ministry of Industry and Trade, Kolomna Locomotive Plant started designing and building a promising next-generation multipurpose diesel motor in 2011. It is code-named D500 (based on the maximum power output per cylinder in HP). In 2012-2013, the plant successfully designed the new diesel motor and built an experimental full-scale single-cylinder compartment of the D500 motor (size 26.5/31), which has been tested to measure parameters and optimize the operating process of the future diesel motors. In 2013, the plant is planning to manufacture a full-scale experimental specimen of a 12-cylinder diesel motor for a freight locomotive, and in 2014 — an experimental specimen of a 20-cylinder diesel motor for future nuclear power plants.

Plant designers will shortly start designing a diesel motor with an increased power output for newly built vessels of the Russian Navy.

Happy sailing!

In recent years, Kolomna Locomotive Plant built a whole series of master propulsion units for modern battle ships and non-nuclear submarines under contracts with the Russian Navy, such as 1DDA 12 000 (power output: 12,000 HP) based on the 16D49 diesel motors, and 5DRA (power output: 2,000 kW) based on the 11D42 diesel motors for next-generation ships built as part of projects 20 380 and 18 280.

In May 2006, Severnaya Verf (North Shipyards) shipbuilding plant floated out the Steregushchiy lead corvette as part of project 20 380. In 2008, the Steregushchiy entered service with the Russian Navy. Two more corvettes, Soobrazitelnyi and Boykiy, have entered service just recently. Meanwhile, Kolomna Locomotive Plant is supplying 1DDA 12,000 diesel generator sets for a fifth corvette currently under construction.

— In October 2010, the first frigate (project 22350) named Soviet Union Fleet Admiral Sergei Gorshkov was floated out in St. Petersburg in a festive ceremony. The name of the frigate and its two diesel motors 10D49 (serving as cruise engine as part of the DGTAM55R combined diesel and gas turbine generator set) represent the town of Kolomna and Kolomna Locomotive Plant itself. This frigate will be turned over to the Russian Navy in the immediate future. On October 28, 2004, a fourth-generation non-nuclear submarine named St. Petersburg was floated out at Admiralteyskiye Verfi (Admiral Shipyards) as part of the Lada project. The master propulsion unit of this vessel is the 28DG diesel generator designed and built by Kolomna Locomotive Plant, which makes it possible to operate the submarine at considerable depths with increased air rarefication and exhaust back pressure parameters. The Russian Navy has decided to build a series of Lada class submarines.

In late August 2013, the plant completed a successful test program for a new shipboard motor built by Kolomna Locomotive Plant and used as part of the DRRA3700 reverse geared diesel set (project 11711) for a new major assault landing ship of the Russian Navy.

Proudly Built at Bezhitskiy

PHOTOS BY: VALERIY ZAKURDAYEV

IN THE LATE 1960S, RUSSIAN RAILWAYS EXPERIENCED AN EPIDEMIC OF FREIGHT TRAIN ACCIDENTS CAUSED BY BROKEN AUTOMATIC COUPLERS OR BRITTLE FAILURE OF FRAMES AND BARS IN THE WINTERTIME. The Railway Ministry of the USSR ordered the manufacturers of railcar castings and rolling stock research institutes to design next-generation automatic coupler castings with a yield strength of 40 kg/mm^2 and KCU impact toughness of 2.5 kg • m/cm^2 at ambient temperature of minus 60 degrees Celsius.

This task had no equals in terms of its ambition and scale. At that time, all parts of automatic couplers and bogies were cast using grade 20L steel with the following delivery parameters of castings: yield strength of 25 kg/mm^2 and KCU impact toughness of 5 kg • m/cm^2 at a temperature of plus 20 degrees Celsius.

Bezhitskiy Steel Mill joined the design process to accomplish this task right away. The plant started working on the new steel grade, researching its heat treatment and weldability properties. A technical board was set up, led by Chief Engineer V. S. Andreychikov. It included the following lead specialists: central plant laboratory chief E. A. Bekerman, candidate in technical sciences; chief metals engineer A. P. Lubenets; Metals Office head M. S. Sokolovskiy; open hearth shop deputy director L. E. Pers; casting laboratory director P. S. Sergeyev; and welding laboratory director Zh. G. Dmitriyeva.

The challenge was in developing the kind of steel for the automatic coupler, which would be also suitable for other castings. Heats from large open-heath furnace ladles were used to cast a very broad range of railcar castings: frames, bars, automatic coupler body, coupler yoke, axle box, and so forth. The major obstacle was that the plant was unable to obtain alloying components. The defense industry was prioritized in the country, and all resources went toward the development of armaments.

After considering the available options, the plant opted for steel 20GL, which was smelted using ferromanganese, ferrosilicon, and aluminum. The plant had no practical experience producing castings from this steel. It was uncharted territory. This immediately gave rise to questions as to mold flow properties, heat treatment, and weldability. At the same time, the plant was mastering the production of new frame and bar castings for the TsNII-KhZ-O bogie (light-weight).

Such high-profile institutions as VNIIV, MIIT, and TsNII MPS supervised the project and made active contributions. Project participants were offered postgraduate scholarships at TsNII MPS

Steel Mill!

Lead Research Fellow All-Russia Railway Research Institute (VNIIZhT) L. N. Kosarev

Head of Welding Laboratory Zh. G. Dmitriyeva

to get the BSZ specialists personally motivated and to step up engineering efforts. Foreign language, philosophy, and history courses were arranged at the plant to help students pass qualifying examinations for a Candidate's degree. Six months later, the students passed the examinations, and theses on the subjects of steel smelting — L. E. Pers, M. S. Sokolovskiy, heat treatment — A. A. Komarov, and weldability — Zh. G. Dmitriyeva earned the status of scientific research projects. Steel was smelted on a daily basis in the induction furnace of the casting laboratory as the team experimented with the chemical formulation, cast specimens, and tried out various heat treatment methods to obtain the desired mechanical properties. The plant's mechanical laboratory worked around the clock. Hundreds of specimens were tested in the space of 24 hours. Pre-test cooling containers and special templates for marking the cut lines along the heat-affected zone were developed.

It was then that the team started using the concept of "equivalent carbon" routinely. Eventually it became the indicator of steel weldability for each heat. Laboratory achievements were immediately replicated in the open hearth. In addition to steel microstructure studies, specimens were tested for strength, impact toughness, and fatigue at various temperatures. Series of castings were tested under static and dynamic loads. Field tests were conducted in low temperatures of northern and eastern railways. This work was carried out by TsNII MPS at the materials and structures testing department of the casting laboratory supervised by L. N. Kosarev, candidate in technical sciences. Following many years of work performed by countless specialists, toward the end of the 1970s steel grade 20GL used in casting parts for the TsNII-KhZ-O bogie and automatic couplers at Bezhitskiy Steel Mill significantly differed from the steel grade described in GOST 7832-65.

The 20GL low-alloy steel for railcar castings started to be made under technical specifications TU24529073 under strict carbon and manganese restrictions needed to ensure the desired quality when casting defects are remedied by welding. The castings of the automatic coupler body and the coupler yoke were hardened and tempered, and frames and bars were normalized. These heat treatment methods produced the desired mechanical properties of parts that differed significantly despite the identical chemical composition of steels.

This professional victory of the BSZ team went down in the history of railway mechanical engineering. The paper themed Increasing the Strength, Operational Reliability, and Running Performance of Existing and New Types of Railcars, their Assemblies and Parts reads: "The technology of casting parts for the TsNII-KhZ-O bogie from 20GL grade steel was developed and implemented at Bezhitskiy Steel Mill". The plant is constantly mastering new types of castings while working with the 20GL steel, seeking to increase its longevity and raise the fatigue strength safety margin for frame parts and bars to 1.2–1.4–1.6. The 20GL steel turned out to be more cost-effective both in the Soviet times and in the contemporary market conditions. It has far from exhausted its technical potential. Many Russian and Ukrainian plants use this steel to cast parts for their rolling stock. Progress is not standing still. Today it is facing the enterprises with new challenges of increasing the fatigue strength safety margin of castings to 2. Starting 2014, the KCU impact toughness indicator of 1.5 $kg \cdot m/cm^2$ at minus 60 degrees Celsius will also apply. For many years the plant has been conducting research and experiments with a view to improving the performance characteristics of steel by developing effective microalloying and metal modification technologies, and additional treatment to remove impurities and gases. In the near future, the efforts to improve the quality of steel will be accompanied by deployment of modern equipment for secondary processing of metals, which will open up new opportunities for the 20GL steel.

The staff of Bezhitskiy Steel Mill is currently actively working on perfecting the technology of making castings with the use of the new automatic molding line as well as castings for the Barber bogie. This a new step forward in preparing the plant for the future in the face of mounting market competition.

Based on memoirs of All-Russia Railway Research Institute (VNIIZhT) Lead Research Fellow L. N. Kosarev, candidate in technical sciences, and Bezhitskiy Steel Mill welding office director Zh. G. Dmitriyeva.

TRANSMASHHOLDING

PRODUCTS AND SERVICES OF THE HOLDING:

- 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:

over **3000** locomotives

over **4000** passenger cars

over **3000** electric train cars

over **230** rail bus cars

over **1500** subway cars

over **2700** diesels

- Transmashholding is NO. 1 IN CIS COUNTRIES in terms of the volume of rolling stock production and sales
- Transmashholding is among WORLD'S TOP TEN LEADING MANUFACTURERS of railway equipment
- Transmashholding is THE ONLY RUSSIAN COMPANY to have experience in creation and manufacture of the machinery for the arctic service
- Transmashholding machinery is operated IN ALL CLIMATIC REGIONS OF THE EARTH

Latest shunting locomotive TEM TMH

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