ON CONTRIBUTION OF RAIL SECTORIAL UNIVERSITIES TO SCIENTIFIC AND TECHNICAL DEVELOPMENT OF JSC RUSSIAN RAILWAYS

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ABSTRACT

The article presents an analysis of participation of rail specific (sectorial) universities in the scientific and technological development of the holding company JSC Russian Railways. Examples of promising innovative projects implemented by the commission and with the assistance of the railway transport business are given. The ways of further improving the effectiveness of research activities of university teams and their creative collaboration and partnership with railway specialists are offered.

Keywords: railway university, railway transport, development, cooperation, research and technical development, priorities.

Background. *For railway universities the importance of their participation in the scientific and technical development of the holding company Russian Railways cannot be overestimated. [In Russia there are 9 universities that are founded by Federal railway agency, traditionally called «railway universities» and having close partnership ties with railway business – note of the editorial board]. The main results of this interaction is the formation of scientific schools and trends, themes of search and fundamental scientific research, improvement of material base of educational, scientific and industrial laboratories, improvement of quality of training of specialists for railway transport in the university environment.*

Obvious examples of the positive results of this cooperation in Omsk State Transport University (OSTU) are:

– participation in the reconstruction of locomotive depot Volkhovstroy of Oktyabrskaya railway in 2000–2003, which became a foundation for development of scientific direction in technological readiness of maintenance and repair of traction rolling stock;

– participation in 2000–2002 and 2003–2005, in the implementation of two programs of cooperation of railways and railway universities of Eastern region of the country «Reduction of operating costs due to optimizing the transportation process and introduction of new technologies and equipment», which determined further development of scientific schools on energy efficiency and energy saving, current collection system of electric transport.

The most important outcome of the cooperation was the creation of a number of technological and diagnostic equipment for repair and maintenance of rolling stock and technical means of railway infrastructure. This is primarily mechanized complexes for repair (disassembling, assembling) of bogies, technological areas for disassembly and assembly of wheel-motor units, the technological position of repair of traction motors and auxiliary electrical machines, certain types of non-standard technological equipment for repair and restoration of components and equipment of locomotives and cars, as well as automated systems for test, control and diagnostics of technical equipment, components and assemblies of railway equipment (Pic. 1–4).

Objective. *The objective of the authors is to consider the contribution of railway universities to the scientific and technical development of JSC Russian Railways, based on the analysis of OSTU activity.*

Methods. *The authors use general scientific methods, comparative method, analytical approach, economic evaluation, scientific description.*

Results. *The priority directions and the themes of work of scientific and technical activity of OSTU for railway transport were formed:*

1. Improvement of energy efficiency of traction power supply and electric rolling stock:

– development and creation of an automated system of control and accounting of energy on electric rolling stock and feeders of contact network on the basis of new (innovative) electric energy measurement method with a possibility to determine power consumption per train traction within the boundaries of tariff zones, borders of railways and problem areas with reduced indicators of energy efficiency of the use of electricity per traction;

– updating application of power quality standards and legal regulatory framework for Russian Railways in view of specific features of construction of the traction power supply system due to the need for simultaneous electrification of railways, industrial and agricultural loads, settlements and cities, as well as a necessary measure of application of inefficient schemes of electrification of rail transport with reduced coefficients of use of the set capacity of transformers and unbalanced load;

– development of standardized filtration units and cross reactive power compensation in AC traction network with automatic power control;

– development of technology of application of electrical energy storage in the systems of traction power supply and non-traction power.

2. Monitoring the quality of current collection, improvement of the technology of diagnosis and design of devices of contact network and catenary and pantographs of rolling stock:

– scientific substantiation of the service speed with account of minimizing the cost of operation of speed and high-speed ERS taking into account resource and environmental performance of the current collection system;

– development and organization of production of contact elements of current collectors of speed and high-speed ERS;

– automated control system of current collectors of high-speed ERS at the exit to the main line;

– development of devices of built-in diagnostics of current collection systems, current collectors and contact network.

3. Technological support of repair and maintenance of rolling stock:

– conducting technological audit of locomotive and car-repair enterprises and preparation of programs to improve the efficiency and quality of repair;

Pic. 1. Automated test stand of rectifier-inverter transformers AC electric locomotives.

Pic. 2. The diagnostic complex for rheostat tests of locomotives.

Pic. 3. Complex for automated testing of power semiconductors.

Pic. 4. Technological disassembly position of wheel-motor blocks of locomotives.

Pic. 5. The laboratory of construction of catenary, power lines and current collection.

– development and implementation of process documentation and non-standard equipment for maintenance and repair of rolling stock, its components, assemblies and elements;

– development of diagnostic equipment and instruments for monitoring the technical condition of parts and assemblies of rolling stock.

4. Improvement of efficiency of work of new series of locomotives. Development of speed, rapid and heavy traffic on the Trans-Siberian Railway, increasing the capacity of the Trans-Siberian railway and BAM:

– modernization of interval control of trains for organization of high-speed traffic on the basis of development of algorithms and methods for determining the exact coordinates of the head and tail of the train, using existing track circuits on the basis of a proven mathematical apparatus of comfort images;

Pic. 6. Teaching and research development laboratory «Metallurgy and structural analysis of metals and alloys».

– development of projects of traction and energy supply of speed and high-speed traffic;

– research and analysis of possibilities of technical equipment of infrastructure, which ensure interval railway traffic control and development of measures to increase the capacity of main lines;

– development of scientifically-based standards of weight and train driving modes.

5. Investigation of the corrosion status and protection against corrosion of underground metal constructions of rail transport:

– development of methods and hardware-software means of determining the state of corrosion of reinforced concrete supports of overhead power lines and catenary;

– development of the system of remote monitoring of engineering state of ground facilities and railway facilities from pulsed electromagnetic influences.

6. Improvement of operation of technical equipment and railway infrastructure:

– devices and systems of signaling, centralization and blocking;

– technical means of power supply of railways and subways;

– systems of communication and informatization support.

Over the past five years, research results have been implemented in the whole complex of works on plans of STD of JSC Russian Railways, the main ones are:

1. Development of techniques for conducting energy audit of facilities of JSC Russian Railways, formation of energy certificates, energy efficiency programs and improvement of energy efficiency of operational systems.

2. Evaluation of the energy efficiency system of traction power supply and electric rolling stock and the potential of its increase.

3. Scientific and methodological support of experimental work on the permanent training ground for the study of regenerative processes.

4. Formation of a new model of technical operation of the locomotive fleet on the basis of technical condition monitoring and technical audit on the Eastern range.

5. Automated system for calculating the traction current in the reverse electric traction network of direct and alternating currents.

6. Methods of analysis and forecasting of consumption of energy resources for train traction.

7. Creation of an automated system for monitoring and accounting of energy of ERS and FCC of traction substations.

8. Development of electric energy efficiency indicators and methods of their determination.

9. Development of techniques of valuation, planning and analysis of the use of diesel fuel for locomotive according to the on-board metering or speed measuring tapes.

10. The method of calculating free capacity at the facilities of traction and stationary power supply of infrastructure complex of JSC Russian Railways.

All research in OSTU is conducted on the modern laboratory and experimental base (Pic. 5–6).

During this period, the volume of work performed on the orders of structural subdivisions of the functional branches, subsidiaries and affiliates of JSC Russian Railways was 363,9 million rubles., including plans of STD295,4 million rubles. Nevertheless, there was a significant decrease in the volume of scientific and technical production, the main reasons of that process started from 2013, in our opinion, are:

– transfer of the locomotive fleet to service companies for maintenance and repair of and unreadiness of LLC TMX-Service and LLC STM-Service to invest money in the development of service locomotive depots;

– lack of funding for scientific and technical developments on the railways and enterprises of JSC Russian Railways;

–transition to a system of determining a contractor through the auction (tenders) on the electronic trading and procurement platform of JSC Russian Railways.

Even after reaching the stage of conclusion and subsequent execution of works under the contract there are new challenges:

– reducing the cost of the work of the expert group under the commission of JSC Russian Railways for prices;

– liability only on the part of a contractor (deadlines, quality of work, etc.);

– difficulties in obtaining from the customer materials and documentation required to perform the work;

– closure of works as a whole, without phased drawing up acts and payment of work performed;

– long process of coordination of results, low responsibility of functional customers for the terms of coordination;

– long payment periods – 45–60 days.

In our opinion, in the coming years for JSC Russian Railways innovative projects of railway universities will continue to be promising and popular.

It is primarily participation in the programs on organization of high-speed traffic: examination and experimental verification of design solutions embodied in STR «Railway power supply of the section Moscow–Kazan of a high-speed main line Moscow–Kazan–Yekaterinburg; technical standards and requirements for design and construction»; conducting aerodynamic and dynamic research of current collectors of ERS.

In connection with the ongoing intensive replacement of main freight and passenger locomotives built in the Soviet time with modern, much more powerful, increasing weight standards of trains it is necessary to develop a concept for development of a traction power supply system and a program for its implementation that will eliminate existing and prevent possible restrictions of railway capacity due to insufficient capacity of equipment of traction substations and contact network.

In terms of perceived gaps in improving the operation and technical upgrading of power supply systems of non- traction consumers of railways compared to urban and regional power grid it is expedient to develop a concept of modernization and renewal of non- traction power supply system and a program for its implementation that will improve the reliability and network bandwidth, as well as reduced maintenance costs.

Experience accumulated in OSTU in the field of theoretical research and practical assessment of the potential for improving the efficiency of the use of electric energy for traction and non-traction needs leads to the conclusion that there are all prerequisites for development in JSC Russian Railways of a concept of creating an automated control system of energy saving, the result of implementation of which should be an automated information complex for decision-making support on implementation of energy saving systems, devices, and technologies.

In connection with the implementation by JSC Russian Railways of strategic objectives for improving technological standards in view of the prior art and technology, optimization of locomotive economy due to the transition to the landfill technology of transportation process, we offer to develop a concept of technological preparation of locomotive repair companies that will optimize the organization and improve the repair and maintenance quality of locomotives on the basis of standardized procedures for the analysis of the current development of new technologies (technological documentation, production equipment and inventory, logistics, qualified maintenance personnel).

To carry out the technological preparation in repair production at the present level, it must be emphasized especially, skilled production engineers with a special basic education are required.

The system of advanced training of craftsmen and mechanics of repair shops require revision, including with the use of capacities of manufacturing plants of locomotives of new series, to provide a truly competent personnel for all types of works on maintenance and repair. It will help to use modern repair control system with a feedback, based on the network planning.

Instead of conclusion

To further enhance the effectiveness of the participation of railway universities in the scientific and technological development of JSC Russian Railways we consider it necessary to:

1. Provide for an annual allocation of funds to universities of the industry (separate program) to perform fundamental and exploratory research aimed at the development of innovative technologies and solution of priority tasks in the field of transport modernization.

2. Create on the basis of railway universities regional branch centers of scientific support and monitoring of implementation and effectiveness of the new series of rolling stock and modern technical means.

3. Create at JSC Russian Railways a database with a list of problematic issues and relevant scientific and technical tasks for formation in higher education institutions of the industry practice-oriented subjects of scientific and technical papers, thesis and final qualifying work (diploma projects) of students.

4. Develop a system to provide branch university with technical documentation and samples of new equipment entering into service in rail transport.

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