Sergey E. ADADUROV
Director General
PhD Engineering, Professor
JSC NIIAS is a subsidiary company of Russian Railways. The Institute’s research and design activities are aimed to improve efficiency and safety of rail transport operations.

The current stage of Russia’s railway transport reform is being carried out amid profound changes influencing both the railway industry itself and the cargo-generating sectors.

Competitive business environment is evolving within the railway industry. While actively interacting with each other, the participants of the transport market are trying to optimize their own financial and economic performance.

Large vertically integrated companies and financial industrial groups account for a fair share of overall freight traffic. Those powerful businesses encompass not only primary and secondary sectors, but distribution and sales centers as well. Therefore, use of RZD’s rail network becomes in fact part of their operating procedures. Their cost and quality are growing more and more important.

Market economy radically changes the requirements for railway transport. Economic criteria grow in significance, business relations become more dynamic. To keep up with the dynamics, rail transport must ensure full-fledged economic interaction between suppliers and consumers via freight flow management and cost-efficient use of infrastructure capacity. Thus, the market economy requires the change of logistics technologies, which entails the change of basic traffic management functions and organization of management, adjustment of research activities and mentality shift for both transport researchers and transport equipment manufacturers.

JSC RZD is implementing a program of great national importance, the goals of which are laid down in the Strategy of Railway Transport Development in the Russian Federation up to 2030.

One of the key innovation objectives of the program is the introduction of systems for integrated
train control, dynamic monitoring of infrastructure and rolling stock status using satellite technologies, including those based on GLONASS.

To implement such systems is to ensure safety of passenger and freight traffic, to enhance traffic speed, to introduce multimodal logistic systems technologies and to reduce operating costs.

The key factor of the development of new transportation management technologies is the transition from automation of routine functions to automation of intelligent functions, such as situation analysis, optimal decision-making, calculation with the use of complex system model and ultimately automatic generation of knowledge on complex system behavior and control methods. It should be stressed that a dispatcher can not make decisions without the assistance of an automated control system as no human can predict the dynamics of system condition over a significant period of time. Under these circumstances the existing multifold excessiveness of the information environment should be used for implementation of analysis and control functions.

One of JSC NIIAS’ priority activities is the implementation of global navigation satellite technology, especially as part of integrated traffic safety systems.

According to the plans, a large-scale campaign to equip Russian railway transport with satellite navigation devices integrated into the common coordinate control system is to be carried out by 2015.

JSC NIIAS actively participates in the designing of the Adler – Alpika Service mountain climatic resort line as part of the 2014 Winter Olympics transportation development. In particular, the integrated system under development will include not only electric interlocking of switches and signals,
automatic block, centralized traffic control and train protection systems but radio-based control and satellite navigation facilities as well.

Among our objectives is the participation of JSC NIIAS’ renowned researchers and experts in international advisory bodies, international public and scientific organizations, as well as in joint research projects.

JSC NIIAS has a significant scientific potential. The staff of the Institute now includes over 100 doctors and PhDs. The achievements of JSC NIIAS’ researchers are widely known not only within Russian and foreign railway communities, but also in the national industry, academic circles, and many other domains.

It should be noted that the Institute pays a special attention to the professional growth of young scientists. Alongside well-known and recognized experts, a new generation of engineers and researchers is showing their worth in the Institute. The success of JSC NIIAS’ products results from the talent and expertise of the Institute’s researchers and experts.

Results of the Institute’s work find recognition among the main customer, JSC RZD, and users, Russian and foreign railways and companies.

Further improvement of efficiency and demand for the Institute’s products and their wide-spread implementation in the transport industry of the Russian Federation and other countries is the main goal of JSC NIIAS’ team.

Director General

Sergey E. Adadurov
HISTORY

For more than fifty years of its history the Institute has done a large volume of work related to creation of new railway automation and remote control equipment, as well as development of information technology and improvement of existing signalling, interlocking and block systems.

In 1956 the design bureau of the Main Directorate for Signalling and Communication of the Ministry of Railways (CB TsSh) was established. In 1987 NPO Sojuzzheldoravtomatizatsia was founded. It took over the Research & Design Institute for Railway Automation (NIIZhA) (successor of CB TsSh) and several departments of the All-Union Research and Design Institute for Railway Transport (VNIIZhT). The latter brought scientific and technical solutions and designs in the area of automation and communications systems subsequently implemented in the railway operation processes.

In 2000, in order to coordinate design and research activities in the area of railway transport information technology, NIIZhA was reorganized into the head research facility of the industry – Russian Research & Design Institute for Informatics, Automatics, and Communication on Railway Transport of the Ministry of Railways of the Russian Federation (VNIIAS MPS of Russia). A new phase of IT penetration started with the integration of branch-wise automatics and control systems.

In 2007 VNIIAS MPS of Russia became part of JSC RZD as its subsidiary company and was renamed as Research & Design Institute for Information Technology, Signalling and Telecommunications on Railway Transport (JSC NIIAS).

KEY AREAS OF ACTIVITY

JSC NIIAS is Russia’s leading research and design institute in the area of railway transport traffic control and safety systems, geoinformation support, rolling stock and infrastructure monitoring.

- Technologies for traffic management and transport services
- Automatics and remote control systems and devices
- Automated transportation management centres
- Railway transport information systems
- Geoinformation systems and satellite technologies
- Passenger traffic management systems
- Transport safety systems
- RZD infrastructure and assets management systems
- Power consumption and energy resources optimization systems
- Testing, certification and expert assessment
- Information security
- Regulatory support.

INTEGRATED TRAIN TRAFFIC SAFETY SYSTEM AND OPTIMIZATION OF STATION AND SHUNTING OPERATIONS

KLUB-U

The key element of safety and train separation systems is the KLUB-U integrated onboard safety system. It increases the reliability of cab signalling, helps eliminate the possibility of unauthorized movement of locomotives, ensures electronic registration of train movement parameters and hardware operation status with automatic decoding.
The distinctive feature of the system is the capability of module interaction with other onboard systems, the availability of a digital data communication channel and the application of GLONASS/GPS satellite navigation systems along with digital maps of railway lines for automatic locomotive localization.

**COMPUTER-BASED AUTOMATIC BLOCK SYSTEM (ABTC-M)**

ABTC-M is a computer-based train separation and traffic safety system for open lines. Train movements are realized both by trackside light signals backed up by cab signalling (ALSN and/or ALS-EN) or with ALSN and ALS-EN as the main headway control system.

ABTC-M ensures automatic opening and closing of wayside signals at danger, aspect selection, supervision of consecutive occupation and liberation of open line track circuits, coding of open line track circuits, change of movement direction on the line, control and supervision of automatic level crossing signalling.

Among the currently available automatic block systems, ABTC-M corresponds best with the criteria of a universal system of train separation for open lines.

**SHUNTING AUTOMATIC CAB SIGNALLING (MALS)**

The satellite navigation based MALS is designed to ensure safety of shunting operations at stations, labour protection of station personnel, station operation speed optimization. The system incorporates the functions of the hump-yard cab signalling (GALS R) and uses a radio channel for data communication between the locomotive and the station controller workstation. Satellite navigation ensures automatic control of shunting movements of locomotives with the accuracy of 1.5 m, which increases their efficiency and creates an information platform for the optimization of station operations control.
CONTROL AND SUPERVISION OF VARIOUS VEHICLES USING SATELLITE NAVIGATION, DIGITAL COMMUNICATION AND EARTH REMOTE SENSING SYSTEMS

This railway traffic safety system has been developed on the basis of satellite technologies and provides for the application of GLONASS (Russia), GPS (USA) and Galileo (EU) global navigation systems. Those technologies form the basis of the spatial data infrastructure of the Russian Railways for the purposes of control and safety.

Satellite technologies are used for rolling stock positioning and for monitoring of various operating systems. They operate jointly with radio communication and radar sensing systems for the purpose of positioning and train integrity monitoring. Such technologies require the development and implementation of an integrated coordinate control system. In the future it is to become the basis of operation for all industries and companies involved in freight transportation, which will ensure online monitoring, positioning and forecasting for all vehicles engaged in the process.

HIGH-PRECISION COORDINATE SYSTEM (HPCS)

HPCS has been developed by JSC NIIAS for the purpose of designing, construction and operation of high-speed railway lines (with speed up to 350 km/h). It is a multifunctional automated information system intended for the acquisition, processing, storage and provision to registered users of coordinate information on the location of railway facilities and vehicles. With the use of differential global navigation satellite system, HPCS provides an integrated coordinate environment. Coordinate data may be used in a wide range of engineering researches, for control and management of construction machinery providing the evaluation of
construction quality when monitoring the conditions of permanent way, superstructure and facilities.

The high-precision coordinate system is at the heart of the digital track model concept used at all stages of the lifecycle: designing, construction, maintenance and reconstruction.

**RZD GEOINFORMATION SYSTEM (GIS RZD)**

GIS RZD is an industry-wise integration project ensuring the performance of a package of organizational, technological and engineering measures aimed at supporting GIS-based decision-making.

As of today, the system provides:

- Description of the industry’s geoinformation resources
- Support of railway systems of the Russian Federation, CIS and Baltic states with the possibility of expansion to other means of transport
- Possibility of monitoring, displaying, and analysis of performance indicators of the railway transport: service speed, traffic safety violations, operated locomotive fleet, car turnaround, average train weight, etc.
- Possibility of schematic displaying of railway facilities and services data.

**GEOINFORMATION DATABASE OF LAND AND REAL ESTATE (GBD ZUON)**

In the light of the development of automated railway transport infrastructure and assets management systems, a special significance is given to the common corporate automated system of assets monitoring (EK ASUMIK) designed for a radical improvement of land and related real estate management processes.

Data support of the system will be ensured by the geoinformation database of land and real estate
(GDB ZUON) developed by JSC NIIAS. The system is intended for:

- Management, assessment, forecasting and dynamics of land use
- Efficient land survey
- Acquisition of precise geometrical characteristics of land plots
- Generation and printing of graphic annexes to packages of documents regarding land allocation for obtaining initial permissive documentation and state registration
- Provision of cartographic materials to land surveying organizations
- Provision of initial information on real estate facilities
- Real estate facilities visualization
- Technical inventory support
- Maintenance and operational use of electronic document repository
- Provision of cartographic materials for capital construction planning, etc.
- Inventory using Earth remote sensing.

FREIGHT AND PASSENGER TRAFFIC CONTROL SYSTEMS

OPERATING CONTROL CENTERS (OCC)

Operating control centers are designed to establish a vertically integrated system of management and operational supervision of car flows. OCCs implement unique control technologies for high-speed passenger traffic, car and locomotives fleets, train operation using state-of-the-art systems for monitoring of rolling stock location and railway infrastructure.

The OCC systems developed and implemented by the Institute together represent the main operational control facility of railway transportation process.
**PASSENGER TRAFFIC OPERATIONAL CONTROL SYSTEM** (AUTODISPATCHER)

The development of the Autodispatcher system was aimed at maximum automation of the passenger traffic organization and control process. Traffic management is based on a common centralized integrated technology.

The Autodispatcher intelligent system performs safe automatic route setting under fixed schedule or operational schedule in case of conflict.

In real-time mode, the dispatchers are able to:

- Supervise the status of controlled facilities (trains, stations, signals, etc.)
- Exercise supervisory control
- Identify conflicts, forecast their occurrence and take prompt measures
- Acquire information on the progress of maintenance works.

**FREIGHT EXPRESS AUTOMATED SYSTEM**

The system is a joint design by the Research and Development Bureau for Information Systems (JSC RZD’s subsidiary), the TsITTrans company and JSC NIIAS. The system is based on the logistical principle of freight traffic management harmonizing the needs of consignors and consignees with the interests and capabilities of the carrier. It ensures the planning of loading and transportation. The system assesses the network-wide loading situations on the basis of the operational network wagons status and location database, transportation orders database and static storages, and evaluates the delivery plan. The system allows overseeing delivery time compliance, taking prompt measures in case of possible disruptions and planning unloading at the destination at the level of centralized traffic control centers. The Freight Express has been deployed and successfully operates throughout RZD’s network.
EXPRESS•3 INTERNATIONAL AUTOMATED SYSTEM

The system constitutes a special computer network for passenger service, automation of seat reservation and ticketing in trains, and real-time passenger traffic control. The key functions of the systems are: issue and registration of travel documents in commuter, domestic and international service, reservation and selling of tickets via Internet, passenger information services, luggage management, passenger car fleet management, financial and statistical accounting and clearing payments, as well as provision of other services to passengers. The system ensures the collection of all information on passenger transportation in an analytical database, which enables the generation of forecasts and analytical information selections on passenger transportation. Express-3 has been deployed and successfully operates throughout the railway networks of Russia, CIS countries, Latvia, Lithuania and Estonia. The system ensures the selling of 150 million tickets annually.

ENERGY REVENUE METERING SYSTEM

The Automated Electrical Energy Revenue Metering System (ASKUE) has been developed and entered into trial operation throughout RZD’s network. The system is intended for optimization of power purchasing and consumption management process. ASKUE enables forecasting and planning of hourly energy consumption, supervises the energy consumption, monitors power supply equipment status and working order, load, operating modes. The system ensures the supervision of both individual traction substations and the whole power supply network. The database of the system contains information on the power supply infrastructure of Russia and JSC RZD. It allows entering data on any electric energy providers and consumers from substations to bus-bars, feeders and meters.
АДЛЕР
НОВОРОSSIЙСК
КУЛЯБ
УЛЬЯновск-Удэ
Северобайкальск
Улан-Удэ
Special analytical tools are used to automatically analyse the results of energy purchasing for various periods, perform comparative analysis of energy purchasing solutions for territorial and time profiles.

The Institute has created a network of centers for planning and supervision of energy consumption by JSC RZD. A center is a state-of-the-art software and technological complex that constantly supervises energy supply facilities, forecasts and monitors energy consumption.

**INFORMATION SECURITY AND PERSONAL DATA PROTECTION SYSTEMS**

The main objective of information security is the protection of the company’s information resources and infrastructure from non-production uses, as well as the protection of personal data and restricted information. With railway control technology in constant development, while new engineering and manufacturing systems with a high degree of information technology application appearing and new threats to information security occurring, the Institute not only designs automated systems, but also performs the following:

- Designing and implementation of integrated information protection systems
- Protection of personal data at information facilities
- Implementation of restricted information protection technologies
- Audit and performance review of information facilities to identify compliance with information security requirements.

Information protection systems have been developed and currently operate at all significant information facilities of JSC RZD.
TRANSPORTATION SECURITY

The most important objective is the development of an efficient administrative and technical system to ensure a required level of counter-terrorist and counter-crime security of railway transport. The Strategy of Railway Transport Development approved by Decree of the Government of the Russian Federation No. 877-r dated June 17, 2008 stipulates the equipment of all critical and potentially vulnerable railway infrastructure facilities with unlawful interference security monitoring systems.

The main areas of the Institute’s activities in transportation security are:

• Development of regulatory and guidance documents
• Vulnerability assessment of infrastructure facilities and rolling stock, development of safety plans
• Automation of transportation security management processes
• Development and implementation of integrated safety systems for standard facilities
• Expert evaluation and development of engineering designs of integrated railway terminals safety systems.

TECHNICAL REGULATION, STANDARDIZATION AND CERTIFICATION

JSC NIIAS participates in the development of national standards, rules and organization standards, as well as other regulatory and procedural documents concerning technical regulation in railway transport. The Institute performs expert evaluation of software, performance specifications of automated systems and program documentation. It carries out software certification according to the requirements of the Federal Service for Technical and Export Control of Russia.
FOREIGN ECONOMIC ACTIVITY

JSC NIIAS is an affiliated member of the International Union of Railways (UIC). The Institute’s experts are permanent members of working groups of leading international organizations of the transport industry, including OSJD (Organization for Cooperation of Railways).

The Institute’s activity is currently focused not only on the development and implementation of high-technology products in Russia’s railway system, but also on extensive participation in international projects. Among the company’s latest international achievements is the equipment of a number of lines in Kazakhstan with the ABTC-M computer-based automatic block system, delivery of more than 350 sets of KLUB-U onboard safety systems to Lithuania, Latvia, Belarus, Kazakhstan and Ukraine as part of comprehensive international projects. The Institute has as well installed and adapted the latest version of KLUB-U on Sapsan trains delivered to JSC RZD by Siemens. JSC NIIAS experts are to participate in the designing and realization of Uzbekistan’s high-speed rail project.

INTERNATIONAL STANDARDIZATION

As the basic platform for railway equipment certification, a test laboratory was established within JSC NIIAS and accredited as a test center of TÜV Rheinland, a leading European railway certification institution, to conduct tests according to EN 50126, EN 50128, EN 50129, and IEC 61508 standards. Jointly with Italian companies Intecs and Italcertifer, works are under way on the certification of onboard safety devices and train separation systems developed by JSC NIIAS for compliance with ERTMS/ETCS standards.
INTERNATIONAL PARTNERSHIP

Over the last few years the Institute has developed strong cooperation with companies of the Finmeccanica Group. As part of the strategic partnership agreement between JSC RZD and Finmeccanica, JSC NIIAS has signed a number of contracts with companies of the Italian group and is conducting joint work in a number of areas. The Institute and Selex Communications have equipped the Cheliabinsk-Glavny station with the TETRA digital radio communication system and developed the technology for organization of an integrated broadband data communication system at stations. A joint project with Telespazio is under way to develop and test at the Tuapse – Adler trial site a monitoring system for potentially dangerous railway line sections. AnsaldoSTS and JSC NIIAS are currently developing the Russian-Italian ITARUS-ATC integrated train control and safety ensuring system for further deployment at JSC RZD’s trial site. The main goal of such international partnership is a mutually beneficial scientific and technical cooperation aimed at developing joint products based on advanced Russian systems with their further deployment in Russia and other countries.
SCIENTIFIC POTENTIAL

20 doctors and 94 candidates of sciences (PhDs) currently work in the Institute. The achievements of JSC NIIAS’ researchers are widely known not only to Russian and foreign railway practitioners, but to the industrial, academic and business communities as well.

In 2009 JSC NIIAS became a laureate of the Employer of the Year of the Youth: Engineering Personnel for Innovating Russia contest held by the Federal Agency for Youth Affairs of Russia in the Epicenter of Innovations nomination for the best practical results ensured by progressive interactions with young people.

That was made possible due to ongoing activities aimed at raising the professional level of young researchers and engineers and developing scientific cooperation with railway colleges. The Institute has established the Council of Young Scientists that has organized the first youth conference of JSC NIIAS titled “Science and Innovations for Railway Transport” with the participation of young scientists and engineers of the Institute and the industry’s higher education establishments.

Young scientists of the Institute have won numerous railway industry research and practice contests receiving grants for railway research.

Due to extensive international activity, JSC NIIAS has established close scientific contacts with the world’s leading researchers, members of railway academies of Germany, Italy, Czech Republic, Croatia, railway engineering institutes of India, Iran, etc. The Institute’s experts take active part in largest international exhibitions and conferences.