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Výzkumný Ústav Železniční, a. s.: Special Services for Railway Infrastructure and Railway Vehicles

High speed trains V250 and AGV in Test Centre Velim

Výzkumný Ústav Železniční, a. s. (VUZ) followed a long-standing tradition and professional activity carried out by its direct fore-runners – the last one was Výzkumný ústav železniční, o. z. as a branch of České dráhy, a. s. (ČD). After VUZ has established itself at the position of a daughter company of ČD, domestic customers as well as customers from the whole EU territory and other countries are offered a wide range of special services within the whole rail system – railway infrastructure and rail vehicles, especially in the sphere of testing activities and conformity assessment.

The foundation of the ČSD Research and Testing Institute dates back to 1950 when it was established by a provision of the director of state railways. The institute took over tasks which had been managed by separate departments of the state railways and based them on scientific and technical principles. This was connected with the implementation of new technologies into all areas of railway operation, mainly electrification and motorization. The institute itself underwent a series of modernizations in the 1950s, which left visible marks in the form of an often changed name and spectrum of activities. In any case, the main tasks remained focused on railway transport. As of 1954, railway research formed one of the activities of the Transport Research Institute, which embraced all research institutes focused on different kinds of transport. The institution collaborated closely with the Czechoslovak Academy of Sciences and with universities and colleges. Good relationships and cooperation with universities and colleges are crucial for the Railway Research Institute (VUZ) even today.

An independent Railway Research Institute was established in 1971 by decree of the Ministry of Transport. Despite successfully resolving scientific and research tasks between the 1960s and 1980s, research activities and follow-up implementation in railway operation were strictly subordinated to economic and other priorities, which trumped railway interests. As a consequence, the railway fell behind technologically and many of the Institute's products were ignored and unused. In the 1980s in particular there was insufficient railway and research investment development. On the contrary, a distinct asset of Czechoslovak railway research was the successful effort to undermine the impact of the Iron Curtain by means of intensive participation in UIC – ORE/ERRI international research. The Railway Re-



The speediest czechoslovak locos of all tractions in Test Centre Velim

search Institute, as a proven mediator between railways and the railway industry (vehicles, components of railway constructions, building machines, safety facilities, etc.), became a natural authority in the certification of railway technologies for ČSD and other European railway administrations.

Test centre VELIM

With the introduction of new tractions and technologies in railway transport it soon became clear that testing conditions in factories were far from sufficient for future development. It was obvious that new features of newly developed vehicles and their parts could no longer be tested just on short test tracks and in regular operation on the public railway network. It became apparent that new locomotives and cars would be much more sophisticated in all respects and that they would need to be tested thoroughly and all their operational features had to be checked in real use before the serial production could commence and their faultless operation could be ensured. As the *Czechoslovak State Railways (ČSD)* assumed the responsibility of the railway test ring development, it was necessary to solve one of the most important tasks before it could begin – choosing the location of the test ring. To solve the task at hand, it was first necessary to stipulate basic dimensions and shape of test tracks, and then deduce parameters of a projected test ring. A number of expert discussions and negotiations on the top level were held on the topic, and the result was a proposal of the ring parameters, which took into account the possibility to reach speeds up to 200 km/h during testing. However, the basic parameters of the track were designed for speeds up to 160 km/h, though, with two straight parts with minimum length of 2 000 m, two



Test Centre VUZ Velim

curves and the total ring length of 13 km. Maximum track inclination was set at 2 ‰. During the year of 1960, the Ministry of Transport and Communications of the Czechoslovak Socialist Republic decided that the location of the test ring would be at Velim. Development of two interconnected buildings of the experimental base was decided upon in December 1960. It was also decided that it would take place in stages. The third stage was added later on – in May 1964. First stage included building the *Large Test Circuit (LTC)* and an auxiliary yard with a railway siding to the Velim railway station. Second stage included elec-



Scheme of test tracks of Test Centre VUZ Velim



Unit CD class 680 on the large test circuit

trification of the LTC for AC power supply system 25kV/50Hz and the third stage comprised building the Small Test Circuit (STC) including catenary and addition of DC power supply systems for all tracks. After the Velvet Revolution in November 1989, we entered the era of a fully open competitive environment. In the 1990s we sought ways to make the test centre's already high parameters even more attractive. One way was to implement an AC 15 kV / 16 2/3 Hz power supply system, which made it necessary to reconstruct the power supply station. Due to the high financial demands of infrastructure maintenance, only the most necessary maintenance was performed until the 1990s. Additionally the technical parameters of the Large Test Circuit track, power supply station and catenary no longer met customers' requirements. These technical condition and growing competition (Žmigrod in Poland, Wildenrath in Germany) were the main spurs to the reconstruction.

The Test Centre Modernization project was launched in 2005. The superstructure of the large test circuit was firstly reconstructed. The whole superstructure type currently corresponds to the structure of corridor lines and can be used to test rail vehicles at the speeds up to 230 km/h for both standard vehicles and tilting vehicles at a maximum axle weight of 22.5 t. Maximum speed of 120 km/h applies for the axle weight of 25.0 t. The reconstruction provided the large test circuit parameters not only complying with the present technical requirements for the inter-

operability of the high speed European railway system but also demanding client requirements. Modernization of supply station focused on the part securing DC power supply systems. The project was implemented in 2009 and we can state today that with their parameters, particularly available performance and the depth of voltage regulation, the new technology and the management systems of supply station fully cover the requirements for all standardly used European railway power supply systems. Following this extensive and quite costly substation modernization, another step was overall exchange of traction mains within the large test circuits. It currently not only complies with the demanding requirements of customers testing their modern and powerful vehicles in test Centre but also to the requirements of Technical Specifications for Interoperability (TSI). New halls for test preparation were further constructed and the existing halls were reconstructed so that VUZ could offer its customers the greatest possible comfort and background for testing. Within the project of modernizing the communication system at the large test circuit, the circuit has been equipped with the indicator of flat wheels, and expansion of the existing system from level 1 of ETCS – European Train Control System at level 2 has been performed as well so that the line could be used to test and verify the whole ERTMS system, which represents a single European system of control command and signalling. Its objective was to renew nearly 50-year-old infrastructure of testing tracks and make it competitive for years to come. This was a basic prerequisite for the continuation of the test centre's activities. All these modernisation activities have been performed within 2005-2015 and supported by EU.

VUZ Specialized Activities

Following the change in political regime at the end of 1989 and organizational changes in the early 1990s, when the Railway Research institute was incorporated into Czechoslovak Railways as a special activity, it was unclear whether the VUZ could stand the test of the new economic situation. its mother company as such could no longer use the full VUZ capacity, as it was forced to reduce investments into its rolling stock fleet and railway infrastructure. Therefore, the Railway Research institute had to revise its original focus on science and research and begin to develop activities in the field of testing. This proved to be the right step. The VUZ became an accredited testing laboratory in spring 1995 and pursued the trend further. Another milestone in the company's history was its transition to



Voith Locos during tests in Test Centre Velim

a joint-stock company in 2005. The newly established VUZ joint-stock company continued developing testing practices, particularly at the Test Centre Velim, where a substantial technological base of test rings and other facilities is available and will be enhanced in the future. The Railway Research Institute joint-stock company is one of the key companies in Europe focused on the future of railway transport. The VUZ currently offers its customers additionally to Test Centre Velim services Accredited Testing Laboratory services and Authorized/Notified Body services.

Accredited Testing laboratory

The VUZ Accredited Testing Laboratory is a legal entity authorized to perform tests of rolling stock. It can offer comprehensive services in the field of rolling stock homologation, not only in the Czech Republic, but also elsewhere in Europe and beyond. The laboratory's main line of activities includes tests of rolling stock and their components. Testing selected infrastructure is just a minor part of the laboratory's activities. The VUZ Accredited Testing Laboratory is included on the ČIA (Czech Accreditation Institute) list of accredited laboratories as entry No. 1462. In the framework of the quality system, the laboratory develops and updates testing procedures so that they conform to the requirements of national and European standards as well as directives for interoperability. The laboratory is currently accredited to perform 37 tests, in particular the following:

- ❑ Running tests: determination of safety against derailment, tests of rolling stock running behaviour and railway track stressing
- ❑ Traction and energetic tests: determination of traction characteristics and characteristics of dynamic brake, resistance to motion of rolling stock, measuring energetic parameters, temperature-rise tests
- ❑ Brake tests: stationary and running tests of pneumatic brakes, testing the interaction of separate types of brakes, testing rolling stock anti-slide devices
- ❑ Hygienic tests: measuring acoustic parameters (noise) according to the TSI methodology, and testing vibrations with impact on humans
- ❑ Electro technical tests – high-voltage current: testing electrical and power supply systems of the rolling stock, pantographs and electrified networks distribution systems
- ❑ Electro technical tests – low-voltage current: electrical tests, tests of environmental impact on communication and security equipment, and tests of rolling stock electromagnetic compatibility (EMC)
- ❑ Strength and fatigue tests (performed at the Velim Dynamic Testing Laboratory): strength tests of bogie frames and their components, tests of rolling stock draw gear and buffers with strokes, fatigue tests of axles and wheels, strength tests of seats, tests of springs, rolling stock, lifting tests, tests of bogie resistance moment of rolling stock against the turning, and thermomechanical tests of wheels; the Dynamic Testing Laboratory also provides tests on parts of infrastructure, for example: fatigue tests of concrete sleepers, tests of rail fastening or hardness tests of welded joints of rails

The testing laboratory uses state-of-the-art measuring technology based on industrially produced measuring computers, and specific devices based on requirements for the actual type



Units of different producers within presentation in Test Centre Velim

of tests. The technology is continuously renewed and upgraded so that it fulfils the ever-increasing demands on performing tests. The laboratory also uses five cars with specialized equipment for performing tests at speeds of up to 160 km/h. Experts at the testing laboratory are able to perform most offered tests both at the Test Centre Velim (under ideal conditions) and in the field (if technically possible). The usual practice of the test teams is therefore performing test on tracks in the Czech Republic and Slovakia, but also in some "exotic" countries. Testing vehicles for the light metro in Istanbul is a prime example of the latter case. As well as rolling stock testing, the laboratory also offers consulting services and support during rolling stock approvals in the Czech Republic and Slovakia based on its status as an accredited certification body. In close collaboration with the authorized body, the laboratory can offer full service during rolling stock homologation procedures.

Authorized/Notified Body

As of 27th February 2006, The Railway Research Institute (VUZ) is an Authorized Body No. AO 258, and as of 17th March 2006 it is also a Notified Body No. 1714. According to the legislature currently in force, the VUZ is:

- ❖ Authorized Body No. AO 258 and a Notified Body No. 1714;
- ❖ Designated Body for assessment under national rules;
- ❖ Accredited Certification Body No. 3149 for product conformity assessment;
- ❖ Accredited Inspection Body No. 4056;
- ❖ Assessment Body under EC regulation No. 402/2013, on common safety method (CSM);
- ❖ assessor of safety recognized in accordance with RAI directive No. 34; and
- ❖ designated legal entity for certification of quality management systems (as complementary activity only).

All activities connected with the above mentioned titles are provided by the Office of Authorized Body. The VUZ as an Authorized/Notified Body is authorized/notified by the Czech Office for Standards, Metrology and Testing (UNMZ) to assess product conformity as defined by Act No. 22/1997 Coll., on technical requirements of products, and based on government regulation No. 133/2005 Coll., on technical requirements with regard to operational and technical interoperability of European Rail-



Unit ICx on large test circuit 1.7.2015



The speedest electric loco of the world during test runs in Test Centre Velim



Alstom Loco for China during tests in Test Centre Velim

way System, as amended. According to the Technical Specifications for Interoperability (TSI) and referenced standards and other documents, the VUZ as an Authorized/Notified Body uses the modules as defined in European Commission Decision No. 2010/713/EU, on modules for the procedures for conformity assessment, suitability for use, and EC verification to be used in the TSIs adopted under Directive No. 2008/57/EC of the European Parliament and of the Council, of 9th November 2010, as amended, or as defined in the relevant TSI. The VUZ's major activities as a Notified Body are the assessments of conformity of structural sub-systems of the European railway system and their specified components so-called interoperability constituents. Internal outputs prepared under the header of the Accredited Product Certification Body No. 3149 and Accredited Inspection Body No. 4056 are used during the above procedures. Based on an application for the certification of a sub-system or of an interoperability constituent, which is submitted by a person with legal interest in their using (producer, suppliers, operator, owner, user), the VUZ as a Notified Body issues various types of certificates (if the assessment result is successful). The VUZ is authorized to assess the conformity of products which are integrated in the Trans-European Railway System. The stipulated extent of these products includes structural sub-systems of this railway system. These structural sub-systems are as follows:

- Infrastructure – abbreviated as “INF” (“INS” was also used)
- Energy – “ENE”
- Rolling stock – “RST”
- Control Command and Signalling – “CCS” (track-side “CCT” and on-board “CCO”)

The stipulated range of separate technical requirements, including assessment procedures and their parts, the so-called modules, is stated in the EC's decisions and regulations as directly executable technical codes based on European legislature and appropriate TSIs are issued on their basis.

As an Assessment Body according to CSM regulations, in accordance with Commission Regulation (EC) No. 402/2013, the VUZ performs the assessment of proposed significant changes to the railway system during the process of their implementation according to common safety methods. As a part of this procedure, the VUZ also evaluates safety requirements according to guide issued by the Czech Rail Authority.

As of 19th December 2007, the VUZ is an assessor for safety declared in terms of RIA instruction No. 34. This activity includes the evaluation of product safety according to the ČSN EN 50129 standard.

The VUZ is also a Certification Body authorized to assess and certify the quality management systems of suppliers of railway vehicles and their components, and railway tracks and their components in accordance with Act No. 266/1994 Coll., on railways, as amended by later regulations and relevant executive decrees according to the ČSN ISO/IEC 17021 standard. The scope of this activity includes the assessment of products in both regulated and non-regulated fields, and procedures requiring the assessment of quality management system in relation to these products (mass production).

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