

Vili, the local locomotive line of Királyrét with zero emission



▲ Premiere of the brand new vehicle on the rails

There is a revolutionary new vehicle designed by Hungarian engineers. By the communication of László Wieszt, the managing director of the Hungarotrain Railway Service Engineering Ltd. that participated in the construction of the vehicle, we can deliver you first hand information about the engineering news of the solar powered local line of Királyrét.

Developments are almost straight after each other at the domestic local railway lines. Remotorized, hybrid diesel engines are running in Lillafüred and on the rails of the Széchenyi Hill Children's Railway, while the introduction of the new engine of Szilvássvár that was originally planned to 16 March was only delayed because of the sudden bad weather. There is an increasing trend in the demand for hybrid vehicles in the road traffic, in the railway field at the development of the pulled cars it has also started but in a slower way.

Engineering Data

- Rail gauge: 760 mm
- Design standard: MSZ 8698/1952
- Distance between fenders: 8275 mm
- Car length: 7500 mm
- Car width: 2000 mm
- Car height (w/o solar panel): 2210 mm
- Floor height: 360 mm
- Distance between shafts: 3500 mm
- Total area of the roof plate and solar panels: 9.9 sqm
- New operational wheel diameter: 600 mm
- Smallest operational track radius: 50 m
- Nominal speed: 25 km/h
- P_{nom}: 14 kW
- P_{max}: 16.8 kW
- U_{nom}: 90 V
- INVERTER:
 - PWM sinusoid with PowerMOS semiconductor technology
 - DSP vector torque controller with reversible braking operation
 - U_{max} 180 V DC
 - I_{max} 100 A
 - F_{max} 200 Hz
- VEHICLE CONTROL:
 - digital, PLC based, with intelligent HMI where the controller switches the additional equipments by the help of a touchpad
- BATTERY CHARGER:
 - integrated that is monitoring the charging and balance of the batteries, from a 400 V AC line with auxiliary operational cables
- SOLAR CHARGING CONTROL
 - optimizes the charging with continuous operating point control
- BRAKE SYSTEM
 - electrodynamic (technological) brake
 - hydraulic (interim) brake
 - mechanical (Bowden operated) parking brake

Based on the operational experience of the hybrid engines on domestic local lines, the Ipolyerdő Rt., owner of the Királyrét local line, had a bigger dream: building of the first real zero local emission, solar powered engine was ordered – the basic idea of the vehicle was found out by the managing director of the Börzsöny 2020 Ltd that deals with railway maintenance as well in Szokolya. Besides the technical innovation the protection of the natural environment and the aim to keep the air of forests and natural parks clean widely meets the requirements of the European Union as well.

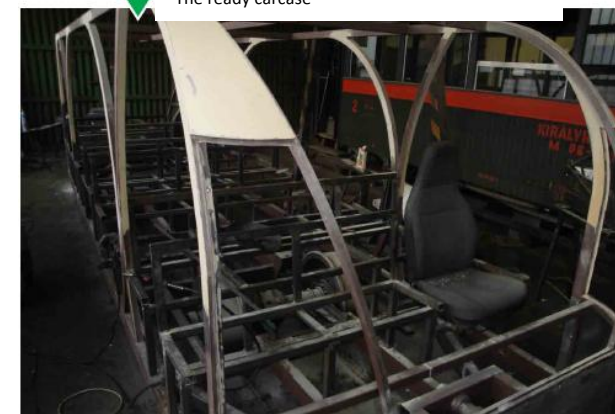
The vehicle called Vili of course would not be managed without preliminary experiments. The Hungarotrain Ltd. that was involved in production has already designed battery operated asynchronous drive assembled into one railcar.



▲ After painting on the shopfloor
▼ The final drive



▼ The ready carcass





Touch panel

The idea of a purely electrically driven railcar was risen by Börzsöny Ltd in June 2012. After meeting the ideas a feasibility study was done that met the expectations of Ipolyerdő Rt. Börzsöny 2020 Ltd. (carcase), Hungarotrain Ltd. (drive and control) and GanzPlan Hungaria Ltd. (documentation and licensing) were participating in the development process of the unique railcar.

The new railcar gains the energy from batteries that can be charged by the solar panels located on the roof or by outer electric connectors as well. Moreover – as it is a requirement nowadays for electrically driven railcars – the energy generated at braking is recuperated to its own batteries since it has no overhead electric cables. In case of ideal circumstances (enough sunlight) there is no need for outer charge, so the vehicle is purely operated by renewable energy.

Company Profile

László Wieszt and László Lantos established the Hungarotrain Railway Service Engineering Ltd. in 1992 following the intellectual heritage of the late Ganz manufacturing plants.



Besides the small amount of employees of the company with total Hungarian ownership (10 permanent colleagues) it actively participates in the life of the rail- and road vehicle industry. Their main profile is the maintenance, service, installation and development of railway vehicles, but in the last years because of the demand of their customers they dealt with service of low- and middle performance engines and transformers and widened the profile of the company with the design of industrial electronic panels and controls. They have significant connections with the MÁV vehicle service and they participate in the main service jobs and installation of the above mentioned vehicles as subcontractors. They have tight contact with the Hungarian universities teaching electrical engineering, they support young engineers to work out environmental friendly technologies.

Main jobs of Hungarotrain:

- Installation of a subway and training of local employees by the order of Bombardier Transportation India Ltd. in New-Delhi
- Installation of the Swiss Stadler Flirt railcars purchased by MÁV and handover to National Transportation Government as a subcontractor of Stadler Bussnang AG
- Installation of Ganz Trollino-12 trams in Sweden (Landskrona) and servicing up till now
- Converting the auxiliary operation of the BDV railcars to frequency changing way with PLC control
- Repair of the 340 kW traction engine of the Talent railcar for Bombardier MÁV Ltd.
- Development of the vessel control electronic system for the Swedish Regina motor cars for extreme climate (-40°C)
- Warranty service activities of the electromechanical brake system of the street cars of Debrecen by the order of the Swedish Sab-Wabco
- Shell Eco-marathon – supporting the team of the Széchenyi István University of Győr

The lifetime of the solar panels are between 20-40 years and in case of required placing they are maintenance free. Further solution is the solar system operating in a recuperational mode that is placed to the top of the maintenance site. The energy generated by this system is used to charge the batteries of the vehicles in non-operating mode. In case of a well calculated system there is no need for any energy from the power system of the country, therefore this operation does not load the environment and generates significant cost reduction.

To reduce the energy consumption – with respect to the narrow bends of the track – this vehicle has equalizing gear which is unique in the world. To avoid the wheel rotation the wheel pair together forms an electric shaft – therefore balancing the torque.

Since this 100% environmental friendly drive does not allow high speed, the vehicles that are similar to this currently produced car can be used efficiently to shorter distances and narrow rail gauges. It has lower power, slower speed and they are capable for shorter distances than combustion engines therefore they are ideal for domestic local lines. We have to keep in mind: we have open lines at the Great Hungarian Plain area as well although they are out of order at the moment.

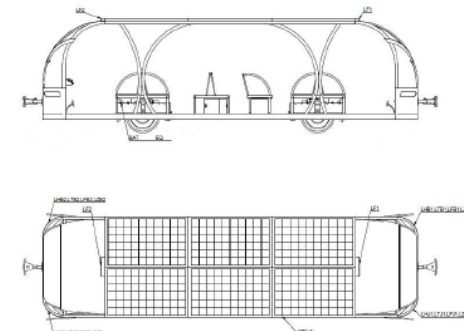
Taking into consideration the engineering and economical possibilities as well as the maintenance and other costs the most practical solution was an industrial asynchronous engine to be used. Because of the special voltage the engine had to be spooled, and because of the railway requirements the bearings had to be modified and the rotating part had to be balanced as well. The proper choosing of the pole number of the asynchronous engine resulted a better nominal frequency than in case of a linear AC machine, therefore transmission could be managed by a simple toothed belt (so there was no need to manage sophisticated driving apparatus at the equalizing gear). The railcar is built according to the state of the art principles: asynchronous engine with inverter, microprocessor control and modern, touch panel for the driver to operate the vehicle.

The development of the prototype was managed without any application for tenders, it was purely managed by the sources of the participating companies. Since the tenders of the European Union highly support vehicles that are similar to this one and also the environment friendly, zero emission technologies, in the hopeful future mass production shall be supported

In connection to the 100% renewable energy consumption, besides the railcar, the Hungarotrain Ltd. proposed a water-wheel to the nearby stream through Királyrét in which a recuperational generator would be assembled. A meter would continuously inform the interested parties about the amount of electric energy recuperated to the local electric line. The accomplishment of the plans depends on the environmental protection government. If the transport with Vili should be completed with the above mentioned option, it would be also a tourist attraction as well beyond environmental protection.

Pictures arisen at different internet sites in the beginning of March were taken at the construction licensing period of the car, test licensing is going to be completed after the days of the article deadline. Test operation will be carried out without passengers according to the licensing rules with artificial loading (sandbags). Public usage of Királyrét's new railcar is planned for May.

>> Zoltán Kemsei



Engineering drawing of the car

in Királyrét



Charging in Kismaros

