

Background paper

Warsaw orders first trains based on the new Inspiro metro platform

At the beginning of 2011, the Warsaw metro operator, Metro Warszawskie Sp. z o.o., placed an order with a consortium consisting of Siemens and the Polish manufacturer Newag for the supply of 35 six-car metro trains worth EUR 272 million. That makes it the largest order Siemens has ever received from Poland. At the same time, it is the first order for complete vehicles from the new Inspiro metro generation.

The first two trains, which are intended for operation on the Warsaw metro system, are scheduled for delivery by the end of 2012 and will then undergo dynamic testing in Warsaw. Three of the cars, which are being produced at the Siemens plant in Vienna, will be exhibited in the outdoor display area at InnoTrans 2012. These new vehicles will give Warsaw a completely new look. The vehicle design was created in cooperation with BMW Designworks USA and fully takes into account the customer's Corporate Design preferences, especially with respect to the color scheme. The combination of futuristic design of the front end and graphic styling of the sidewalls of the "Inspiro" symbolizes the forward-looking spirit of present-day Warsaw. The bright, open-plan interior highlights the modern chic and appeal of the city's metro. Together with the end-to-end accessibility of the train, the interior design contributes extensively to enhancing the passenger's sense of security.

Warsaw has one metro line (Line 1), which is about 23 kilometers long and serves 21 stations. The central section of the new East-West line (Line 2) is currently under construction. The new trains are to be used on both these lines. The 35 trains just ordered are the Warsaw metro's answer to the ever-increasing number of passengers. Between 1998 and 2008 alone, the number of passengers per year tripled to a figure of well over 126 million passengers. The customer is planning to use some 10 to 15 trains on the existing metro line and the rest on the new route. For the further extension of Line 2, there is an option for the call-off of 17 more trains based on the new Inspiro platform within the next three years.

Each train comprises six cars that are made of aluminum and have an MC-T-M-M-T-MC configuration. The traction system consists of four self-ventilated asynchronous motors per motor

car (M), which are fed by an advanced force-ventilated IGBT compact inverter of the proven SIBAC series. The vehicle boasts a number of special features such as the sliding steps at the first doors of the end cars that bridge the gap between the tram and the platform for persons with restricted mobility as well as a passenger information system adapted to the needs of the Warsaw metro. A video surveillance system is installed in the passenger compartment. An external camera is provided on the end cars (looking in the direction of travel) as well as rearview cameras.

The order comprises the supply, commissioning, testing and certification of the Inspiro trains. The first ten trains will be completely built at Siemens' Simmering plant in Vienna. The final assembly of the remaining vehicles will be carried out in Nowy Sącz, Poland by the consortium partner Newag. Newag is supplying all parts of the interior furnishings and onboard systems, including the automatic train control (ATC) system and the passenger information system. Siemens is providing the entire engineering and the core components, including bodyshell, bogies and traction equipment.

The trains are each capable of carrying up to 1,450 passengers (at 7 persons/m²), with seating for a total of 256 and standing room for as many as 1,194. The train is designed for tunnel operation and based on the modular Inspiro platform from Siemens which enables trains to be optimally adjusted to specific customer requirements. The end cars are each equipped with a driver's cab to permit bidirectional operation. The individual cars are connected by means of semipermanent couplers. Fast separation in the center of the train is possible by means of a semiautomatic coupler. Each half of the train can operate under its own power for shunting purposes. Both end cars are equipped with couplers to permit not only fleet-wide towing, but also towing in combination with the older vehicles and the shunting locomotives. The electrical connections within the train are designed as pluggable jumper cables. Pneumatic functions are transmitted via hoses and by the air pipe connection of the coupler halves. Between the cars there are wide, open gangways (vertical clearance 1,950 mm, clear width of approx. 1,500 mm), which ensure unrestricted passage through the cars during passenger service. Two-thirds of the train's axles are electrically driven. The 750 V DC line voltage is supplied via current collectors from the third rail.

Each car is carried by two bogies. The wheelsets of the bogies are each driven by a traction unit (traction motor with gearbox), thus there are two traction units per bogie and four traction units per car. The four traction motors per car are fed by one IGBT traction inverter. The trains are equipped with an ATC system that permits operation both on the new Line 2 and on the existing Line 1.

The exterior carbody surfaces are painted. The distinctive circumferential yellow stripe is implemented by applying a film. All cars are equipped with eight electrically powered exterior sliding doors (four per each side). The opening width of the doors is 1,400 mm. The driver can

enter the end cars through either one of the cab side doors or through a cab door leading from the passenger compartment.

The internal noise level is 75 dB(A) in the passenger compartment and 67 dB(A) in the cab, both measured at 80 km/h. The measuring method is based on ISO 3095 for external noise and ISO 3381 for internal noise. The external and internal noise and the vibrations created during operation have been minimized for the convenience of the passengers and people living near the metro lines.

Technical data of the Inspiro Warsaw

Train configuration	Mc-T-M-M-T-Mc
Wheel arrangement	Bo'Bo'+2'2'+Bo'Bo'+Bo'Bo'+2'2'+Bo'Bo'
Carbody material	Aluminum
Track gauge	1,435 mm
Length over couplers	approx. 117,800 mm
Width of car	2,740 mm (over door leaves)
Floor height above top of rail	1,130 mm
Wheel diameter max. / min.	850 / 770 mm
Max. axle load	12.6 metric tons
Seats	256
Train capacity at 7 passengers / m ²	1.450
Passenger doors per car	8
Min. curve radius service line / depot	300 m / 60 m
Max. negotiable gradient	4.5%
Maximum speed	90 km/h
Max. starting acceleration	1.2 m/s ²
Maximum braking deceleration	1.3 m/s ²
Power supply	750 V DC / third rail

The metro platform made by Siemens and marketed under the name Inspiro makes consistent use of lightweight construction methods and modern traction technology to achieve a marked decrease in energy consumption. When it came to selecting materials – for the carbody and for the interior – Siemens placed great importance on reusability. The recycling rate is over 95 percent.

The new Inspiro sets also standards in terms of operating costs. Maintenance intervals have been extended considerably, thereby lowering the cost of routine servicing while increasing the availability of the trains. Consequently, the metro operator is able to achieve a higher passenger

capacity with the same number of vehicles. The flexible seating arrangement, the optional use of driver assistance systems and the possibility of driverless operation ensure that the operator gets the utmost capacity out of his system. The trains can run at a top speed of 90 km/h. The modular, self-contained concept allows the formation of two- to eight-car train configurations with varying degrees of motorization. Passenger boarding and alighting times have been greatly reduced thanks to the use of maximum door widths and load detection systems. Since it has been possible to eliminate all the technical equipment cabinets inside the cars, the interior design can focus on offering full comfort to the passenger.

For more information about the Inspiro, visit <http://www.siemens.com/press/innotrans2012>