

## The case for electro-diesels

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Until recently the use of electro-diesel or dual-mode locomotives has been rare, but new designs are starting to appear. Dr Alex Luvishis states the case for their wider deployment.

AN electro-diesel locomotive has some significant advantages over a conventional diesel locomotive. As it can run as an electric locomotive on electrified lines, the consumption of diesel, the emissions of harmful substances and noise are all reduced. Journey times can also be reduced by eliminating the need to change locomotives at the boundaries of electrified and non-electrified sections.

Electro-diesels have advantages over electric locomotives in that they provide for autonomy, to allow operation in the absence of a power supply system or in the event of a crash.

Bombardier has designed and started production of a new electro-diesel locomotive series ALP-45DP for New Jersey Transit and AMT in Montreal (pictured). ALP-45DP will be able to operate under both 25kV 60Hz and 12kV 25Hz overhead electrification and on lines equipped with 750V dc conductor rails.

The use of multi-system electro-diesel locomotives on the railways of countries with a significant proportion of non-electrified lines, such as the United States, is not in doubt. But is there a need for such locomotives in Europe, where most railways have a high percentage of electrification?

On May 9 2004, a Halkali - Cologne freight train was hauled by a Siemens ES64F4 Europrinter four-system electric locomotive and Siemens ER20 Eurorunner diesel locomotives on its route from Istanbul to Cologne. It travelled some 3000km through six countries without changing the locomotive for 79 hours. Lorries operating on the same route would take 96 hours and during the trip they would emit more pollutants.

The ER20 diesel locomotive hauled the train on several sections of line in Bulgaria; but for most of the way this became an 80-tonne additional load to be hauled. A four-system dual-mode locomotive would have obviated the need to change locomotives.

If, as in the case of the ALP-45DP locomotives, the dual-mode locomotive is based on a standard AC electric locomotive, then all that needs to be added to the existing electrical equipment are one or two diesel generator sets and a fuel tank.

The new locomotive would need a single diesel-generator unit weighing about 12 tonnes. The weight of the tank and fuel with a reserve adds another 12 tonnes. Adding the 24 tonnes of diesel equipment to an 87-tonne ES64F4 electric locomotive would produce an electro-diesel locomotive weighing 111 tonnes. The axleload of the locomotive will therefore be 27.5 tonnes, but there are very few sections of railway in Europe where such an axleload is allowed. This is an impossible variant.

However, the embodiment of this locomotive as a six-axle unit is possible.

I believe that the six-axle electro-diesel locomotive would have 24 tonnes of additional equipment, a capacity of 6.4MW, and an axleload of 22 tonnes.

The calculation shows that in this case, the electric locomotive, on which the new locomotives will be based, should have a weight of 108 tonnes and a specific power output of 60kW/tonne.

When the locomotive has a power output of 5.6MW, which exists in a large number of electric locomotives in Europe, the specific power of the electric locomotive should be 52kW/tonne.

The four-system six-axle electric locomotive currently does not exist. Specific power outputs of modern single and two-system six-axle electric locomotives with asynchronous traction motors are 50-70kW/tonne.

So today, you could create a four-system six-axle electric locomotive with a power output of 5.6-6.4MW which corresponds to single and two-system electric locomotives with asynchronous traction motors. The weight of the electric locomotive would be 108 tonnes and hence the weight of the dual-mode locomotive would be 132 tonnes.

So modern technology allows us to obtain a four-system six-axle dual mode locomotive with asynchronous traction motors and a power output of 5.6-6.4MW in electric mode and with a power output of 2-2.4MW in diesel mode and an axleload of 22 tonnes.

Will this locomotive be built? Time will tell. But we can confidently say that the multi-system dual-mode ALP-45DP locomotives will begin operation in 2011 in the United States and Canada. In Europe, the single-system electro-diesel CC3600 Bitrac locomotive has been built by CAF in Spain, and is available in four and six-axle versions. Bombardier is also building a fleet of single and two-system electro-diesel AGC passenger trains for French National Railways (SNCF).