

# A city committed to tram-trains

Kassel's tram-train system has transformed public transport in the region. With other cities starting to take an interest in the concept, it is no wonder people from around the world are making the journey to central Germany.

REPORT AND PICTURES BY TONY STREETER



A few years ago, Kassel's main station was a gloomy sort of place, a rundown dead end where trains could go no further.

Now, at the station's heart is a modern, attractive tram-train through stop that's connected the outlying regions directly into the city centre; it's an impressive example of how this new transport mode can transform local connections and lead to welcome redevelopment.

These days, Kassel is a place of pilgrimage for people from across the world wanting to see what tram-trains can do for them; fast efficient vehicles that reach 100km/h (60mph) on the main rail network yet which slip easily through the tramway's tight city curves have replaced heavy rail trains and the inconvenience of changing modes at the railway's terminus.

Perhaps no wonder then that in late 2009 tram-train builder Alstom was keen to show its Kassel wares – and the Salzgitter plant that built them – to media from many of those interested countries.

Above: A Kassel diesel-hybrid *Regio Citadis* at Wolfhagen, terminus of the only partially-electrified route RT4.

Kassel, in Germany's north Hessian region, isn't the first place to have tram-trains; Saarbrücken and Karlsruhe both beat it and other places also have versions. However, a specially-built tunnel connecting heavy and light rail systems, and attractive hybrid diesel/electric tram-trains that can run on non-electrified rural railways, give Kassel's EUR180m scheme wide potential relevance.

## The genesis

Transport in Kassel became slightly dysfunctional with the opening of the new Kassel-Wilhelmshöhe station in 1991: high-speed and long distance trains henceforth used the new facility, with the now misleadingly termed Hauptbahnhof (main station) relegated to serving regional trains.

Then in 1999 a report commissioned by the Nordhessischer VerkehrsVerbund - North Hesse's passenger transport authority - recommended creating a tram-train system, with Kassel Hbf as its key node. The main station would once again become key to the city's transport, but



Left: Kassel's tram-trains (left) share tracks with heavy rail trains, such as this Kurhessenbahn Diesel Multiple Unit.

Below: Kassel's 'RegioTram' network. NVV

### REGIO CITADIS

Alstom's *Regio Citadis* was developed at Salzgitte to meet a specification laid down by Kassel for its new tram-trains. Essential to the requirements was a need to offer a hybrid diesel/electric version for the non-electrified route to Wolfhagen. Core to the project's success was the development by Germany's federal transport ministry of a new set of rules to bridge the gap between light and heavy rail, and so cover the proposed new vehicles.

Other technical obstacles included overcoming differences between heavy rail and tramway track profiles in the design of the vehicles' wheels. Also, extendable steps are included in the design, to allow *Regio Citadis* to call at platforms with different geometry.

The *Regio Citadis* is available in a number of different versions, variations including different power combinations (hybrid, single voltage or a range of dual voltage systems), the number of doors and internal layout.

#### Key statistics of the Kassel vehicles are:

- **Length:** 36.76m
- **Width:** 2.65m
- **Gauge:** 1435mm (standard)
- **Entrance height:** 360mm
- **Minimum curve radius:** 22m
- **Low-floor area:** approx 75%
- **Maximum speed:** 100km/h (62mph)
- **Power:** 4 x 150kW (diesel) 2 x 375kW

The 28 Kassel *Regio Citadis* have so far covered 8.6m km (6.9m km dual-voltage and 1.7m km hybrid vehicles). In the Netherlands, the 54 single-voltage vehicles have already covered 11.4m km. A new order for 18 additional vehicles was placed in November 2008, with delivery expected between February and July 2011. This latest batch will be built at Alstom's Reichshoffen plant in France.

The Salzgitte plant – owned by Alstom since its takeover of Linke-Hofmann-Busch in the 1990s – has traditionally been a major builder of trams, with its products sold throughout Germany. Current contracts include building large numbers of regional trains for Deutsche Bahn, private and export orders.

An alternative Alstom offer is the *Citadis Dualis*, a new 100% low-floor tram-train on order for SNCF. Designed to meet the French state railway's specifications, *Dualis* vehicles are to be built in France. Tram-trains are also in the product palettes of Stadler, Siemens (see p27) and Bombardier, which in September 2009 won a EUR129m order for 30 tram-trains for Karlsruhe for delivery between 2011 and 2013. The contract includes an option for 45 more.





Left: As well as Kassel, *Regio Citadis* are now working at Den Haag in the Netherlands, where they run on the RandstadRail system. Unit 4028 demonstrates perfectly the vehicles' 'tramway' qualifications in the city centre. Alstom Transport

“Compared to the overall benefit for the region, the expenditures seem rather small!” **NORDHESSISCHER VERKEHRSVERBUND**

this time as part of a much improved regional system.

A decade on, the transformation is clear: a new tunnel under the concourse, and the removal of platforms 4-6 plus a section of the overall roof, have allowed a new four-track stop to be built on a ramp down from the main line alignment to the 'dive under' below the station. Outside Kassel Hbf, the line passes invisibly under the forecourt before climbing to street level, where it is integrated with the city's tramway. The result is a true regional network with villages connected directly to central areas for the very first time.

In the words of NVV: “with less than 10km of new tracks it is possible to create a completely new traffic system with a network length of 122km.”

Deliveries of *Regio Citadis* tram-trains from Alstom started in 2004, the same year infrastructure work started. Initial services (to Melsungen and Wolfhagen) began in 2006, with the new Hauptbahnhof stop and tunnel opening in 2007 to bring the full advantages of the new scheme.

Tram-trains currently run on four routes. Three are

electrified throughout (although they need dual-voltage vehicles to swap between the 15kv AC of the main lines and the 600v DC of the tramway), with one needing hybrid diesel/electric tram-trains to cope with the non-electrified heavy rail line it runs on.

The routes are:

- **RT3 Kassel–Hofgeismar–Hümme** (29km/18 miles, with some services to Warburg a further 20km/12 miles away)
- **RT4 Wolfhagen–Kassel** (30km/19 miles)
- **RT5 Melsungen–Kassel** (31km/19 miles)
- **RT9 Schwalmstadt-Treysa–Kassel** (55km/34 miles)

All except RT4 are electrified throughout; electrification to Wolfhagen was considered, but with estimates at EUR20m – rebuilding of the 1km (0.6-mile) Zierenberg tunnel alone accounting for EUR7.5m – the decision was made to go for hybrid vehicles (see below).

Although most of the network runs over Deutsche Bahn heavy rail infrastructure, creation of the 'RegioTram' network resulted in a swathe of station modernisation



The entire centre of Kassel's main station has been rebuilt with a new roof and angled platforms sloping down to the 'dive-under' tunnel under the concourse. This RT3 service has just hit daylight.



Tram-trains access Kassel's tramway via this specially-designed 'dive-under', which passes beneath the forecourt and concourse of the main station...



... and suddenly, the tram-train hits the city's streets. The benefits of such a flexible system are appreciated by an increasing volume of regular customers at all hours of the day.



schemes, as well as new stops being built. One of the most recent milestones was the opening of a stop at Kassel-Kirchditmold in 2009.

In many cases, RegioTram now serves closely-spaced stops at distances more associated with tramways than heavy rail lines, a benefit directly stemming from the tram-like acceleration and braking of the *Regio Citadis*.

Still to come are a new stop at Melsungen, Bartenwetterbrücke and reconfiguration of the station at Melsungen itself, both in 2010. The year should also see a doubling of service frequency from 60min to 30min, enabled without fleet expansion by the dropping from RegioTram of the 55km southern route to Schwalmstadt-Treysa. Further plans include provision of a third track at Obervellmar, building a station at Ahnatal-Casselbreite, rebuilding of Heckershäuser to allow services to cross, and a new platform at Espenau-Mönchhof.

The EUR180m allocated to the RegioTram scheme is split between the EUR90-95m spent on infrastructure work and up to EUR85m on the rolling stock.

Infrastructure funding has come from local communities (10%), with 90% from either the Hesse state government or Germany's federal government budgets.

Says NVV: "One might argue about the investment costs. However, with a total of EUR180m, the investments for such an ambitious project like RegioTram still remain manageable. And compared to the overall benefit for the region the expenditures seem rather small!"

### Swift, bright, welcoming

The *Regio Citadis* tram-trains were developed specifically for Kassel at Alstom's plant in Salzgitter near Braunschweig. Similar vehicles have subsequently been built for RandstadRail in the Netherlands (see panel), with more on order.

The Kassel contract was let in 2001 and was for 28 trainsets, 18 dual-voltage and – a key innovation – a further ten hybrids.

Both versions supplied to Kassel are three-car, 36.76m-long trains, with around 75% low-floor; up to four sets can be coupled together.

The dual-voltage vehicles have space for 223 passengers (90 sitting, including six on folding seats). Hybrid versions

Clockwise from left: The design features a spacious, comfortable interior.

*Regio Citadis* cabs incorporate features from both trams and trains.

Fuel tanks for the diesel hybrid versions are discreetly hidden behind panels.

The vehicles have extendable steps to allow them to call at stations with platforms at different distances from the rails.



can carry 211, the lower figure coming because on-board diesel tanks slightly reduce the standing area.

Diesel power for the hybrid versions comes from roof-mounted power packs, with the engines started and pantograph dropped by RT4 drivers (at Kassel Hbf) in a process that's clearly barely noticed by most passengers. Underway too, the diesel performance is impressive.

Lightweight construction (heavier than trams, lighter than heavy rail vehicles) leads to lively performance, as well as better fuel economy in comparison to the trains the new vehicles replaced. Regenerative braking is also featured – and in terms of Kwh/passenger *Regio Citadis* vehicles are claimed to be around four times more economical than a bus, and ten times more economical than a private car.

From a passenger point of view the *Regio Citadis* are attractive vehicles – swift, bright and welcoming, and most importantly allowing direct and comfortable transport from communities direct into the city centre. Although direct passenger figure comparisons are not yet available, evidence shows that the tram-trains and the changes they have brought about have been well-received.

With French state railway SNCF having ordered large numbers of tram-trains (see panel), RandstadRail and Karlsruhe buying more, Germany's Braunschweig expected to develop a system, a small-scale UK trial due to start soon and other countries showing interest, the question now is, which other cities will make this quantum step in high-quality public transport? **TAUT**

## NORDHESSISCHER VERKEHRSVERBUND

NV is the passenger transport authority for north Hesse, a central German region encompassing 7100sq km (2740sq miles). Around half of the area's one million inhabitants live in the Kassel conurbation (195 000 in the city itself), which lies in the northern part of the region.

NVV carries some 280 000 passengers a day, on ten heavy rail (Regional Express/Regional Bahn) routes, nine tram routes, five 'RegioTram' tram-train routes, 70 regional bus routes and some 150 local bus routes, citybus and call-a-bus and taxi schemes.

Trams account for 37% of people carried, with regional bus 36%, urban bus 18% and regional train 9%. Passenger revenue amounts to EUR62m.

For more information on the tram-train network, see [www.regiotram.de](http://www.regiotram.de)