

NOISE

▲ MITIGATION MEASURES BY DEUTSCHE BAHN

IN 1999, THE GERMAN FEDERAL MINISTRY OF TRANSPORT, BUILDING, AND URBAN DEVELOPMENT BEGAN SETTING ASIDE AN ANNUAL SUM OF AROUND €51 MILLION FOR “NOISE MITIGATION MEASURES ON EXISTING FEDERAL RAILWAY INFRASTRUCTURE.” AND SINCE 2007, THE FEDERAL BUDGET HAS ALLOCATED AROUND €100 MILLION EVERY YEAR FOR THESE PROJECTS. TO BRING THEM INTO BEING, A NATIONAL STRATEGY HAS BEEN DEVELOPED IN COOPERATION WITH RAIL OPERATOR DEUTSCHE BAHN (DB).



▼ Deutsche Bahn's marshalling yard, Nuremberg

With a total of about 3,500 kilometres of railway sections nationwide in need of upgrading, and overall costs estimated at around €2.5 billion, the time-frame for completing the programme largely depends

on the level of funding available each year. Nevertheless, DB is determined to achieve its self-imposed goal of halving its rail noise by 2020.

The overall project management for the sections requiring

urgent attention, i.e. where noise pollution is extremely high, affecting a large number of inhabitants, is carried out by DB ProjektBau – the subsidiary of DB responsible for carrying out and supporting large-scale railway projects – on behalf of DB Netz – the operator's infrastructure branch. With its regional project centres and in cooperation with consulting engineers, DB ProjektBau ensures that the measures are planned and implemented – either in-

dividually, or in the form of packages, depending on the local circumstances. The division is currently planning the upgrade of 600 sections of track, with the precondition being that noise mitigation limit values here are exceeded, and following two lines of possible action:

- **at the source of origin** (active noise protection) on rail installations, e.g. installation of wheel flange lubrication facilities in tight track curves; noise reduction measures on bridge structures; “specially monitored track” with early rail grinding; construction of (earth-mound) noise barriers (note that since the latter may impede the immediate neighbourhood by, for example, shading properties, planning approval is conducted by the Federal Railway Office)

- **at the point of exposure** (passive noise protection) on structural works, e.g. installation of soundproof windows and ventilation devices.

IMPACTS OF MARSHALLING

One of the loudest noise

Area	Day: 6am to 10pm	Night: 10pm to 6am
Hospitals, schools, pure residential	70dB (A)	60dB (A)
Core and village areas and mixed-use neighbourhoods	72dB (A)	62dB (A)
Industrial areas	75dB (A)	65dB (A)

▼ Noise mitigation emission limit values in dB(A) Source: www.bmvbs.de

sources in marshalling yards is the braking of wagons by hump retarders. Reducing this high-frequency braking noise has proved an unsolved problem throughout the world. Deutsche Bahn's yard, located almost in the Bavarian city of Nuremberg, is equipped with 3 downhill brakes, 10 secondary retarders, and 80 tertiary retarders. And with up to 3,500 freight wagons braking through here every day, it is located close, too close, to housing, for comfort. To describe the site as a major noise hot spot is no exaggeration!

To counter the squeal, DB has taken advantage of the government funding to install a new noise-abatement system for rail brakes – BREMEX-ANNSYSY – developed and patented by the Slovenian firm Elpa. Designed to reduce the noise at its very source of origin, the solution essentially comprises trackside sensors, electronics cabinets, reservoirs containing a composite material, and floating applicators that 'capture' the wheels of the passing wagons. As the wagons pass the sensors, the latter capture vital data

on the direction of the wheel, weight of the wagon, and speed – all this is then transmitted in real time to the electronics controlling the dosage. The applicators apply the DBM-50, environmentally friendly composite material directly to the part of the wagon wheel flank in contact with the rail brake. "We developed and designed more than 80% of the parts specifically for this system, in order to handle the high-viscous nature of the composite material," explains Bojan Pavčnik, managing director, Elpa, "It is impossible to buy them off the shelf," he adds.

The timely and precise application of the material to a wagon wheel creates an intermediate layer of composite, which is thermally decomposed during the braking process. The resulting kinetic energy released is converted into heat, rather than sound energy, thus effectively reducing the braking noise.

The system is a high-precision piece of equipment because for it to function efficiently, the composite material must be applied at a specific moment and



Wagon passing over the floating applicators

at a specific point, i.e. the wheel and not elsewhere, nor seconds later. Hence the reason it took six months to bring the set-up for DB to optimal performance (even though it works immediately and there is a difference in noise in the minute the device is installed). "Feedback information from the operating centre at the yard provided us with valuable data during this fine-tuning period," Mr Pavčnik told EURAILmag, "which made it easier for us to manipulate the set-up. Good noise reduction results have also been achieved thanks to the very good cooperation and the synergy during the project implementation with the DB railway people at this marshalling yard in Nuremberg," he adds.

REDUCTION RESULTS, AND MORE BESIDES

According to European directives, the noise limit for marshalling yards is 90db. Measurements carried out so far at the Nuremberg yard – on just 4 of the 14 Elpa devices in

service here since December 2011 – show that levels here have already been reduced by 11 decibels, considering that the set-up was not final yet at the time of measurements. Another measure has been the response of local inhabitants, who even contacted DB to ask if it had stopped operations at the yard because it was so quiet! "We prefer to say that our device can eliminate 99% of braking noise at source," points out Mr Pavčnik, 'because there is always the case of a damaged wheel, for example, which might generate squeal that we can do nothing about.'

A further, welcome benefit of this particular abatement solution is its ability to prolong the life cycle of brake blocks, as well as switches and frogs, thanks to the film of tough composite material acting against wear of those particular parts. Comprising around 50% solid particles, the composite is extremely hard and capable of withstanding high pressure. And there is no fear of the

Reservoir of composite material (left); electronics cabinet (right)



material ingredient failing to perform its magic in extreme conditions – it can withstand temperatures down to -110°C and up to $+200^{\circ}\text{C}$. “This means that the material functions in all extreme temperatures,” adds Mr Pavčnik. “What we would have to adapt, if, for example, installing the device in Russia, would be defined components of the device such as the motors, sensors, etc., to cope with the climate there.”

FIFTEEN YEARS IN THE MAKING

While the finished solution may look very simple today, it is the result of 15 years of research and development, which Mr Pavčnik recalls: “We have always had a good business relationship with Slovenian Railways, and their management presented me with braking squeal in the hump yard as a problem as-yet-unsolved worldwide. This was the basic information which led us to developing our system, as we had already gained expertise through our other products to start the development process.”

The system was brought to market as a prototype in 2004 in Slovenia. In the same year, Elpa won the European Commission’s Product Award for Sustainable Development[1]. The first foreign customer was in the Czech Republic in 2006, followed by the company’s signing with DB in 2010, marking its first contract in Western Europe.

The long procedure to actually put the solution into service in Germany was extremely protracted, with DB benchmarking the device in service in the Czech Republic before signing, and also testing the composite material at its own laboratory, equipped with a special dynamometer, in Minden (northeast Germany). “This was because there was some doubt about this solution,” explains Mr Pavčnik. “Our system is innovative and totally different from those established on the German market or elsewhere. Plus it’s difficult to convince railway people, who tend to be quite conservative, especially when introducing controversial technological solutions such as the BREMEX-ANNSYS,” he adds.

Deutsche Bahn finally carried out the certification process with the German Federal Railway Authority EBA (Eisenbahn-Bundesamt), which took about 12 months since it had to cover both the summer and winter seasons. Nevertheless, Elpa is confident that obtaining certification from a heavyweight body like EBA, together with adoption by DB, will serve as a ‘calling card’ to ease and speed up the procedure in other countries.

“Our philosophy is to solve the problem of noise with economic benefits for the customer,” Mr Pavčnik told EURAILmag. And with the board of DB Netze reporting that “the measured



Stretch of solar noise barrier, Nuremberg

results are absolutely successful and have by far exceeded our expectations,” it looks like the German DB Netze is one satisfied customer.

ONE STEP FURTHER

As well as taking on noise at the source, another solution, and one Germany is big on, is the noise barrier. Deutsche Bahn has already built noise barriers along around 387 kilometres of its network. As a general rule, the louder the route and the more people who are affected, the more likely the track is to be included in the Government’s noise remediation programme priority list. “This is aimed at existing tracks with heavy traffic, plus there is the condition that the houses must have been built before April 1, 1975,” adds Alexander Pawlik from DB ProjektBau.

Deutsche Bahn has taken the traditional barrier one step further by combining it with an energy-generating technology in the form of solar panels. A total of 4km of this sound/energy combo has been erected at four spots in

Nuremberg, at a cost of €5 million. The solar panels combined cover a surface area of 1,159 square metres, spread along 1,387 metres of noise barrier.

“This is one of the first tests for this combined solution on aluminium barriers,” explains Mr Pawlik. “There is another one in Munich that is about ten years old, with the panels mounted on wooden noise barriers; and another in Duisberg, near Cologne, with stone noise barriers.”

One particular stretch of the Nuremberg combined barrier, which EURAILmag visited in July this year, was installed in March 2012, running for 600 metres alongside one major earsore

The European Commission’s Product Award for Sustainable Development is for companies that have developed a new product or related service that makes an outstanding contribution to sustainable development. The award criteria are innovation; environmental, social, and economic benefits; commitment; and replication potential.



▼ Mayor Horst Förther in front of the solar noise barrier, Nuremberg

of a freight track. Houses are located within what looks like centimetres from the rails! "Yes, it's very busy and noisy," confirms Mr Pawlik, "with up to 250 trains running day and night, and with one passing every five minutes."

"Noise is one of the big five problems in the city," says Horst Förther, one of the mayors of Nuremberg. Indeed, according to a citywide survey, noise reduction and energy consumption rate among the top five preoccupations of his electorate.

Not only have these particular 600 metres been crucial for local inhabitants, but also in terms of timing, with the State providing DB with €2 million to build panels on noise barriers within a limited time frame of between 2010 to 2011. And as well as the right time, the right place had to be found too, i.e. finding a location correctly orientated to the sun in order to capture the maximum amount of rays from east to west during the day.

Equipped and supplied by three German firms – Abel ReTec, Heckert Solar, and SMA Solar Technology – the panels are also strategically tilted on the barriers to limit breakage, e.g. flying ballast, to just 1%. And with regards to graffiti and other wilful damage, "there are signs saying each panel is 400 Volts, so people are warned not to touch them." On this point Mr Pawlik is surprisingly laconic. "You know what it's like, in all the big cities... Paris, Berlin, Nuremberg..., if anyone wants to damage the panels or the barriers, they will." Cleaning is scheduled twice a year to avoid braking dust (an aggressive agent), from collecting on the surface of the panels, eroding the glass and so reducing their capacity and performance.

ON THE SUNNY SIDE

To date, the panels appear to be performing well on the energy front, with electricity board N-ERGIE satisfied with the production levels, reporting: "140,000 kilowatt-



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hours... the equivalent of the energy consumed by 35 x 4-person households." DB cannot use the photovoltaic-generated power directly, due to voltage differences, so it is fed into the national grid.

Yet on the noise front, there seems to be some debate as to whether the barriers are really doing their job properly. "Not all the local inhabitants are happy," Mr Förther told EURAILmag. "They say the noise is louder than before, and we don't know why. They say it reflects off the photovoltaic panels. But we don't know if it's true or not."

EURAILmag turned to Mr Pawlik for his explanation. "We have calculated the amount of noise before and after installing the barrier. We have the results that prove it works," he replied. "The problem is that the frequency of trains passing this spot is so high that people are subjected to noise on an almost permanent basis. So although the levels have been reduced, there's always noise. It's pure mathematics. It's 'quieter' than before, but the noise that people were hearing before was already very loud. So they can't tell the difference."

QUIET(ER) PLEASE!

In its report *Railway Noise in Europe*[2], the UIC describes noise as "the major environmental issue of the railways." Yet at the same time it recognises that action is being taken. "The rail sector acknowledges noise as a problem and has put much effort into understanding [its] creation and propagation, and into finding solutions. As a consequence, significant progress has been made in [...] abatement over the past 50 years."

A noise-free railway may be a utopia, but rather than turning a deaf year, Deutsche Bahn is one operator taking serious steps to tackle the complicated task of abatement. With a host of measures up its sleeve, backed by financial incentives from the State, the operator has another eight years to achieve its personal goal of slashing levels by half... ■

Lesley Brown

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References

- [1] Source: <http://ec.europa.eu/environment/awards>
 [2] www.uic.org/download.php/publication/516E.pdf

WORLD NOVELTY
Anti NOISE system for rail brakes
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- ✓ High IRR (internal rate of return)
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quite simple decision



Nightmare on Nürnberg
marshalling yard finally ended



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