



1 Repowering a V290 locomotive: at the Deutsche Bahn repair depot in Cottbus, 400 of these locomotives have been refitted with MTU 8V 4000 engines.
 2 Re-equipped with Series 396 engines, Russian DR1A trains can continue to operate economically.
 3 The Alstom locomotives used by the Thailand national railways are being converted to Series 4000 engines because, apart from anything else, they use 28 percent less diesel fuel.



Repowering as alternative to a new locomotive.

Second time around

Locomotives are among the longest-lasting investment goods. Even when the paintwork has dulled, scratches, oil and rust marks do not diminish their technical and economic value. Rolling stock can be used intensively for 20 to 40 years. With advancing age, however, the maintenance costs increase, fuel consumption rises in comparison with more modern locomotives, and performance decreases. In such situations, MTU offers the option of rejuvenating an asset with a modern power unit. In many cases it is an economical alternative to a brand new locomotive.

The city of Tallinn on a Thursday in September 1989. Rail expert Wolfgang Geiselmann had traveled to the Estonian capital in connection with a locomotive repowering project. "It was like a ghost town." The reason behind the eerie silence was an historic event – the end of the Soviet Union. In the period of transition from state-controlled to market economy, the wheels ground to a halt for a while. Ultimately, it was the reason for Wolfgang Geiselmann's trip. Because from then on, the DR1A multiple unit trains of the Estonian Railway had to be profitable, fuel consumption had to be drastically reduced. And because new power cars were too expensive, the existing Zvezda engines were replaced by 8-cylinder MTU Series 396 units. Twenty-two of those trains are still in service today. To date, MTU has repowered a total of more than 50 multiple unit trains in Latvia, Lithuania, Georgia and the Ukraine. And with the Series 4000, MTU now offers powerful and economical engines for reinvigorating an enormous diversity of railway stock.

The question of whether it is better to buy a new power unit or a new locomotive depends on a lot of factors. A new locomotive costs a lot of money, but then replacing an engine is far more than a mere removal and refitting opera-

«MTU offers not only technically advanced engines but also comprehensive consultancy services.»

tion. The components and interfaces on the locomotive will be fundamentally different than those of an engine 20 or 30 years younger. Nevertheless, repowering is frequently a sensible alternative. On average it costs roughly 60 percent of the price of a new locomotive but extends the longevity of the asset by as much as its original life expectancy. MTU rail expert Peter Pfitzke expands: "Experience shows that the investment can pay for itself in two to four years and brings a financial return in the long term. Added to that, there is the ecological benefit of recycling."

Concept design and comprehensive advice from MTU.

As part of the very first preparations for an engine replacement, MTU engineers analyze the economic viability based on a detailed study of the market. It forms the foundation for a potential repowering project. "Fundamentally, any locomotive is suitable for conversion and repowering," emphasizes Peter Pfitzke. The decisive requirement is that the vehicle is basically sound. Load-bearing components, the structure of the chassis and bogies must be largely intact and strong enough. With diesel-hydraulic locomotives, the transmission should be in good enough condition to be reconditioned or con-

verted. With diesel-electric locomotives the old generator has to be examined to see if it can be modified to suit the requirements of the new engine or needs to be completely replaced.

The MTU Series 4000: more power, lower consumption, lower emissions.

The MTU Series 4000 offers a choice of models comprising V8, V12, V16 and V20 cylinder configurations and a range of power outputs from 850 to 3,000 kilowatts that spans the requirements of shunting, multipurpose and mainline locomotives. Compared with older engines, their power-to-weight ratio is substantially better. For example, the 2,400 kilowatt (3,264 hp) rated MTU Type 16V 4000 R43 rail engine boasts the best power-to-weight ratio in the world in its performance class. It also meets the stricter 2009 European Stage IIIA emission standard without the need for external exhaust aftertreatment systems.

Numerous train operators are already profiting from the higher performance of the newer MTU engines. Deutsche Bahn, for instance, repowered 400 V290 multipurpose locomotives with the 1,000-kilowatt 8V 4000 unit. And 160 British HST (high-speed train) power cars that have been in daily use since 1976 have been given new Type 16V 4000 R41R engines. In Thailand, the national railway is upgrading its 20-year-old Alstom locomotives with MTU 16V 4000 diesel traction units (1,700 kilowatts). They will reduce fuel consumption by more than

- 1 Repowering a V290 locomotive in Cottbus: its new 8V 4000 engine produces 1,000 kW, almost 200 kW more than the previous power unit.
- 2 Reconstructing a dismantled V290.
- 3 MTU engineer Wolfram Nirschl provided onsite support for the repowering project.
- 4 The data from the new engine is analyzed in Friedrichshafen.



28 percent. Other deciding factors for the award of the contract were the performance and availability of the engines. The Swedish logistics provider Green Cargo is refitting

operator Pacific Harbour Lines has also invested in ecologically sound engines. As a result of its decision to repower its entire fleet of locomotives with MTU 12V 4000 R33 engines, it was

and monitoring engine and traction system play a decisive role. They are developed and produced in house by MTU. In conjunction with data bus technology, they offer fast and flexible data communication and optimized interface technology, which substantially simplifies integration of a new engine in an older locomotive. The new MTU Powerline product is a modular-structure automation system that monitors, controls and modulates all traction system functions.

«Fundamentally, any locomotive is suitable for conversion and repowering.»

62 Bombardier T44 diesel locomotives with Type 12V 4000 R43 PowerModules in a program to be completed by 2011. The MTU power unit will reduce fuel consumption by 20 percent and emissions by 75 percent. In the USA, railway

voted Short Line of the Year. With its 16 new diesels, PHL now complies with the US EPA Tier 2 emission requirements.

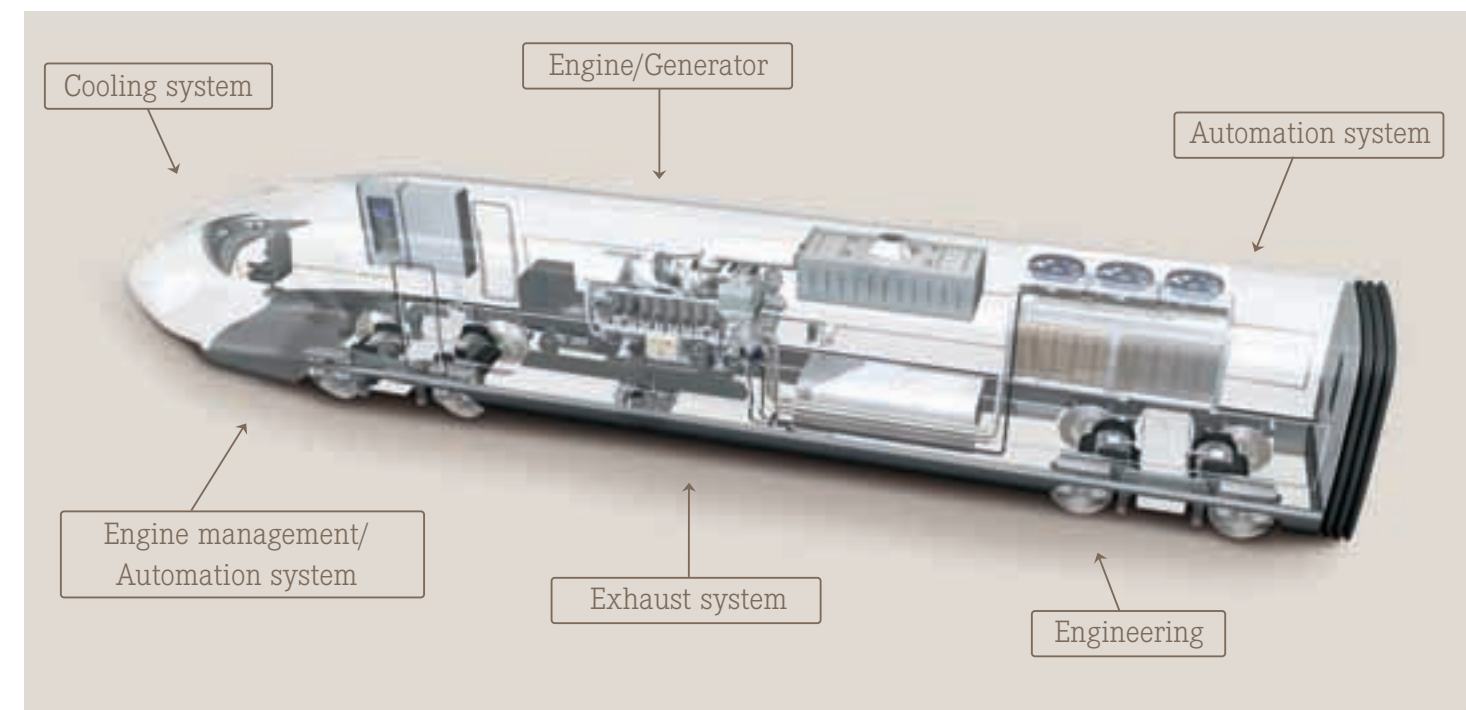
Technical project planning: mechanical and electronic system engineering expertise.

Once the decision to repower has been taken, the MTU specialists determine the as-is situation as part of the technical project planning that follows. They match up the interfaces, the locomotive data and the engine data. In so doing, they take particular account of the future operating conditions such as altitude, air humidity, intake air temperature, and make a detailed examination of factors such as speed profile, which is necessary for optimizing sound levels on station approaches. On the basis of the information collected, they produce an installation study detailing the extent and special features of the project. MTU offers extensive system engineering skills in that regard (see graphic on page 37). As well as the mechanical components, the electronic equipment for controlling

Scientific engineering calculations.

Just as important for the desired outcome is soundly based engineering science expertise. For example, in order that the traction system components function perfectly even under tough mechanical operating conditions, they are precisely matched to one another in terms of their vibration characteristics. That requires the MTU engineers to work out the rotational vibration properties of every traction system, if necessary incorporating flexural vibration calculations as well. Another critical aspect are the resilient engine mountings. They have to be designed so that the locomotive can withstand hard buffer impacts of up to 3 g – three times the weight of the engine. Even after a 5 g impact it must remain capable of operation and only suffer minor deformation. Consequently, MTU has for many years worked with the suppliers on the in-house development of resilient engine mountings.

Comprehensive system engineering expertise



From oil pump to electronics

Within a repowering project, the MTU engineers take account of all decisive components and systems for the conversion (see graphic above) including traction unit fans, fuel heat exchanger, fuel filter, control probe heater, starter battery, battery charger, MTU CaPos capacitor starter, oil heat exchanger, fuel pump, preheaters, compressor, traction generator/DC, ADEC electronic engine management module, POM starter module, auxiliary electrical system generator, cooling system, air conditioning auxiliaries, engine room fan and inverter, air filter, exhaust aftertreatment system and diagnostic system.

MEMO
MTU offers comprehensive system engineering services incorporating the engine and all engine peripherals in the conversion concept and its implementation.

The Deutsche Bahn locomotive repair depot in Cottbus: with its comprehensive array of plant and machinery including laser cutting, abrasive blasting, paint spraying, measuring and testing equipment, almost nothing is impossible for locomotive repowering purposes.



Advantages of repowering

- ◇ Longer duty periods
- ◇ Shorter maintenance times
- ◇ Lower maintenance costs
- ◇ Greater availability
- ◇ Preservation of assets
- ◇ Electronic detection of operating statuses
- ◇ Shorter idle times

MEMO

“Living partnership”

Interview on service concept for repowered British HST power cars

Between 2005 and 2009, MTU repowered a total of 160 British HST (high-speed train) power cars and subsequently agreed an all-round service concept for the engines with a number of train operators such as First Great Western and National Express. How successful have the repowering and support package proved so far? To find out, we talked to Phil Buck, fleet manager for British train operator National Express (NEXC) and Michael Topp, MTU project manager for the HST service program, attach importance to close cooperation based on personal contacts.

What are the particular conditions under which the trains operate?

Phil Buck: NEXC operate around 140 Inter-City services per day using 43 train sets of which 30 are electric locomotives and coaches and 13 are diesel powered HST's. These HST's form the backbone of the Inter-City route on the east coast of the UK between London, Edinburgh, Aberdeen and Inverness. They serve the business and leisure traveller to and from London on a daily basis.

Why did NEXC contract MTU to be responsible for servicing the engines and guaranteeing their unlimited availability?

Phil Buck: From the outset, we realised that the MTU 4000 series engine is a quality and highly technical product that would require a high level maintenance competence. Therefore it seemed appropriate that the OEM should be involved in the maintenance. MTU offered a fixed price contract through the entire life of the franchise, from QL1 to QL4, MTU provide total logistics and technical support.

How successful has the arrangement proved so far?

Phil Buck: The maintenance contract is not a rigid construction, but a lively partnership, driven by constant changes and personal relationships. We have built excellent links with MTU UK and MTU Friedrichshafen over the last 3 years. This has been proven by a smooth change out operation during the QL3 engine program, enabling all our trains to be available as required. We are able to have frank and open discussions on all aspects of maintenance support and look forward to enhancing this relationship.

That sounds very positive. Was it like that right from the start?

Phil Buck: In the early stages of the project, MTU were a new Company to NEXC and there were long discussions regarding operator maintenance philosophy and MTU maintenance philosophy. Now, MTU manage the complete maintenance and overhaul of the “power unit”, comprising of the engine and alternator, not just the engine. This has allowed the two companies to develop a combined strategy to fulfil the expectations of NEXC to achieve the PPM (Public Performance Measure) of 90.1% in punctuality by January 2010. Since 2007, this figure has increased from 81.7% to 87.4% in May 2009. We are currently recording above 93% of trains arriving on time. I therefore firmly believe that MTU have fulfilled our expectations and will continue to do so.

Would you choose MTU again?

Phil Buck: Yes. The reliability of the product, the successful delivery of the Maintenance Contract and the competence of the personnel providing this, has proven that the right choice of partner was made. The relationship of the two Companies on a personal level is the foundation of this successful partnership. We would certainly use this experience and philosophy when considering future re-power projects.

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Phil Buck, fleet manager at National Express (right) and Michael Topp, MTU project manager for the HST service program, attach importance to close cooperation based on personal contacts.



Statement by Michael Topp, general manager of the HST project at MTU

The HST maintenance contracts offer the clients an all-round carefree package whereby MTU takes over complete responsibility for servicing and, therefore, the availability of the engines. A particular benefit for the customer is that, as the original equipment manufacturer (OEM), we have the complete technical knowledge. So our clients can concentrate on their actual business of providing reliable passenger train services. What is more, we are not just experts on our own engines, we also know the overall train system inside out, right down to the rails. To be able to develop suitable products and systems for our customers, we maintain close relationships with them based on personal contacts. If possible, we like to offer our rail clients a complete rail traction system from engine to generator and subsystems such as exhaust aftertreatment, cooling and electronics; and take responsibility for the system as a whole. We also offer technical support with the integration of the system in the locomotive and commissioning; and we provide comprehensive documentation. In that way, we are underlining our aspiration to be the preferred provider of advanced and efficient rail traction systems.

Looking back Since the 1980s, MTU has sold large numbers of Series 396 and Series 4000 engines for repowering locomotives in Europe, Asia and the USA, and more recently PowerPack units for railcars as well.



One of the biggest repowering projects completed by MTU involved refitting British HST power cars with Type 16V 4000 engines.

MTU experts on site.

In larger projects, an MTU technician is permanently on site. Right at the start, he will check whether the supporting structure for the engine is OK and verify the tolerances when aligning the fitted unit. Step by step, other engine interfaces are then tackled – the hydraulic pump on the auxiliary PTO end, pipe connections to cooling, fuel and exhaust systems. “Where large numbers are involved, even the minutest errors can have serious consequences. To minimize the risks, we make sure not only that the numerous electrical, mechanical and electronic interfaces are right, but also that the overall system functions perfectly,” emphasizes MTU rail expert Klaus Peiler. Following final assembly, the moment of truth arrives when the engine is

«After commissioning, support continues with comprehensive after-sales care.»

first started. The MTU engineer records all mechanical and electronic data on a laptop and sends them for analysis to the experts at Head Office. Finally, the locomotive is taken through a test run in which all essential operating modes from crawling to maximum speed are given a thorough tryout.

After-sales: from standard maintenance to all-round carefree package.

Support continues after commissioning with comprehensive after-sales care. The extent of the associated services is tailored to the particular client and has been continually improved

and refined in recent years. It ranges from standard servicing work and engine overhauls to complete all-round carefree packages including preventive and corrective maintenance. An outstanding example is the support package agreed for the British HSTs (high-speed trains) previously mentioned. A preventive maintenance

concept whereby MTU fitters and spares are available on site guarantees efficient operation. Local subsidiary MTU UK also provides support for the project at a new workshop recently set up near London. The results are certainly something to be proud of: “With their longevity and well above-average availability of 99 percent, our engines have emphatically demonstrated how reliable and durable they are,” observes HST project manager, Michael Topp.

WOLFGANG STOLBA

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