

Time to recharge

Years of heavy work in the bone-dry Chilean desert and thin, high-altitude air take their toll. And age is creeping up. The power – though always dependable – is waning and it gets more difficult every day to perform the daily tasks. High time, then, for the patient's internals to undergo a course of treatment. The magic cure? Repowering.

Fully laden, the behemoth drags itself slowly out of the mine pit in the dry and dusty heat. After nearly an hour it reaches the upper plateau exhausted. In recent times its strength has noticeably faded. For years it has toiled ceaselessly without even allowing itself a day's rest. But now it costs a lot of energy to complete the daily quota. Too much energy in the opinion of its employers. Although it is a long way from the scrap heap yet, its power is definitely not what it once was. But some new internals should put that right and extend the dump truck's life expectancy by many years. In just a few days the old engine will be replaced by a gleaming new MTU Series 4000 diesel power unit.

« Vehicles made by Hitachi, Le Tourneau, Liebherr, Belaz, Komatsu and Terex can easily be refitted with Series 4000 engines. »

Sick leave? No chance!

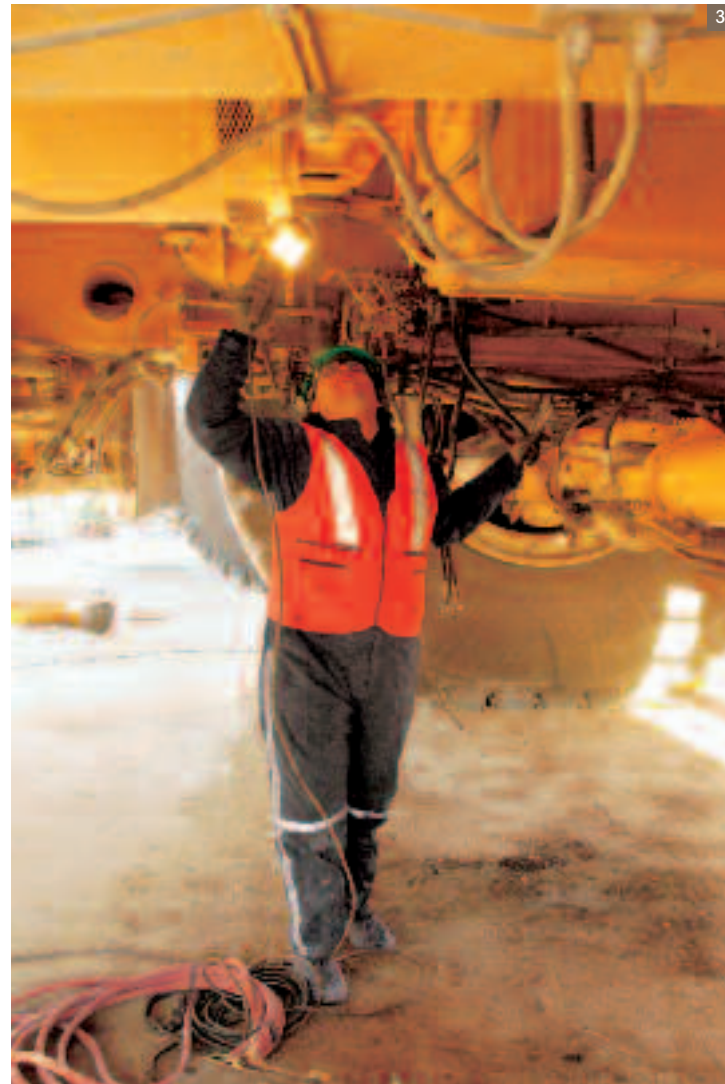
The conditions in which the nearly nine-meter-high, 600-tonne monster dump truck has had to labor in the Chuquicamata copper mine are absolutely unforgiving. For years on end the rainfall is sparse and infrequent. The dust spirals incessantly around the oval open-cast mine nearly a kilometer deep. Here, in the north of Chile in the middle of the Atacama desert, shade is impossible to find. Even though the temperature rarely rises above 30 degrees, the region is one of the driest in the world. Coupled with the thin air at 3,200 meters above sea level, the extreme environment demands everything of the people and plant employed in the copper mine. "Here in Chuquicamata work goes on around the clock, seven days a week," recounts Ricardo Henoch, General Manager of DD Chile. "As copper mining only makes money above a certain yield volume, the machines never stop." The 200 million tonnes or more of copper ore that are extracted here every year equate to 684,000 dump-truck loads. On average a truck carries 300 tonnes of copper ore per load, though as much as 400 tonnes is possible. It takes just under an hour for a dump truck to transport its valuable cargo from the bottom of the pit up the terraced slopes to the top of the mine. And no matter whether the work has to be done in the searing daytime sun or the icy wind at night, there is no time off sick for the mine vehicles. What counts is the volume transported and keeping the cost per tonne as low as possible. Which is why the trucks are in use unceasingly.



1 It takes just under an hour for a dump truck to transport its valuable cargo from the bottom of the pit up the terraced slopes to the top of the mine. **2** There are 125 dumpers in use in Chuquicamata, each of them capable of carrying up to 400 tonnes of copper ore.



1 The gigantic mining truck can not allow itself any breaks. For the cost-intensive mining process to make money for the operator, the vehicles have to run 24 hours a day. 2, 3 To make sure that all truck interfaces exactly match the engine, the vehicle undergoes a thorough inspection prior to repowering. 4 The gigantic haul trucks are ready for operation again after just a week.



About Chuquicamata

Chile is the world's biggest copper producer. Mining makes up around 25 percent of the country's gross domestic product and the largest proportion of the construction trucks are used in copper mining. In the north of Chile is the largest copper mine in the world. Chuquicamata is 4.5 kilometers long, 3.5 kilometers wide and almost a kilometer deep. As part of the pit is at risk of collapse, mining will move underground in the foreseeable future. For reasons of cost, however, the copper ore is to be surface-mined for as long as possible.

Such unbroken continuous duty is not without consequences. The performance capacity of the engines diminishes over time, while the running costs rise due to wear and higher fuel consumption. And the risk of failure – a horror story for the operator – increases. Because every week that a dumper stands idle, the mine operator is faced with a six-figure loss.

From waiting room to engine clinic in one.

So to obtain high levels of long-term economic efficiency in Chuquicamata, the engineers prescribe a routine procedure for well-preserved vehicles. It involves the replacement of the existing engine with a newer model. Known as repowering, the process places compatibility at the top of its priorities. So for many widely used dump trucks and mine excavators there is a matching MTU engine model that can be used. Vehicles made by Hitachi, Le Tourneau, Liebherr, Belaz, Komatsu and Terex can easily be refitted with Series 4000 engines offering outputs of up to 3,750 bhp. In the past five years, more than 30 vehicles have been re-equipped with MTU Series 4000 engines in Chuquicamata. The repowering process has to be handled quickly and efficiently in order to keep the operator's losses to a minimum. That is where the careful preparation and planning by the MTU experts on site pays off. When a vehicle is approaching its repowering appointment, it first undergoes a thorough examination. That is the only way to be sure that all interfaces with the truck such as electrical, piping and electronic connections exactly match the new engine. The ultimate aim is to complete the repowering operation as swiftly as possible.

Often the package includes a matching radiator and air intake and exhaust systems along with the new engine. So the customer gets all the necessary parts for repowering from one supplier. Despite undergoing a major trans-

plant, the dump trucks require very little recovery time. Once the right replacement engine is ordered, it takes no more than a week including installation and system configuration for the vehicle to be back on its wheels and ready for thousands more hours of continuous duty. And to make sure that the engines continue to perform to their full capabilities long after the operation, MTU takes care of all future health checks. The 30-strong team looks after the nearly 60 engines that drive the copper mine's heavy-duty vehicles. The technicians know their "charges" inside out and see to everything from filter replacement and oil changes through to regular services. In order to avoid expensive breakdowns, the experts are available 24 hours a day, seven days a week, 365 days a year.

Doctor's orders: exercise and fresh air!

Equipped with new insides and with the benefit of regular servicing, the heavy trucks at Chuquicamata soon operate a good deal more economically than before. For the mine owner, a dump truck that goes faster with a full payload is a worthwhile long-term investment. But it's not just the performance that counts. When engines are exposed to such extreme conditions, the cost of fuel, oil, coolant, spare parts and repairs due to unforeseen problems add up to a considerable sum over the life of the product. As the maintenance costs of an engine amount to several times the acquisition cost, it is certainly worthwhile looking for savings potential. A new engine that is technically more advanced and has to be serviced less often saves money and thus pays for itself in a shorter time. All driveline components of the MTU 12, 16 and 20-cylinder engines are perfectly matched so as to meet the demanding requirements of everyday mine work. But how do the MTU engines in the Atacama desert protect themselves from heatstroke? The triple-walled, water-cooled exhaust pipes limit the surface temperatures



They are the true giants of mining. The dump trucks stand nine meters high and weigh 600 tonnes. Next to them, ordinary cars look like toys.

to around 200 degrees Celsius and minimize the fire risk. The cooled turbocharger ensures that the engine delivers consistent performance even at high ambient temperatures. The electronic engine management adjusts the most important operating parameters such as injection volume and pressure to suit the onsite conditions. So even at altitudes up to 3,600 meters where simply breathing is difficult, the turbocharger can still reliably deliver the charge air at a boost pressure of around 2.5 bar. The Series 4000 also features the latest-generation electronically controlled common-rail fuel-injection system, which MTU has been fitting as standard since 1997, having been the first manufacturer of large-scale diesel engines to do so. It atomizes and delivers the fuel at ultra-high pressure so that only the precise amount required for the work being done is used. And what is so special is that, compared with preceding models, the latest version consumes around five percent less fuel. At the same time it is kinder to the environment because the MTU Series 4000 engines not only satisfy the emission restrictions demanded by the US EPA Tier 2, but also meet all the requirements for compliance with future exhaust emission limits.

After a series of thorough tests, the patient is discharged from the care of the engine health professionals. With new-found zest it accelerates to 60 kilometers an hour then quickly slows down to descend the switchbacks into the deep mine crater. It's difficult to believe that it was struggling up these slopes only a week ago. And now it is looking forward to being able

Definition of repowering

Repowering involves replacing an existing engine with a new, more powerful MTU model. The vehicle is ready for use again within a week. MTU has carried out more than 300 repowering operations on an enormous variety of mining vehicles in recent years.

to carry hundreds of tonnes of copper ore out of the mine again. And to being restored to full power by the engine doctors if it should ever be necessary again in the future. Which is what repowering is all about.

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1 The conditions in the Chilean desert demand everything of the vehicles and their engines. Dust, heat and thin, high-altitude air make work much more difficult. **2** The only chance for the trucks to take a breather is when they are being loaded in the mine. **3** Then they carry the valuable cargo out of the mine up elongated switchbacks.