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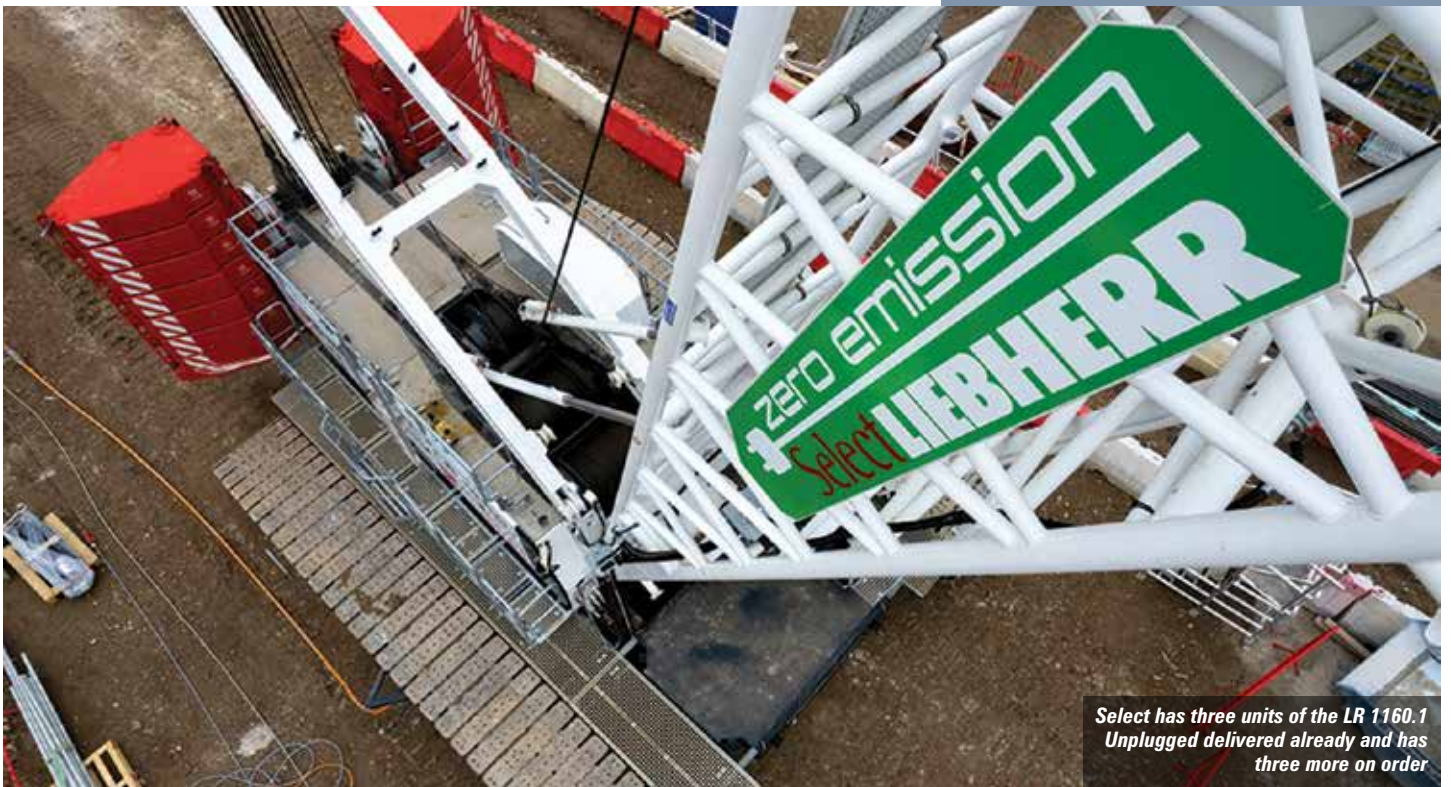
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Select has three units of the LR 1160.1 Unplugged delivered already and has three more on order

POWER SURGE

The past year has seen a significant surge in electric crawler crane launches, Will North reports.

A growing number of manufacturers are busy developing electric cranes and the past year or so has seen battery electric crawler cranes enter the mainstream market with units starting work on sites in London and Oslo.

Dutch newcomer PV-E has held a launch event for its first models, while Marchetti has entered the market with two new models at the smaller end of the size range. Liebherr Nenzing has fleshed out its Unplugged range with two new models and rumour has it that Sany has an 80 tonne all-electric telescopic crawler out with customers and a 150 tonne battery powered lattice crane on test.

HOT SWAPPABLE

While Liebherr Nenzing's range uses permanently installed batteries, and recommends that its cranes are kept plugged in if possible, PV-E has chosen to use battery packs that can be charged remotely and swapped over. The battery pack is designed to hold enough charge for eight hours of operation but can be replaced rather than recharged if the crane needs to work a double shift.

In March, the company held a launch event for its first crane in the range, the PV-E EC 160. As reported in *Cranes & Access* last February (issue 23.1- p39, Green Shoots) the first units are destined for Volker Wessels, which has ordered three cranes to use on projects in the Netherlands. The company expects to have the first of these cranes working on site later this summer.

The EC 160 is a 160 tonne crane with a 43 metre main boom and 42 metre luffing jib. Its 200kW

motor will be powered by a 260kWh lithium iron phosphate (LiFePO4) battery pack. "They are super safe, chemically stable and inert," says PV-E CEO Joost Bömer. "They also have a long life and you can recharge them from any level of charge without shortening their life."

The cranes use components from a range of well-respected suppliers including Rexroth, Avesaat, Hirschmann and Fuwa. The CE approval was carried out by Eager.One, the lifting engineering subsidiary of the Meemaken group, founded by former Mammoet chief executive Rod van Seumaren.

Volker Wessels is not the only buyer for these cranes. Jens Christoffersen, sales manager for construction and rail equipment distributor Lesansco has stated that the Danish company will be offering the cranes across the Nordic region.

NEVER STUCK

Marchetti has taken a different approach to bringing electric power to market. While Liebherr and PV-E's ultimately rely on having access to mains power, Marchetti offers a more hybrid approach. It will launch two electric powered versions of its 25 tonne Sherpina telescopic crawler crane at Vertical Days. The all-electric model uses a 100kW AC permanent magnet electric motor to power the hydraulics fuelled by a large lithium iron phosphate battery (LiFePO4) battery pack that is said to be good for a full eight hour shift. The battery is enclosed in a steel electrically heated box. The crane is also



PV-E battery pack



PV-E launch of the EC 160 in March

equipped with a small Stage V Perkins diesel which can be used to recharge the batteries when it is not possible or convenient to recharge them from an AC mains power outlet. The other option is a regular diesel powered model with a 230 volt AC electric motor also available to power the hydraulic pumps when a suitable outlet is available.

Rob Law of UK distributor AGD said: "It's a beautiful idea, it's really flexible, and ensures you'll never get stuck without power. It can be charged from the mains quickly enough for a mid-shift lunchtime top up, or fully charged overnight. And if all else fails the diesel will top up the battery pack. Marchetti will almost certainly launch further models if customers respond positively to the new cranes."

Law points out that on many jobs such as on underground projects where the crane is used to lower loads down a shaft, a crawler crane can work quite happily for months, or even years, while plugged into an electric power outlet. A challenge can come though, he says, when the crane needs to be driven on site, particularly on a large site without adequate power supply or plug in points as the crane could run out of power. The small diesel engine on the electric Sherpa ensures they always have power and can always be moved.

POWERING ON

Liebherr Nenzing's engineers have not been sitting idle since the launch of its first two Unplugged models, the LR 1200.1 and LR 1250.1 Unplugged.



Marchetti's new hybrid power system for its Sherpina cranes offers Battery, diesel or plug-in power



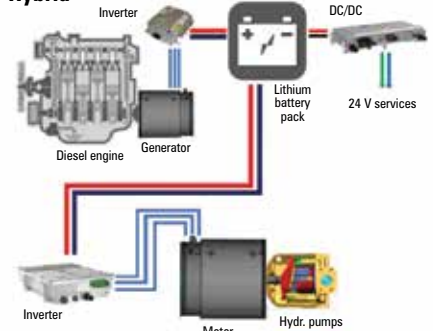
The latest unplugged models are the 130 tonne LR 1130.1 and 160 tonne LR 1160.1.

The first three units of the LR 1160.1 Unplugged have been delivered to Select in the UK joining their existing LR 1250.1. The company has an order in place for a further three units to join its fleet in 2022 and Liebherr says that it has also taken orders in Finland, Sweden, Hong Kong and Australia.

As well as being battery powered these new cranes feature three new safety aids, available on many recent Nenzing machines. The 'Gradient Travel Aid' in which the control system automatically calculates the crane's centre of gravity as it negotiates sloping ground and warns the operator before the crane becomes unstable. While travelling, the operator receives real time information about the permissible and actual gradient and the crane's overall centre of gravity. If necessary, the boom angle can be altered so that the machine remains stable.

'Ground Pressure Visualisation' calculates the

Hybrid



actual ground pressure of the machine in real time and compares it with the specified safety limits of the relevant jobsite. This means the operator is permanently aware of whether the machine is situated in, or is approaching, a critical area.

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Liebherr LR1160E electric crane at HS2's Canterbury Road vent shaft

Photos Courtesy of Patrick Moreby

CHARGING AHEAD

Select Plant in the UK was one of the first two buyers of Liebherr's Unplugged electric crawler cranes. Will North spoke to staff across the company to find out what it is like to own and operate one of these new electric cranes.

Select received its first 'Unplugged' cranes from Liebherr early last year as one of two launch customers along with Nordic Crane in Norway. Select ordered two units of the 160 tonne LR 1160 and one 250 tonne LR 1250. For the past 12 months or so the cranes have been working on a variety of contracts including two key projects, Old Oak Common in north London where they are working on the UK's new HS2 high speed railway line and Olympia in central London which is a mixed use development. On both jobs, they are performing general lifting duties.

IN CONTROL

Select crawler crane operator Patrick Moreby has been working with the Unplugged cranes since the first pre-production prototype. He is now training apprentices on their use including Rachel Penfold, who is working alongside him at Old Oak Common.

Moreby was unfazed when asked to work with the first electric crawlers. "A crane is a crane," he says. "There have been electric cranes at ports, for example, for a long time. Now it's coming full circle to construction."

With the prototype, some downtime was expected, as Select and Liebherr worked to fine tune the crane control systems. This would sometimes take a few hours or even overnight as data was sent back and worked on at the

factory in Nenzing, Austria, and then adjustments sent back to the crane. On site, reliability of the production models has been as good if not better than that of the diesels.

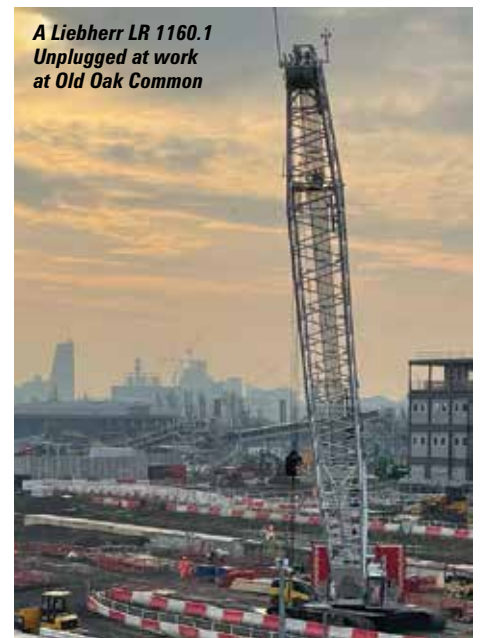
At Olympia, Moreby was operating the LR 1250.1 Unplugged for 12 hour shifts without needing to recharge. With the crane remaining stationary he could run the power draw down to almost nothing with no slowdown in operation. Even at Old Oak Common where the crane is moving around the site more, he feels it could have run longer without needing to plug in.

THE IDEAL APPRENTICE

Penfold came to the crane industry after starting out as a carpenter and engineer/concrete technician. Hearing of an opportunity to train as a crane operator, she leapt at the opportunity and first trained on a 60 tonne LTR 1060 telescopic crawler in Select's yard in Cambridgeshire before moving on to a lattice boom crane.

She is enthusiastic about a career in the crane industry and about the chance to learn on the new electric models, with a conviction that electric crawlers need to replace diesel cranes. For Moreby, Penfold is the ideal apprentice, a quick learner who is eager to get in the cab and start working. She took to the crane immediately, finding the control system easy to get to grips with following her training on the LTR.

A Liebherr LR 1160.1 Unplugged at work at Old Oak Common



The future of lifting: Apprentice Rachel Penfold is learning quickly on the LR 1160.1 Unplugged



The Unplugged Liebherr at work at Olympia



The 1160 at work at Old Oak Common

Both operators praised the responsiveness of the electric crane's controls saying it is even better than on the diesels. "You can feel it as soon as you press the lever," says Moreby. "If an operator has transferred from a larger crane with three main hydraulic pumps, they might find the electric a little slower when operating multiple functions at the same time. But, comparing like for like, the two pump electric works just as fast as an equivalent diesel."

"On site when a diesel crane would normally be idling, there is total silence with the electric machines. When lifting, the hydraulics make the same noise whether you are working on diesel or electric, but this provides useful feedback on the crane's performance."

BAPTISM OF FIRE

While the cranes perform as well as, if not better than diesel rivals, making the most efficient use of them requires site owners and lead contractors to plan for their deployment. James McKenzie was appointed person on the Old Oak Common site and worked with the cranes from their arrival on the site. I spoke to him shortly before he left the project for another role.

In his role as AP (Appointed Person), he is very much the point of contact for the lead contractors and project owner. If a crane stops working, he is the one who will bear the brunt of the customer's disappointment. It's a role that demands a conservative, risk aware, approach. His focus has



Liebherr LR1250E electric crane at HS2's Old Oak Common site

been on ensuring the crane remains charged.

At the Old Oak Common project the crane is required to track around site a lot. Moving a 170 tonne crane consumes a lot of energy taking a lot of charge from the batteries. This requires knowledge of the crane and planning of the charging schedule.

Unlike on the Olympia job where the crane was working in a stationary position, McKenzie has been keeping the Old Oak Common crane plugged in constantly to ensure the batteries have as much power as possible to keep up with the tracking requirements. As batteries are sensitive to temperature, the Liebherr Unplugged cranes have both battery heating and cooling systems to ensure they stay within the optimal temperature band and this is done whether the crane is plugged into the mains or operating unplugged.

McKenzie says that part of his day-to-day work on site has been managing the cranes' charging cables. For example, the lengthy access road required a longer journey without direct access to power. As the crane is only designed to track around 600 metres on a full charge this needed to be planned and managed carefully ensuring that the cables would be available to avoid any charging downtime.

But he is keen to stress this isn't a flaw of the cranes. "The cranes themselves are phenomenal," he said.

PROPER PLANNING

McKenzie identified that on the Olympia site his job would have been much simpler if the charging infrastructure could supply more power (63A) due to the large amount of tracking the cranes needed to undertake.

Andrew Lloyd, Select's lead lifting engineer for crawler cranes, hoists and specialist lifting, worked on positioning the mains distribution units (MDUs) on site, and on sourcing the long cables required. Neither of which were easy. Lloyd's task was to balance the need to reduce cable lengths with minimising the number of MDUs.

"We had to do a bit more planning than usual," he

CHARGING POINTS

Liebherr says that the life of crane batteries can be prolonged using a few, fairly simple, steps. Owners should distinguish between daily work and storage on site.

DAILY OPERATION

1. Operate the battery between 10 and 90% of the battery capacity
2. Whenever possible, operate the crane on the charging cable - plugged in
3. Keep the crane plugged in so that the batteries are properly tempered (important at temperatures below 15°C and above 35°C)

STORAGE

1. If work will be interrupted for more than three weeks, first discharge the battery and then set the charging target to 50%.
2. Keep the crane plugged so that the batteries are at the proper temperature. This is particularly important when outside temperatures are below 15°C or above 35°C.

says, "particularly the siting of the power points. Finding the optimum cable length was a learning experience. You draw more power with a longer cable, but we don't want to have too many charging points. Liebherr says the sweet spot was about 50 metres so, we've located charging points within 50 metres of the cranes' position."

POWER FAILURES

It's a constant of the industry that clients leave their first contact with a crane supplier until the last possible moment. Crane owners have come to accept this and are always ready to come up with the equipment and lift plan needed to complete the job.

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sufficient power will become a routine part of project planning.

Stephen Bradby, technical and engineering leader, lifting solutions said: "Fundamentally, there is an issue getting large amounts of power to sites quickly, even though project planning will often have started two years earlier."

One huge bonus of the crane is it can charge on less than 32 amps, which is usually readily available even before the temporary builder's supply is installed. The sites expected this to be much higher, but because the crane doesn't consume significant power when it is not physically moving the overall daily power requirement is very low.

With the energy sector struggling with the ongoing disruption of Covid, a potentially very long war prompted by Russia's invasion of Ukraine, and the need to urgently address climate change, electrification is hopefully, now, at the top of the political agenda. But it would be unwise to bet heavily on a major restructuring of the sector coming anytime soon.

In the meantime, says Lloyd, it will fall to the owners of electric cranes and other electric construction equipment to nudge project owners to consider their needs. "It is going to take education, trial and learning on our part and on their part, to see what works and what doesn't."

CLEARLY CLEANER

The electrification of the economy, as part of a net zero strategy, has become a deeply polarised issue. Certainly, that is how it plays out across much of social media.

The reality is more complex. Finding commercially efficient ways to halt emissions and limit climate change will take experimentation and some ideas will not work out. Some sceptics may be acting in bad faith, but most have legitimate concerns based on the limited information available on this new technology.

Select's staff members knew that they would need to be ready to refute some commonly made objections to electric cranes such as they lack power, they require generators, they are slower... Some of these claims have some elements of



Select's new LR 1250 and LR 1160 on their way from Nenzing The second pic here would work better in the Electrics update piece

truth but none of them are convincing once you look in detail at how cranes use power.

A good starting point is to ask yourself what a diesel engine is used for on a crane. The obvious answer is that it drives the winches, the tracks, and so on. On most jobs though, that is far from the case. For as much as 90 percent of the time, the 230kW diesel engine on a crane like an LR 1160 is being used to keep the screen on in the cab.

In many ways, using a diesel engine to power a crane makes as much sense as buying an SUV to use as a backup charger for a mobile phone. This is because an engine produces power constantly, regardless of whether it is being used or not. A crane working from a battery, or the mains only draws the power it needs.

With a battery powered crane, this is true even when the battery itself is charged by a generator. The generator will produce some fossil fuel emissions. But as these are being used to charge a battery, and the power from them is only used as needed, the overall environmental impact is typically less than using a diesel engine directly. Weight for weight, batteries hold less power than diesel fuel. Most modern crawler cranes from companies such as Liebherr of Kobelco are highly optimised. But the need to use electrical power sparingly has pushed for even closer attention to detail. Lloyd says that looking at the way the cranes have been put together, he sees changes



like straighter hydraulic hose routing and layout. This reduces wasted energy - essential with battery powered machines.

Liebherr says that its engineers spent a lot of time to increase the efficiency of the hydraulics but the effort was worth it.

Bradby is of the opinion that this is merely the beginning - cranes could potentially be made more efficient by replacing most hydraulic functions with electric drive motors. "What Liebherr is doing with these cranes is using an electric motor to power a hydraulic pump. Longer term, the logical route is to get rid of the bulk of the hydraulic system altogether. You could have an electric winch and electric slewing gear."

"Most manufacturers of electric equipment are simply replacing the engine with an electric motor. What you find is that the hydraulics are relatively inefficient, because they've been designed to work with a diesel engine that is over-



Plugging in the Liebherr Unplugged crawlers at Old Oak Common



Select was one of two initial buyers of the Unplugged machines. Here, Kynningsrud Nordic Crane's LR 1250.1 Unplugged is shown at work in Oslo

**Liebherr LR1250E electric crane
at HS2's Old Oak Common
construction site**



powered. The logical route is a complete change of architecture to a fully electric, battery powered machine improving efficiency and potentially reducing the price as well. The only place where it really makes sense to retain hydraulics is in the big hydraulic cylinders used to luff a jib or to extend a telescopic boom."

Select was able to use telematic data supplied by Liebherr to assess the power use of its cranes. At Olympia - where the crane was used in a stationary position almost like a tower crane - Lloyd says that it used around 750kWh per week. A diesel working on the same site used 420 litres of fuel a week, or the equivalent of almost 4,300kWh meaning the energy use of the electric crane was just 20 percent that of the diesel.

Another criticism aimed at electric cranes is that they are slower than diesels. Moreby and

Penfold's direct experience was that this is barely noticeable. Lloyd, looking closely at the data from the cranes says that in terms of single functions, there is a very slight difference in the performance, increasing when performing multiple crane functions simultaneously.

But while this difference is measurable, it is not significant because as already mentioned, cranes on construction sites rarely work constantly and are more typically at idle. Even with the heaviest load on the hook, the crane uses no power while it is fixed into place.

"One of the things we occasionally have to address is a question around speed where some companies will claim faster luffing speeds," says Bradby. "But that is only looking at a tiny element of the total work day. When you analyse the telematics data, you see that the cranes are idle

for 70 to 80 percent of the day. And yet they're wanting to gain two seconds on the lift, it's so illogical!"

Nick Hooper, product lead for crawler cranes, is responsible for renting the new cranes to external clients. He saw these concerns play out when he was talking to a client considering using these cranes. The client would be operating the crane above a shaft from a stationary position. "They were worried about hoist speeds," said Hooper, "I told them there's no difference, we have checked the effect of hoisting speeds and it won't have any effect, it will be fine. When we looked at what they were looking to do, it involved one lift every 20 minutes. The crane has now been on site since January, doing exactly what the client needs it to do, as fast as the job requires."

COST CUTTING

There is one clear measure by which diesel cranes beat their electric rivals: purchase price. Liebherr says that it designed its electrification concept for efficiency from the very beginning, with the aim of keeping the entry price as low as possible. The additional costs compared to a conventional machine are made up not only of the batteries, but also of all the necessary electrical components, such as the electric motor, wiring harnesses, chargers and thermal management. With today's technology, the company says the price of a typical 160 tonne crane increases by about 30 percent, depending on its configuration.

As battery technology develops, this cost premium is expected to reduce. And it is an upfront cost, which translates to lifetime savings. With an electric crane, you pay for the batteries' energy storage capacity when you buy the crane, with a diesel crane, you pay for energy storage capacity every time you fill the tank.

This was a consideration when Select confirmed the details of its order for the first of the Unplugged LR 1160 cranes. While the 250 tonner

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Liebherr LR1160E electric crane at HS2's Canterbury Road vent shaft site

is offered with only one battery pack - consisting of eight battery modules - the 160 can be supplied with either five or seven modules. McKenzie, faced with the challenge of deploying the cranes on site, would have preferred the larger batteries. But Hooper and Bradby realised this would have pushed the price beyond commercial viability. Hooper explains that the cost of the batteries is reflected in the rental rates for the electric cranes, which are higher than for their diesel counterparts. But, over the duration of the project, the cost of keeping the crane charged will be significantly less filling the diesel tank. Overall project costs will be the same, if not less, for an electric.

New crane buyers are used to spending large sums on cranes often borrowing to do so, knowing that in 10 or so years' time they will be able to recoup most of their initial outlay by selling the crane. While a well maintained crane will retain almost all of its performance and value for decades, that isn't the case for batteries.

But while batteries may have a limited lifetime to power a crane, that does not mean they have zero value when they need to be replaced. Companies like Tesla are already giving old car batteries a second life by using them in homes and offices to store power when it is cheaper - often overnight - and release it when it is needed. This means there is already a second-hand market for batteries. It is also possible to imagine how a crane company might use old batteries on site, perhaps with solar panels to store energy in the day and then use it to charge crane batteries overnight?



Liebherr LR1250E electric crane at HS2's Old Oak Common construction site

THE FUTURE OF LIFTING

There is no way, Bradby says, to achieve net zero in construction without electrification. "Eight years from now we hope to meet the Scope One provisions (of the Greenhouse Gas protocol used in environmental accounting). In other words, we would achieve net zero. If we're going to achieve that then diesel has to go. HVO (Hydrotreated Vegetable Oil) is not the long-term answer, because that still generates emissions."

If it could, the company would buy more electric equipment, Bradby says, "But the suppliers need to build them. We'd love to buy electric cranes, but in many segments, they just don't exist yet."

Achieving this will also require the support of external clients, adds Hooper. "We can do our bit as Select but obviously it's going to need external clients to have the appetite for what we're trying to do."

Thankfully, many clients are forward thinking enough to ask for electrics already and many are keen to be seen to be early adopters of the more environmentally friendly machines. ■



On the Olympic site, the team working with the LR 1160.1 Unplugged avoided risk by keeping the crane plugged in while tracking. With more planning of charging points, and more power, this should not be needed



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