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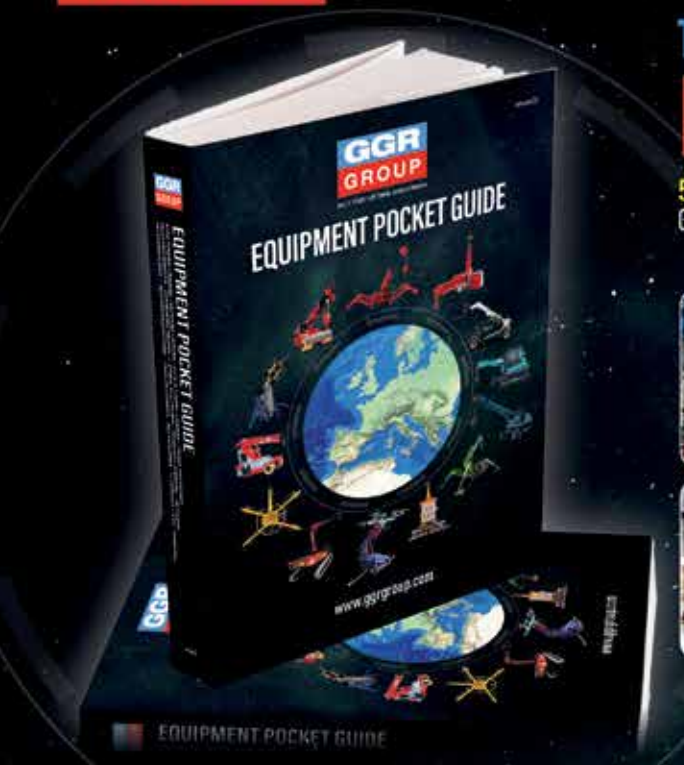

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THE ABC OF LIFTING WITHOUT CRANES

The growing preference to construct as much as possible off-site by prefabricating modules in factory type setting, is leading to building larger and heavier components, all of which need to be moved and lifted into place. As a result contractors are looking for innovative alternatives to big cranes which are in short supply or require more space than is available.

Offsite production is nothing new, oil rigs have been built in production yards for more than half a century as have power station components and more recently wind turbines. Over the years lifting equipment manufacturers and heavy lift and rigging companies have risen to the task devising innovative solutions to handle the heavier loads. In this feature we cover just a few examples of engineering ingenuity showing some alternatives to using large cranes.

While heavy lift companies are managing to keep up with handling the larger modules, the challenge now is transporting them on the world's road networks. As one European heavy lift company put it: "We have the capability of building these massive components, but are rapidly getting to the stage of not being able to transport them due to an inadequate road infrastructure." This issue is discussed on page 30 with input from ESTA - the European association for the abnormal road transport and mobile crane rental industry. The problem is exacerbated by a growing number of bridges in a state of disrepair, leading to reduced axle weights and permitted loads.

This issue is possibly even worse in the United States, with the American Society of Civil Engineers (ASCE) reporting that 42 percent of the country's 617,000 bridges were built more than 50 years ago, and of those almost 20 percent are structurally deficient. The sheer number of bridges needing to be repaired or replaced has led to a new methods of construction such as Accelerated Bridge Construction (ABC), which according to the Federal Highway Administration is a process that involves constructing large sections of bridges offsite, then installing them quickly, often within 48 to 72 hours, helping reduce road closures, traffic delays and overall project costs. Thankfully the new structures are also being designed to have long service lives.

According to the Administration there are three ABC technologies employed:

- Prefabricated Bridge Elements and Systems with bridge components - the deck, beams and railings - built offsite or adjacent to a site and then installed in place.
- Slide-In Bridge Construction - installing the prefabricated elements or replacing an existing bridge with a new one.
- Geosynthetic Reinforced Soil-Integrated Bridge System - a method for constructing abutments and approach embankments that are less likely to create the common issue of a bump at the end of a bridge.

While this speeds up the bridge replacement times - especially the actual installation - it does not mean the whole process is quick. The design and engineering phases can take a significant time since everything has to be perfect for the installation to go smoothly. However, the many benefits also include improved safety, lower construction costs, reduced environmental impact along with a higher quality, longer lasting structure.

While heavy lift companies are managing to keep up with handling the larger modules, the challenge is transporting them on the road networks

The Texas Department of Transportation says: "The ABC method marks a paradigm shift in the project planning and procurement."

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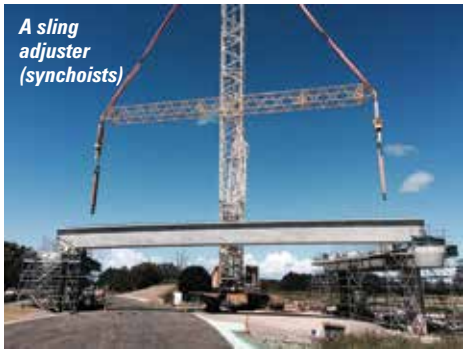
A distinguishing factor of ABC is that it utilises Ultra-High Performance Concrete (UHPC), which is exceptionally strong and durable resulting in a longer bridge life. According to the Federal Highway Administration (FHA), "UHPC has been used in prestressed concrete girder simple span bridges, precast concrete deck panels, and field cast connections between prefabricated bridge components. The mechanical and durability properties of UHPC make it an ideal candidate for use in developing new solutions to pressing concerns about highway infrastructure deterioration, repair and replacement."

ENGINEERED RIGGING

One company that specialises in ABC is Engineered Rigging which has locations in North and South America as well as Europe. Its co-founder and principal Eddy Kitchen says: "When it comes to streamlining the planning, procurement and construction portions of bridge projects, our clients appreciate the fact that we provide the engineering services, specialist equipment rental and technical support. By offering this trio of services under one roof, we can save bridge contractors time and money."



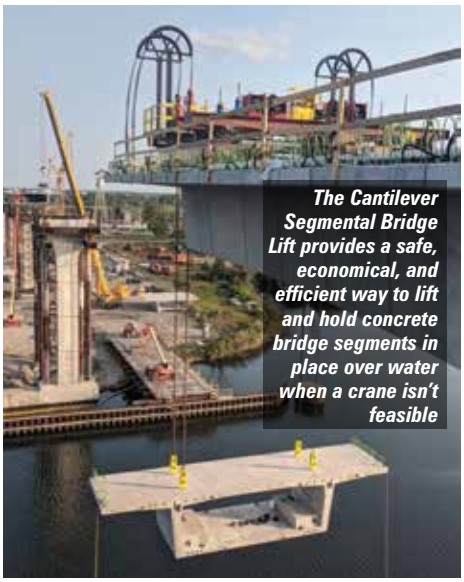
A sling adjuster (synchoists)

Resources critical to its success include detailed planning by engineers with the relevant knowledge and experience, the specialist equipment to transport the prefabricated concrete elements and then lift or lower them into position, not to mention the highly trained technicians skilled at operating the equipment and understanding the concept.

"We have extensive first hand experience in Accelerated Bridge Construction," says Kitchen. "Our engineers have developed detailed lift plans for the placement of bridge decks and bridge trophies as well as their demolition. We also have a team of heavy lifting professionals to provide on-site technical support."

Engineered Rigging's rental fleet included a 2,200 ton jack up system

The company's rental fleet includes a 2,200 ton jack-up system, strand jacks, sling adjusters (synchoists), self-propelled modular transporters (SPMTS) and a custom built Cantilever Segmental Bridge Lift.



The Cantilever Segmental Bridge Lift provides a safe, economical, and efficient way to lift and hold concrete bridge segments in place over water when a crane isn't feasible

POND CREEK BRIDGE

A recent contract which highlights the approach was the construction of the Pond Creek Bridge on US460 in Pike County, Kentucky. Incremental bridge launching is ideal when a bridge is very high and access for cranes is difficult or impractical. Contractor Bush and Burchett of Allen, Kentucky, constructed what would become the tallest bridge in the Bluegrass state and one of the highest traffic bridges in the country. The rugged terrain on site coupled with a bridge height of nearly 100 metres created several challenges.

According to Paul Burchett, co-founder of Bush & Burchett: "Being 324ft /98 metres high and 1,000ft (305 metres) long, the slopes on each side of the bridge were extremely steep making conventional crane erection almost impossible."

Bush and Burchett determined that the safest and most economical strategy was to build the steel bridge on the embankment and incrementally move the girders into position onto the eight sets of piers. Engineered Rigging brought in a range of equipment, including two 63.5 tonne HSL7006 strand jacks, a SLPP7E strand jack pump system, strand guide, strand recoiler, gold box, a laptop and industrial Hilman rollers. Engineered Rigging also provided an on-site technician to operate the strand jack system.

As one section of girders was completed in the launch bay, the strand jack system pulled it onto the bridge pier, thus allowing the next section of the bridge to be constructed on the embankment. In total, 10 jacking evolutions were necessary to pull the entire bridge into position. The pulling weight for the first pull was approximately 7.3 tonnes and increased with each subsequent pull reaching 36.3 tonnes.

The pulling force is a function of how easily the bridge slides on the rollers and on the dead weight of the steel span.

"The launch went as well as we could have imagined," said Burchett. "We encountered a few challenges during the launch related to the small tolerance margin. On the piers, we only had about a half inch (12.7mm) of tolerance with each gap. Any lateral movement or minimal inconsistencies in fabrication of the girders or rollers leads to rollers not lining up with the gap in the splice plates. While this caused a bit of a delay on the eastbound launch, we modified the splice plates on the westbound bridge that helped reduce the frequency of these issues."

Once the launching of the bridge was complete, it was lifted off the Hilman rollers and lowered onto its bearings. This step of the bridge construction process used additional Engineered Rigging heavy lifting equipment including one SFP421SJ split flow pump, hydraulic hoses, four 145 tonne LPL1602 locking pancake jacks and four HCL1006 90 tonne locknut cylinders.

"This was the first time a girder launch has ever been performed in Kentucky, and I was glad to be a part of it. We would definitely use the approach again if the conditions called for it. The designer, Stantec led by David Depp, Engineered Rigging and the inspectors from the Kentucky Transportation Cabinet did a great job working with us to make this happen." ■

Photo courtesy of Baumann

Photo courtesy of Fagioli

HEAVY TRANSPORT HIT BY BUREAUCRACY AND CRUMBLING INFRASTRUCTURE

European heavy and abnormal transport companies are facing growing and damaging restrictions caused by inefficiency, bureaucracy at a local level, along with aging infrastructure. That is the view of ESTA, the European Association of Abnormal Road Transport and Mobile Cranes and its network of national associations and members.

Ton Klijn

ESTA director Ton Klijn, a former managing director of Dutch company Wagenborg Nedlift, said the increasing problems make the industry less safe and increase costs to the detriment of both the transport companies and their clients.

The problems are also hindering the growth of the wind industry and come at a time of increasing off site and prefabricated construction in both the building and civil engineering sectors - all of which rely on heavy transport services to deliver structures and equipment to their final destination.

Klijn says: "We understand that in macro-economic terms, the heavy transport industry is very small but it is crucially important and is becoming more so. We are appealing to our political leaders, both in Brussels and the various national parliaments, to take action, and soon."

GERMAN CHAOS

In recent weeks, the focal point of the debate has been Germany, but the situation in other countries is just as serious. The issue was raised in the German parliament at the end of January and follows a growing chorus of complaints from industry, port authorities and transport companies.

ESTA has been pressing the country's authorities to deal with the difficulties of obtaining heavy transport permits since the country introduced its controversial new VEMAGS permitting system over a year ago. VEMAGS is the German online system for the application and approval for oversized and heavy transport in all 16 federal states.

The new system was meant to be simpler and more efficient, but transport companies and their clients say that it is leading to higher costs, unnecessary paperwork and ever greater delays. They also complain that permit issuing offices are often under resourced and lacking in the necessary expertise.

"We fear that a large number of transports in Germany are being forced to work without the necessary permits in place - simply because the system is not fit for purpose," says Klijn.

Other industries have joined the debate, saying that the situation is badly harming German business. At the end of last year, the Bavarian construction association Bayerische Bauindustrieverband launched a scathing attack saying that the current rules and regulations are inefficient, expensive and often impractical.

One of the many examples it cites, concerns the transport of large construction machinery. It says that the rules demand that the cargo is precisely identified, including the exact type, manufacturer and model. But this is often not possible, as the type of machine required on site and its availability is often not known far enough in advance. The contractors say that the regulations governing large and heavy transport must be streamlined and simplified - and follow common sense.

Photo courtesy of HLS

Photo courtesy of Bolk

Similar concerns have been expressed in Hamburg where some companies are reportedly using alternative ports such as Rotterdam and Antwerp because of the delays in Germany.

ESTA member and German heavy transport and crane association BSK - Bundenfachgruppe Schwertransporte und Kranarbeiten - issued a

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joint statement with fellow organisations in the engineering, construction, transport, logistics and wind energy sectors, complaining loudly about the poor state of the country's roads and bridges. They said: "A real fiasco is threatening, especially for larger heavy duty transports and the affected sectors of the capital goods industry, due to a failure of the transport infrastructure. For example, there are no new wind turbines without corresponding transport routes."

Now German chancellor Olaf Scholz has been pressed to intervene. Speaking in the German Parliament on January 26th, MP Bernd Reuther - the transport spokesman for the FDP, a minority party in the ruling government coalition - called on the Federal Government to take urgent action and speed up the planning and approval procedures for all modes of transport. Scholz replied that the government will be presenting new measures soon, although details are not yet available.

The situation is little better elsewhere. In France, heavy transport and crane companies have long complained about petty regulations and the lack of coordinated heavy transport routes between different regions which sometimes mean they do not connect to each other.

ITALIAN CONFUSION

In Italy, companies have objected to the "excessively large" number of permit issuing organisations in the country, leading to confusion, delays and unequal treatment of permit applicants. Italian heavy transport and lifting company Fagioli and the association ANNA have both complained, while ESTA has written in their support.

ESTA said: "The slow and opaque processing of applications leads to unnecessary costs and delays which in turn incentivises companies to drive without a permit at all."

Of further concern are the repeated technical reviews of bridges needed for the application of permits over a certain gross vehicle weight. While the Italian regulation stipulating that only the owner of a crane can apply for a permit causes difficulties for leased cranes - as the legal owner is the finance company, rather than the user who needs the permit. In its letter, ESTA said that "it sees no valid grounds for this restriction…no other EU country requires this".

Fagioli chief executive Fabio Belli - the current ESTA president - said: "Infrastructure problems and transit restrictions is an issue all over Europe. In Italy we are facing a situation in which some transports are delayed by months and in specific cases the cargo has to be 'sectioned' or divided in order achieve an acceptable load, with enormous cost to re-assemble on site."

Fabio Belli

The situation is compounded by a loss of expertise. "There is a lack of engineers, specifically civil engineers and this will affect the planned infrastructure renewal. This is causing local authorities serious difficulties as they do not have the expertise needed to allow non-standard transports."

A SIGN OF PROGRESS?

ESTA has members in 25 countries and companies each of which has similar stories to tell. Yet the solutions are not difficult - and there are some reasons for guarded optimism, at least in the EU, where the European Commission is showing signs of appreciating the importance of the heavy transport sector to the wider economy.

A number of companies and organisations - ESTA included - have been lobbying for the creation of a European network of heavy transport routes that would give clients increased certainty, while saving money. Investment could be focussed on ensuring those routes have the necessary facilities and standards. It is an approach that has received a sympathetic hearing from some in Brussels.

The European Commission is also showing fresh interest in adopting the European Best Practice Guidelines for Abnormal Road Transport, first published in a European Commission Transport Directive back in 2005. The directive contains SERT, the Special European Registration for Trucks and Trailers, intended to reduce the paperwork and bureaucracy faced by the industry.

To date only the Dutch road traffic authority RDW issues SERT documents for new vehicles, which are accepted as an information document by the Belgian, Swedish and English road traffic authorities. But ESTA hopes that national authorities will see that a European registration system - as part of accepted best practice guidelines - will save time and money as well as making the industry safer.

ESTA believes that a lot of Brussels' aims can be achieved by revisiting the guidelines. But it is also crystal clear that without making the new regulations compulsory, no changes 'on the ground' will come about. A revived best practice guide would help create a European abnormal transport system of regulations and permits that is fair and harmonised, a one-stop shop across the continent that can be accessed through the internet.

Experiences in other parts of the world - in particular, the United States and Australia - show that the introduction of effectively designed online permitting systems leads to a rise in the number of transport permits applied for, and at the same time reduces costs for the issuing authorities. In addition, the number of infrastructure damage incidents is significantly reduced. None of this is ground-breaking…the systems are already in use in various parts of the world. The only reason we are not using them in Europe is because of regulatory barriers at a national level.

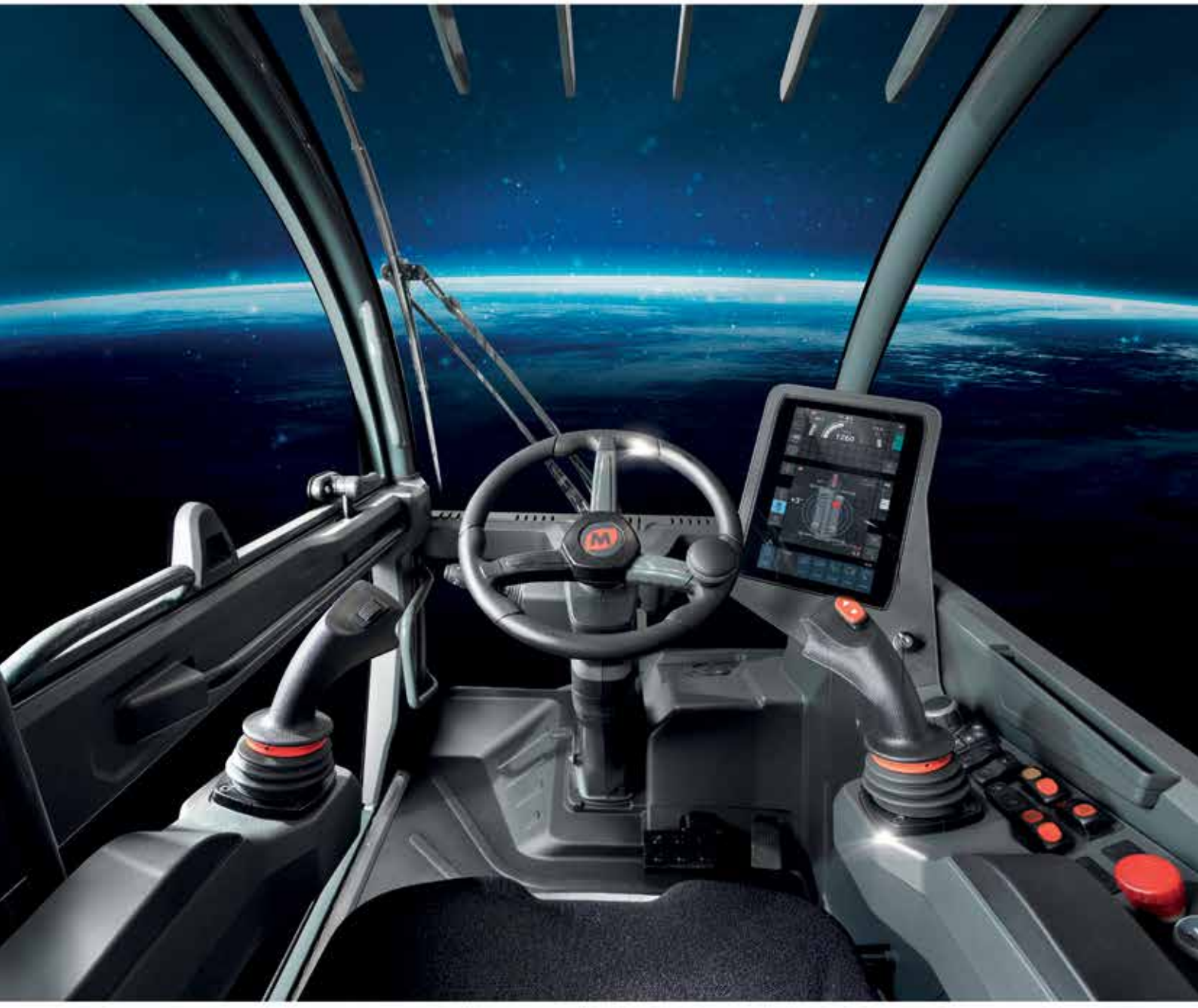
CHANGES IN MINDSET ARE LONG OVERDUE

Fabio Belli said: "Politicians must understand that for every transport, there is a manufacturing company behind it, not all of which can be moved to more accessible locations. If this topic is not correctly and urgently addressed many European industries will risk closure and their production transferred elsewhere."

"Some countries have already created 'special corridors' to simplify transport routes. The same strategic approach must be adopted by others, if their manufacturing companies are to survive and thrive, with alternative solutions like rail and river transportation being considered as well, to help make transportation as sustainable as possible. We know what needs to be done. We now need our political leaders to take notice and act." ■

Photo courtesy of Fagioli

1st class cabin



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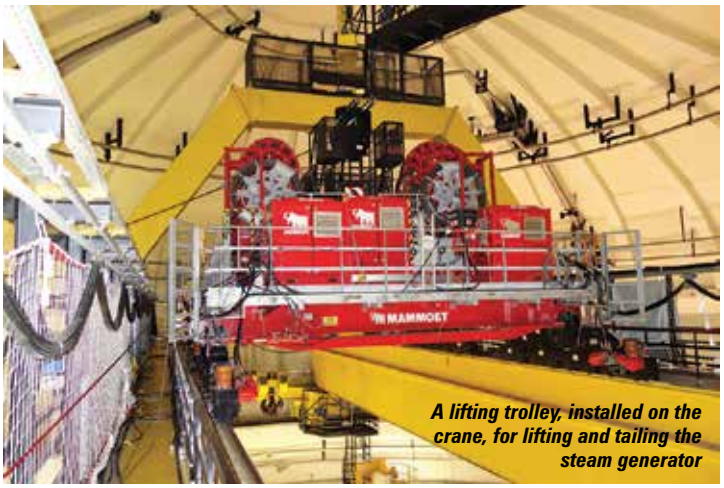
The steam generator is manoeuvred out of the reactor building



A lifting trolley, installed on the crane, for lifting and tailing the steam generator

CUSTOM ENGINEERED SOLUTION

Any work inside a nuclear reactor building has its challenges, but carrying out large scale maintenance and engineering work is another thing particularly as little regard was given at the design stage to the removal of the large and heavy components. Working alongside a nuclear reactor makes meticulously planning and co-ordination essential. Failure to do so leads to substantial penalties and safety risks.

Dutch international heavy lift and transport company Mammoet was approached five years ago by France's Framatome to assist with the removal and replacement of four steam generators from inside its nuclear power plants. The first project - Flamanville FA1 - has been successfully completed and demonstrated the efficiency of the equipment and procedures designed for the job.

The project was led by a combination of Mammoet specialists from France and its main engineering offices in Schiedam, the Netherlands. The steam generators had to be moved out in one piece due to possible contamination and for a shorter downtime for the power plant.

Mammoet designed a specific method to lift each of the 25 metre long, 6.5 metre diameter, 520 tonne generators from their compartments, then carefully rotate and manoeuvre them into a position allowing them to be skidded out of the building and lowered to ground level using a jacking system. They were then transported away for decommissioning. These steps were then reversed for the installation of the new generators.

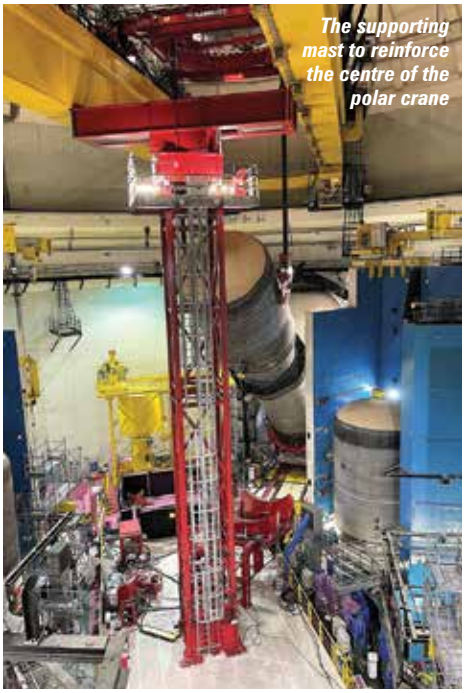
The polar crane inside the reactor building is normally used for servicing and replacing parts, however it could not cope with the size and weight of the whole generator which was installed in two parts, thus the need to design and build a specific solution to work in concert with it.

Olivier Vanesse, nuclear activities manager and project director at Mammoet France said: "The facilities and infrastructure inside the reactor buildings mean you cannot simply use a basic tailing operation. You need to be able to steer the steam generator, and rotate it. There are a number of steps that need to happen in order to move each of them through the main hatch, it is a really difficult operation."

"The lifting and tailing operation for a 1300MW nuclear unit is very complex - each generator weighs 520 tonnes, far more than the capacity of the polar crane. Therefore, you need to use a support in the middle of the polar crane to ensure that during the tailing process it has sufficient capacity - constraints and deflections wise."

As Mammoet had no handling equipment capable of completing the task, it set out to design, prototype, manufacture and test a solution, ensuring that it complied with the stringent technical and regulatory rules of EDF.

The solution comprised four parts - a lifting trolley installed on the polar crane for lifting and tailing the steam generators, a supporting mast to reinforce the centre of the polar crane, a device for down ending and tailing the generators and the saddles and skidding tracks to move the generators in and out of the reactor building. The space around the generators was tight, with just a few hundred millimetres to spare.


The supporting mast to reinforce the centre of the polar crane

3D EFFICIENCY AND SAFETY

A very accurate 3D computer model of the inside of the reactor building highlighted this lack of space. "We had scans, as well as high resolution photos, and were able to make virtual visits to take measurements and see the equipment going inside the reactor building," said Vanesse.

The data gathered informed the project's site execution studies, with the work rehearsed hundreds of times to ensure absolute safety before any equipment ever went to site. Framatome now has a set of equipment and a method to safely and efficiently replace 1,300MW steam generators which will now be utilised on the other nuclear units. ■

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Each of the 71 concrete structures has a 31m diameter base, is 48-50m high and weighs 4,800 tonnes

FÉCAMP OFFSHORE WIND PROJECT

Belgian international heavy lift and transport company Sarens played a major role in the construction of the Fécamp offshore wind farm at a yard in Le Havre, France. Commissioned by the consortium BSB - Bouygues Travaux Publics, Saipem and Boskalis - the company carried out the lifting, moving and load out operations for the 71 concrete mast foundation structures which have a 31 metre diameter at the base and heights of between 48 and 50 metres, while weighing up to 4,800 tonnes. They had to be moved from the manufacturing site in Le Havre onto transport barges which moved them to their final locations 13 to 22km off the Normandy coast.

To lift and move each structure, Sarens designed a system of two, SPMT mounted moveable gantry units, which were positioned either side of the structure. The load was secured to four cast in lugs and lifted with the two gantry systems connected by data cables allowing them to operate as one. After raising the structure, it was lowered into position on 180 SPMT axle lines and moved to one of three cargo barges at the quay side.

Sarens had installed a sounding system on each barge capable of measuring the amount of water in the ballast tanks, and a series of interconnected pumps for de-ballasting was used during loading operations. To ensure the offshore installation process did not suffer downtime, Sarens conducted a 24 hour loading regime. Three foundation bases are loaded onto each barge in a continuous operation with a maximum of 38 hours per barge - a process that must be repeated 24 times - requiring skilled personnel not only for the loading manoeuvre itself, but also the handling of the winches, the preparation of the gantry system and reconfiguration of the SPMTs prior to the loading of each barge.

Sarens equipment on site required 120 delivery trucks over a three month period. The 71 turbines will generate 500 MW of electricity - enough for 770,000 homes. ■

The two girder frames in convoy

The A27 road had to be closed

IN-HOUSE SOLUTIONS

UK based heavy lift specialist Allelys provides specialist lifting, heavy haulage, industrial installations and logistics services along with specialist rental equipment, primarily to customers in the UK. Mark Darwin met managing director David Allely and his team at its Warwickshire headquarters to find out more…

Established more than 60 years ago Allelys has consistently invested, evolved and grown to maintain its status as one of the leading UK players in the heavy lift and shift market. Its yard in Studley has doubled in size to 12 acres over the years as have the facilities, including new warehousing and fully equipped workshops. The business has annual revenues of around £20 million and employs180.

"As we have grown so has our arsenal of equipment, allowing us to cover most jobs and provide the best solution for our customers," says Dave Allely. "We have a 550 tonne Liebherr LG1550 which is mostly kept busy on our contracts, but it is also available for external hire. We have also had a variety of lower capacity mobile cranes over the years - our biggest at the moment is a 200 tonner. These, combined with skidding, jacking and gantry units, as well as the associated equipment means we can carry out most larger contracts including bridge installation."

The company's bread and butter work is transporting and installing transformers and generators, however it also works in automotive facilities shifting power presses and with forges and energy from waste projects.

"Over the years loads have grown in size and weight, which means you have to be much more careful when moving and installing. In the 1980s 100 tonnes would be classified as large, in the 1990s it was 300 tonnes and now we have a few thousand tonnes lift for a bridge install."

"There is a lot of investment and work in the electrical sector due to the changing UK power generation landscape. We are generating a lot more electricity from wind which is moving generation from the traditional coal field areas to more remote regions such as the North of Scotland, turning the transmission system on its head, and requiring delivery systems to be upgraded."

However, with the increased electricity demand the upgrades cannot keep up. "Transformers are on 36 to 48 month lead times. European and Korean-built equipment is lighter with slightly better designs, but companies are looking at Chinese units because of cost and quicker delivery."

"Currently the major issue is the road infrastructure, with bridge downrates leading to routing problems. Most of the problems are due to data loss rather than weak structures. Local authorities are becoming more risk adverse due to loss of experienced staff, work is then subcontracted and data lost. We have transported heavy loads over many such structures over the years without problems."

Coupled with this is the upheaval of the electrical supply system, the 400kVA system was built in the 1950s and 60s when the motorway network was also being built.

"There was joined up thinking then - power stations were served by motorways with good routes in and out etc. With the demise of coal fired power stations we have to take big loads to places that the road network was never designed for."

One of the company's most complicated projects - delivering a 150 tonne reactor and 195 tonne transformer to National Grid Ninfield near Catsfield, Kent - highlights these problems. Using specialist girder frames with a combined transport weight of 667 tonnes, it was the first ever double girder frame convoy in the UK.

The cargo was delivered in three stages - from Stafford to Ellesmere Port, via sea to Shoreham Port then on to Ninfield. The final stage by road to Ninfield was the most challenging and saw the two girder frames used in convoy, one for each of the components and configured with low set hangers for the reactor. The major A27 road was closed and the bridge over the River Ouse had to be overbridged in order to reduce the load on the structure. To do this 27.5 metre bridging mats were positioned with a tandem lift involving 500 and 300 tonne cranes.

Bridging mats used on the bridge over the River Ouse

Once on site, Allelys installed both units. The transformer was jacked up off the transport and lowered onto skates and skidded 25 metres into position. The reactor was transhipped to SPMTs and lifted and positioned by Allelys 200 tonne lift n lock system. ■