hottopics
EFD Induction Heating News
No 1, 2008

Contents

Induction makes waves offshore

BP, Rolls-Royce, KCA DEUTAG—each a major international company with rigorous standards on worker safety, economic efficiency and environmental protection. And each a company that uses EFD Induction expertise in the demanding conditions of North Sea oil and gas fields.

Imagine the dilemma. You are about to carry out maintenance work on a Rolls-Royce gas generator located on a BP North Sea platform. Normally you'd use a gas torch/naked flame to heat and remove the various components—thrust collar, auxiliary gear, coupling hub—attached to the generator's power turbine shaft. But there's a problem. Since the generator is located in a designated hazard zone, the use of open flame means the platform's production wells must be shut-in, and all hydrocarbon production must cease.

But for Adair Swan and his colleagues at Rolls-Royce, the dilemma was anything but imaginary. It was real.

Workshop trial

Naturally, BP were anxious to find an alternative to gas open flames for turbine maintenance. It wasn't long before their attention was drawn to EFD Induction. Paul Evans of EFD Induction UK recalls what happened next: "Well, this is North Sea oil and gas production; an industry that along with nuclear power is

Read more on next page ▶

Declaration of Independence

Independence Tube Corporation (ITC) is one of North America's leading manufacturers of square and rectangular structural steel tubing. And with customers in the transportation, agricultural equipment, manufacturing and materials handling industries, its output must meet stringent quality and productivity levels—day in, day out, year after year. Which is why when it comes to choosing welders, ITC opts for EFD Induction.

John Helinski has a tough job. As the man running ITC's brand new 310,000 square foot facility in Decatur, Alabama, he must ensure that the plant's output of ASTM A500 2-1/2" square through 10" square tubes satisfies the quality requirements of some very demanding customers. At the same time, he has to maximize the plant's equipment uptime and throughput. How does he do it?

"Obviously, our choice of welder is crucial," comments Helinski. "Weld quality must be consistently high, and the welder must deliver exceptional uptime. Other key criteria were flexibility and ease-of-use. For the new mill here in Alabama we wanted a welder that lets us change smoothly and quickly between different tube sizes. Finally, we wanted top-class technical support. If anything should go wrong, we don't want excuses—we want prompt professional service."

For Helinski and his team, the choice of welder supplier was quickly narrowed down to EFD Induction. "Actually, it wasn't such a tough decision. We chose a 1,000 kW EFD Induction welder back in 1997 when we commissioned a new facility in Marseilles, Illinois. That plant has been very successful, due in no small part to fantastic weld quality and productivity. This positive experience with EFD Induction made them a natural choice for the new plant in Alabama."

The new EFD Induction welder is a 1,200 kW Weldac. And according to Helinski, the equipment was ready to produce tubing less than a day after welder testing was completed. Moreover, since its installation last year the welder has, in Helinski's words: "operated flawlessly." Helinski is also impressed with the service and support ITC has received: "Absolutely, the EFD Induction guys are always ready to answer our questions. And should we need a service technician, one is dispatched to us as quickly as possible."

Green Machines

Greenhouse gases. Global warming. Carbon neutral. If there is topic that's truly hot right now, it's the environment. Or rather, the dangers posed to it by human activities.

But instead of merely echoing the chorus of doom and gloom, we at EFD Induction would like to focus on the many concrete steps that are being taken to minimize man's negative impact on the environment.

That's why the next HotTopics will focus on induction innovations and applications that are promoting a greener, healthier planet. You'll read, for example, how EFD Induction France helped develop a range of high-tech equipment for producing purified silicon ingots for photovoltaic power cells.

So keep an eye out for our next special green issue. In the meanwhile, EFD Induction wishes you all the best for 2008.

Talkline

Welcome to HotTopics.

You probably already know that induction heating can be—and is—used in practically any industrial heating application. Some of these applications are very well known, and are areas in which EFD Induction solutions have been widely used for many years. Some areas are relatively new, and our entry into them highlights not only the flexibility of induction technology, but also our technical skill in adapting solutions to new conditions.

Consider for instance the aerospace industry. As the article on page three shows, induction technology has played a key role in making, maintaining and repairing aircraft. Induction heating has also contributed to making aircraft lighter, quieter and more energy efficient. Induction melting, for example, is used to make high-purity titanium and aluminum. And EFD Induction solutions are currently hard at work helping to make the main engine shafts for the Airbus A380, the world's largest passenger jet.

Or take a look at the North Sea offshore oil and gas industry. As two stories in this issue show, EFD Induction solutions have succeeded in delivering astounding financial benefits. Moreover, they were benefits delivered to highly demanding customers; companies with tough demands on operational stability, worker safety and environmental impact. That we could meet such stringent requirements, then perform beyond expectations is a testament to the advantages of induction heating—and to the expertise of EFD Induction's people.

Mention of the energy industry leads naturally to a very 'hot topic'—the environmental consequences of the modern world's energy consumption. As you will read in the next issue of HotTopics, EFD Induction is playing an active role in developing and commercializing renewable energy sources such as wind and solar power. It's an exciting area for us. And one that yet again showcases our skill at adapting induction technology to new and evolving applications.

I hope you enjoy this HotTopics, and that you find something that might be of use in your own particular area of industrial heating. And please remember, if you have any questions—about EFD Induction or our solutions—just contact your nearest EFD Induction representative.

Elvin Jørgensen
Chief Executive Officer

EFD INDUCTION

Induction makes waves offshore, continued from page 1

perhaps the most rigorously regulated and safety conscious in the entire UK. So our first task was to organise a workshop trial of our induction heating solution. Rolls-Royce and BP weren't just going to fly our equipment out to a platform. To be even considered a viable option, we had to first satisfy these companies' strict operational and safety requirements. But the trial went well, and Rolls-Royce and BP decided to go ahead with a further test—this time offshore."

The offshore site chosen for the second trial was a redundant package of the Bruce Platform. Located 380 km northeast of Aberdeen on the east coast of Scotland, the Bruce Field is one of the largest gas/condensate (light oil) fields in production in the UK North Sea. Plans for the onsite were moving ahead when fate dramatically intervened. Jon Philpott, EFD Induction UK Offshore Application Manager explains: "Just before the planned offshore trial there was an unscheduled shutdown of a power turbine rotor on the Bruce Platform. Our equipment and an EFD Induction technician were rushed to the platform to heat and remove the turbine's thrust collar, auxiliary gear and coupling hub from the turbine rotor. Once a new rotor was installed, induction heating was used to reassemble the components."

The new standard

The emergency intervention by EFD Induction on the Bruce Platform was a great success from an operational and safety perspective. Indeed, according to Rolls-Royce, the use of EFD Induction's repair capabilities "resulted in the work being completed early and production restored several days ahead of schedule."

But the story doesn't end there. Due to the proven success of the Bruce Platform project, induction heating has been adopted as the preferred method of removing/reassembling thrust collars, auxiliary gears and coupling hubs on almost all Rolls-Royce power turbines in operation in the North Sea. Other platform operators, too, are gradually phasing out costly and dangerous open flame methods in favour of induction heating.

For EFD Induction UK, the successful Bruce Platform project was a major breakthrough. Adds Evans: "Of course, it was great to help such well-known companies as BP and Rolls-Royce. It was a vindication of everything we've been saying about induction—its speed, mobility, controllability and safety. But it was also great to be nominated for a BP Helios Partnership Award." The award referred to by Evans is a prestigious recognition by BP of external partners "delivering over and beyond what is expected contractually, demonstrating true team spirit."

Coils to the rescue

Another North Sea success story involves KCA DEUTAG, a major onshore and offshore drilling and engineering contractor. The task was similar to the BP/Rolls-Royce challenge: to heat-treat equipment on a platform rig where the presence of gas pipes ruled out the use of naked flames. However, this time the equipment to be heat-treated consisted of three mud pumps located on the Magnus Platform.

KCA DEUTAG began by removing the pumps' covers and chains in order to start removing the drive sprockets. The first two came away easily, but then… stuck! The remaining sprocket wouldn't budge. A heavy-duty strongback and pulling rods were made and sent to the platform. But even with a 200 ton pull there was still no progress! The on-site technicians then considered using a conventional heated element blanket. But that would have taken too long, and raised the temperature of the shaft and sprocket. It was time to call in EFD Induction.

After assessing the situation, EFD Induction designed and made customized coils for the inside and outside of the sprocket. The coils were put in place, the heat was turned on, the puller set at a lower torque, and presto! The sprocket came off without any problems. Two other customized EFD Induction coils were then used to remove and replace all the bearings. And the operation was completed safely and in record time. KCA DEUTAG have since used induction heating—and the specially made EFD Induction coils—for similar jobs on other North Sea platforms.

The shortcut to better short-circuit ring brazing

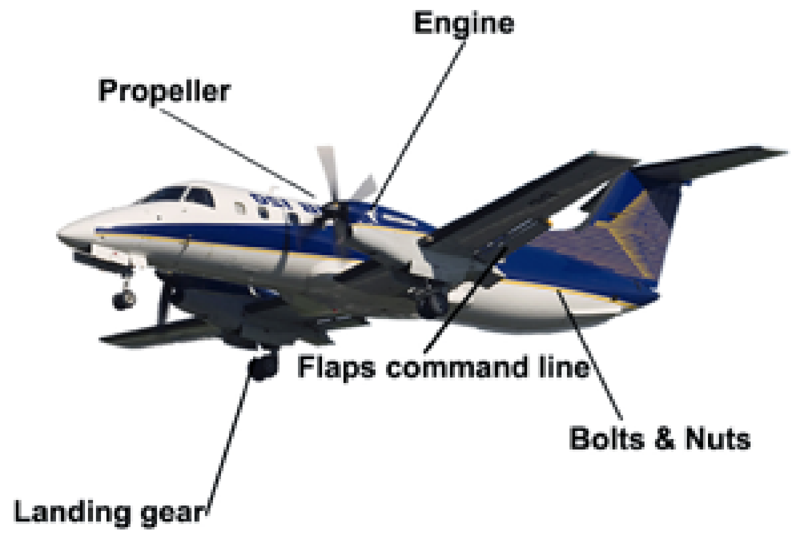
Brazing the short-circuit ring (SCR) is a crucial step when manufacturing motor rotors. And as more and more companies are discovering, induction technology is unrivaled as the heat source for brazing. Climber Zhao of EFD Induction China explains what makes induction heating the natural choice for rotor brazing.

Induction heating offers numerous advantages over traditional flame methods for brazing SCRs. One key advantage is that induction generates a more homogeneous temperature distribution around the SCR. Also, as induction heating can be very precisely controlled, overheating of the copper bars is avoided. Finally, induction heating is fast. Its accuracy and repeatability means it can boost throughput without sacrificing quality.

SCR induction brazing can be done in two ways: single shot and segment brazing. The major difference between the two methods is that the former needs more heating power. When the diameter of the SCR is less than 1200 mm, single shot brazing is used. EFD Induction's series of Sinac universal power generators provide a wide range of heating power from 25 KW up to 200/320 KW. A temperature regulating system can be integrated into Sinac for closed-loop control of the brazing power. Both the set and real time temperature curve can be displayed on the Sinac's monitor and stored in the memory stick at the ECU. Also, Minac's ECU can monitor, print and store the feedback temperature. Normally there are two ECU-controlled pyrometers in the system: one for measuring the temperature in the SCR and the other for measuring the temperature on the copper bar to ensure it reaches the brazing temperature.

EFD Induction can provide customized, turn-key solutions for virtually any SCR brazing task. These solutions include the equipment, optimized temperature curves, customized coils and a comprehensive range of training and service support.

Space-age technology—down-to-earth applications



Specialized applications. Stringent quality levels. Tight leadtimes. The global aerospace industry sets tough demands on its parts and equipment suppliers. But they are the kind of demands that induction technology is uniquely qualified to satisfy.

Vulcain engines are used on the European Space Agency's Ariane 5 rockets. The lightweight engine cone is made from graphite produced used induction heating.

Growing international trade and the boom in global tourism over the past two decades have stimulated spectacular growth in the aviation and aerospace industries. The demand for new planes—and the maintenance of existing fleets—has in turn led to the increased use of induction heating technology in numerous aerospace-related applications.

So what makes induction heating so attractive to the aerospace industry? In short, the same features that make it attractive in so many other fields: it is a repeatable process, it is extraordinarily accurate, it is fast, it is controllable, it is energy efficient. It is also flexible. Induction heating is used to harden, temper, anneal, shrink fit, braze and melt a large range of components. And as an added bonus, induction heating can be mobile—especially good news for emergency repair crews and cramped workshops.

The specific demands of aerospace customers have also prompted technical advances in induction heating technology. One example is EFD Induction's patented method for simultaneously delivering two different frequencies—one high and one low—to a single coil. This multi-frequency breakthrough made induction heating a practical choice for the contour hardening of geometrically complex components such as gears.

Induction brazing has long been used for maintaining and repairing aircraft. Common brazing uses include repairs to compressor fan blades, tube connections and cooling plates. However, induction brazing is being increasingly used during the actual production process for many aerospace-related components. Several factors contribute to this trend: compact and mobile converters, easy in-line integration, and extremely high uptime rates.

New challenges—new solutions

The growth of the aerospace industry hasn't been free of challenges. Many governments, responding to widespread public concern, have legislated for quieter, cleaner and more fuel-efficient engines. Induction technology has played a key role in helping manufacturers meet these demands. Induction melting, for example, is used in vacuum furnaces to produce single- and poly-crystal turbine blades. Induction melting is also used in cold-crucible (auto-crucible) solutions that result in exceptionally high purity rates for titanium and aluminum—materials widely used in the aerospace industry.

Correct pre- and post-heating processes are crucial to the aerospace industry, as they are essential to maintaining components' integrity and safeguarding against metal fatigue and failure. EFD Induction bar end heating systems, for example, are used during the manufacture of the main engine shafts for the new Airbus A380, the world's largest passenger plane. EFD Induction solutions are also used to pre-heat engine bodies prior to welding.

Induction heating has already made tremendous contributions to the efficiency, safety and profitability of the aerospace industry. But more can be achieved. After all, with its precise, repeatable, controllable and contact-free heat delivery, induction is ideal for aerospace applications. We at EFD Induction are committed to perfecting even more of them.

Launching a revolution

The transistorised induction heating revolution was born to address the needs of one specific application: deck-straightening in the shipyards of Norway. It's an exciting story—one that underscores EFD Induction's background as an applications-driven pioneer.

In the mid-1970s, there were growing concerns in Norway over the health risks of flame-straightening in shipyards. An independent group with no bias toward any particular method was established to find a viable alternative.

After intensive work, the group concluded that induction heating was the best method. But the researchers were not satisfied with the induction generators then available. To start with, the generators were much too large to be of practical use in shipyards. They didn't operate at the right frequencies. And they were also potentially dangerous. The decision was made to conduct further research—and to develop solutions suited to the specific demands of deck straightening.

The legend is born

This research had three far-reaching results: induction heating equipment designed for straightening decks, the world's first transistorised (aircooled) induction generators, the formation in 1981 of ELVA. With a tiny workforce, but unlimited faith in the potential of induction heating, ELVA launched its very first product, the now legendary Terac thermal-straightening system. It should be noted that the original members of the research group who went on to found ELVA are still with the company, which has grown and evolved into EFD Induction.

Also still with the company is the Terac. The latest version, the Terac 25, has been developed to meet the needs of today's commercial and technical conditions. Chief among the former is a ruthless drive to cut costs. Among the latter is the widespread use of light and thin metal sheets for ships' hulls. These sheets are stronger than their thicker predecessors, but they are still susceptible to one of the great challenges of metal shipbuilding—weld-induced distortion.

The problem is that welding the plates together induces buckles and distortions that are unsightly, can prevent correct fit, and even weaken the entire assembly. Traditionally, open gas flames have been used to straighten the distortions. But it is a slow, expensive process that requires skilled operators working in uncomfortable, often dangerous environments. It also delays the entry of other trades into the production process.

Faster, safer, easier

With traditional straightening (or 'fairing'), an operator heats the metal plate with a gas flame. As the area cools the heated side contracts more than the un-heated, causing a bend downwards or away from the heat source. Skilled operators exploit this effect to flatten bulges in steel deck plates, and to create the flowing curves seen on modern vessels.

Clean, safe, comfortable. Induction fairing drastically improves the quality and the working environment. Nitrous gases, for example, are radically reduced.

The trend towards lighter, thinner plates has however compounded the problem of weld-induced distortion. Flame fairing is less effective on thin sheets. In fact, it can lead to even more distortion if not done correctly. Induction heating on the other hand achieves superior results in less time. In fact, in a soon-to-be published paper, one of the largest producers of naval vessels reveals the results of a recent trial carried out on thin plate decks and bulkheads. The results show a time saving of 75 per cent in the heating process alone! More savings will be realised when the cost of sacrificial materials and rework time to remove the scars caused by the traditional process is taken into account. Moreover, samples sent to an independent laboratory showed an improvement in the metallurgical properties of the steel after heating with induction compared to flame.

Induction heating is controllable. The result is faster, better quality fairing than that achieved by open flames.

But the benefits don't end there. Induction heating is more user-friendly than gas. Then there are the health and safety benefits. Induction heating is clean, with none of the dust, fumes or radiated heat common with flame straightening. Also, the lack of any open flames greatly reduces the risk of fire, and lets other trades continue working in the vicinity of the Terac operator.

One key feature that makes the Terac 25 ideal for fairing thin, high-strength plates is its automatic overheating protection. This is a crucial benefit, as the thin plates can become brittle if overheated. And of course, the accurate, repeatable—and most importantly, the controllable—heat delivered by the Terac 25 brings previously impossible levels of process control and quality assurance to deck fairing.

Heating up refrigeration

EFD Induction equipment is used at some of the world's largest consumer refrigerator manufacturing facilities as a superior alternative to traditional flame brazing of tubing connections, as well as for heating pre-painted panels prior to bending. Tom Brown of EFD Induction USA explains more about this safer, more consistent, repeatable method of heating.

The right heat just where it's needed. A hand-held transformer fitted with a customized coil makes it easy for the operator to deliver the benefits of fast, clean, accurate induction brazing.

Since induction heating is "flameless heating", meaning that no open flame is used, it is safe for the operator. Heat source related injuries are eliminated because there is no open flame, and the induction heating coil is cooled internally by flowing water. Therefore, the coil does not get or stay hot during and after brazing. Even though induction heating is generated by electricity, the heating coils used in conjunction with EFD Induction Minac power units provide output voltages that are less than 50 Volts, typically 38–40 Volts, which is in a safe operation range. Tube type induction heating equipment, on the other hand, generates coil voltages of over 400 Volts.

Another benefit of "flameless" induction heating is that the heat source does not damage surrounding components such as pre-painted surfaces, freezer and refrigerator cabinet enclosures or plastic electrical connectors and wiring bundles. There is no need to pre-place heat shields to prevent damage as is typically done with flame brazing. Because of this, brazing cycle times can be reduced due to the elimination of this manual operation.

Due to manufacturing issues associated with operator turnover, it is sometimes difficult to get consistent, repeatable braze joints from many different operators. Flame brazing is a skilled operation that is highly operator dependent. Because of the dependency on the operator, much more cost is incurred due to higher wages, inconsistent usage and/or overuse of expensive brazing alloys, as well as re-work due to a higher rate of leaking joints. Induction heating used together with pre-placed brazing rings eliminates these issues. Since brazing cycles can be pre-programmed into the Minac power unit controller, the same heating cycle will be provided every time.

The EFD Induction Minac is unique and ideally suited for use on high volume, mass produced refrigerator production lines as well as for use in manufacturing low volume, custom built units. EFD Induction equipment features hand held transformers that allow the induction heating coil (heat source) to be brought directly to the braze joints, as opposed to traditional, fixed induction equipment. Due to the use of IGBT transistor technology and innovative engineering, Minac induction power units are compact and take up much less floor space than traditional induction heating equipment. Also, the Minac comes in twin-output models that provide two separate heating outputs that can be used independently at the same time. Full unit output power can be provided to each output. This option reduces equipment costs and the amount of plant floor space required.

Brazing is not the only application of induction heating in refrigerator manufacturing. It is used for adhesive bonding and paint drying. And is widely used to heat pre-painted sheet metal panels prior to edge bending. This method allows the metal to be bent without cracking the pre-painted surface because induction will heat the metal, making the paint pliable.

Induction pre-heating dives deep

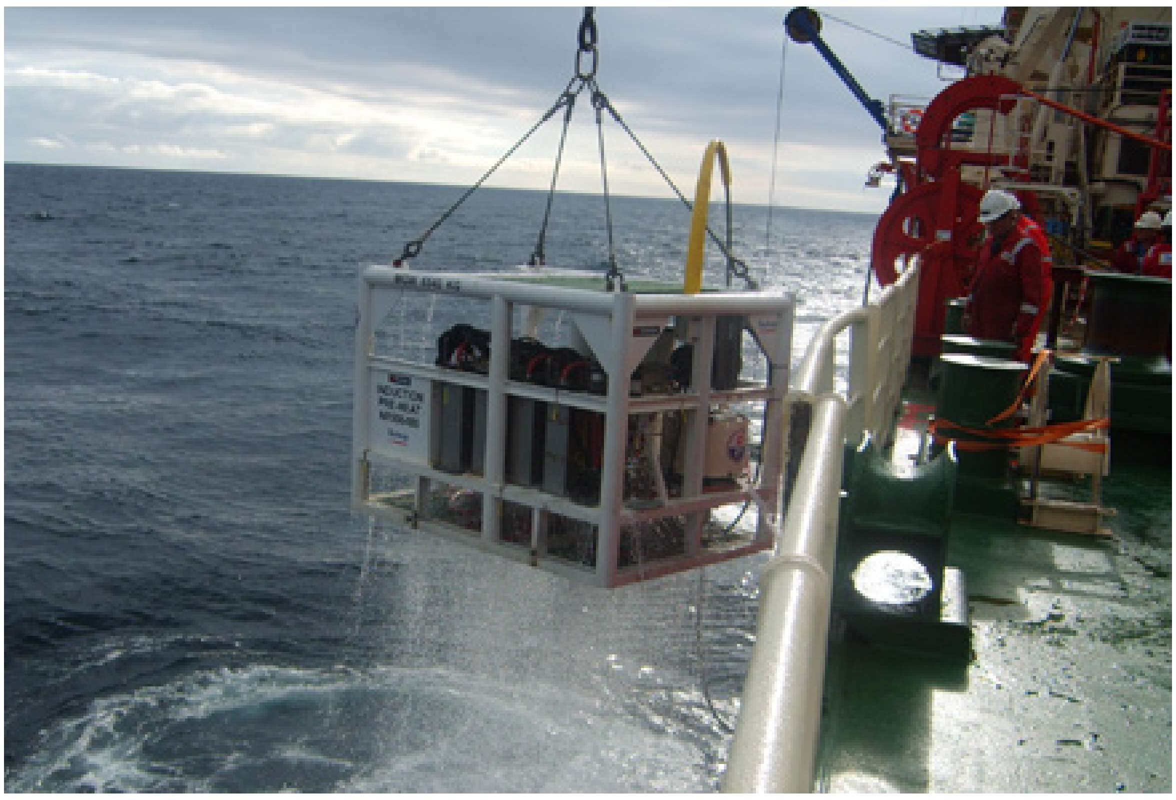
The Tampen Link project in the North Sea underlines the amazing versatility of induction heating. In this case, EFD Induction expertise is helping weld a branch pipe onto a 20" main high-pressure gas pipe located 145 m below the surface of the North Sea… without any interruption in the flow of gas!

As oil production peaks in the North Sea, energy companies are keen to exploit existing pipelines to maximize output, and to export the remaining—and vast—gas resources. A key part of this strategy is the Tampen Link project. Put simply, the project involves linking Statoil's Statfjord Field gas output to Shell UK's existing pipeline for export to the UK.

But how is it possible to open up a gas pipeline and connect a new branch without shutting down the flow of gas? The answer is 'hot tap' welding, a method involving a drilling (or 'tapping') machine that, together with a full-ported valve and a pressure-containing fitting, cuts open the pipe while it is still in operation. However, the actual welding on of the new branch presents its own technical challenges. As the existing pipe is in use, the gas moving at high pressure results in a massive cooling effect. This makes it extremely difficult to pre-heat the outer surface of the pipe to the temperature required for successful welding.

The traditional way to pre-heat 'live' pipes for welding is to use heating mats. But in the case of the Tampen Link, welder-divers working in a sealed subsea habitat 145 m below the surface do the welding. Heating mats would have resulted in unbearable working conditions for them. Induction pre-heating, it seemed, was the only viable option. Once induction heating was selected, EFD Induction began working closely with all the stakeholders involved in order to perfect a technically feasible and safe solution. Key partners in the project included Technip, Perry Slingsby Systems Ltd., and of course Statoil.

A crucial task for EFD Induction was to design, make and test customized induction coils to pre-heat the pipes prior to welding. Then there was the issue of minimizing the manual operations to be performed by the divers. Finally, EFD Induction cooperated with its partners to develop equipment capable of delivering heat at low voltage but very high frequency. The solution has been fully tested at the National Hyperbaric Centre in Aberdeen, Scotland, and the project is scheduled to get under way this summer.



Recovering the subsea work skid that stored the induction equipment on the sea bed. The actual welding was carried out by welder divers in a subsea habitat structure.

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