



## The nuts and bolts of better business

Induction heating is rightly prized for its versatility. But bolt heating? Is induction really an effective alternative to traditional gas and resistance heating methods? Here we report on how two customers fared when they turned to EFD Induction to solve their bolt heating challenges.

British Energy, the largest electricity producer in the UK, utilises induction heating for bolt expansion. Fred Hunter, Development Engineer at British Energy's Turbine Support Group, comments: "We used to rely upon resistance heaters to release the studs on turbine control valves. But it was a far from efficient procedure. Such technology is inherently unreliable. The electrical elements are fragile, fuses are prone to blowing, and it is essential to have a huge spares inventory on-site. Moreover, such heaters are not mobile. You can imagine the considerable prep-work that was needed before we could deploy the equipment."

The limitations of resistance heaters had serious implications for British Energy. Opening control valves for inspection is a statutory obliga-

tion. That is, it is a legally mandated maintenance action—it has to be done. Since the frequency of such mandatory outages cannot be changed, the only cost-cutting opportunity lies in reducing the duration—and the knock-on disruption—of each outage. Converting to EFD Induction's mobile Minac converters let British Energy achieve reductions in the duration of these maintenance activities.

### From days to hours

"That's correct," agrees Richard Stewart, Engineering Group Head at the Turbine Support Group. "We were very impressed when we ran our first trials with Minac. Previously, bolt loosening at one of our power plants took up to two days. Minac slashed that time to a couple of hours."

The main reason for the time saving is Minac's extremely quick and precise heat delivery. With gas or resistance heaters, excessive heat is entered into the workpiece and heating times are slow. During re-assembly, lengthy periods are spent waiting for the assembly to cool down prior to measuring the bolt strains.

"The EFD Induction method," adds Stewart, "lets us better deliver the right amount to just the right place, leading to considerably shorter cool-down times. Minac is now part of the standard maintenance kit used by our Group at three British Energy power stations." The conversion from resistance to induction was a relatively painless experience. "There were the inevitable teething hitches, one of which was a high starting current that caused tripping. But the EFD Induction guys worked with us and they fixed the problem by adding an additional transformer."

Shorter outages are not the only benefits delivered by Minac. Because the Minac equipment is mobile and so easy to use, British Energy's

*Read more on next page* ►

## Weldac makes the grade

EFD Induction Inc. and Century Roll-forming Incorporated (CRI) of Norton Shores, Michigan, team up to create a perfect solution for the welded, roll-formed shape industry. The Weldac took center stage.

When producing roll-formed products, welding can be a complicated business. Roll-formed shapes come in endless permutations so production is often set for many more parameters than with tubular welding. Include pre-punched holes in these profiles and the configurations can be very complex indeed.

So end-users are asking a lot when they ask for the prototype products before they award the long-term production contract. Resources have to be switched to the prototype and other production stops.

This is where companies like CRI come to the rescue. CRI is a full-service roll-tooling designer,

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*The working station of Hägglunds Drives new hardening system from EFD Induction. Note the possibility to quench the cam rings by quench shower or agitated bath.*

## Hägglunds Drives on the road to faster production

A new EFD Induction solution has helped Hägglunds Drives slash hardening cycle times by 85% for large cam rings, and 45% for smaller rings.

Located in Mellansel, north of Stockholm, Sweden, Hägglunds Drives manufactures heavy-duty hydraulic motors, the largest of which has a maximum torque capacity of 1400 kNm! Producing such motors, of course, places tough demands on the hardening process. A key requirement from Hägglunds Drives, for example, was that the new solution boost throughput, but at the same time

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# Talkline

Recent years have witnessed more and more calls for all of us to become 'more productive.' Advertisers, magazines, trade journals, expos and seminars have joined in the chorus. Everybody, it seems, knows how to boost productivity—or can sell us something that promises to do it for us.

This is all good and well. But all too often, those promising to make us more productive fail to show us detailed proof. Just as often, 'productivity' goes undefined. What exactly is productivity, anyway? And how exactly can you improve it?

Put simply, productivity can be understood as 'efficiency in industrial production.' Efficiency, in turn, depends on three factors: equipment availability (your available production time), equipment performance (your throughput speed), product quality (your total of on-grade, sellable products). Improve any of these, and you improve your productivity.

Of course, actually improving these three factors in the real world is slightly more problematic. Your equipment has to be more reliable. It has to work faster. And it has to consistently produce products that meet your desired quality levels. It sounds tough, but for more than fifty years EFD Induction has been doing just this for customers around the world.

Consider, for example, just one of our breakthroughs: a patented switching pattern that lets us use rugged, reliable IGBT transistors in a wide range of solid-state converters at frequencies up to 350 kHz. The innovation is already in use in our Weldac family—boosting output, uptime and quality for small-diameter welding.

Or take our patented 'dual-frequency' technology that delivers simultaneous high and low frequencies into a single coil. This option gives you the freedom to successfully handle the toughest hardening jobs and complex geometries.

The list could go on. We could for instance detail how our services achieve and maintain maximum uptime for customers worldwide. Or how we offer customized induction solutions for practically any heating challenge. To learn more about us—and our proven ways of improving productivity—simply contact your nearest EFD Induction representative. You'll find contact details on the back cover.



► *The nuts and bolts of better business, continued from page 1*



*Waiting for induction—a typical bolt assembly at a power station.*

own in-house maintenance staff—in this case its Turbine Support Group—can now perform the bolt loosening and tightening. The procedure was formerly outsourced to external sub-contractors with Induction Heating expertise. "This," says Stewart, "of course means we have complete control. We can undertake our main-

tenance actions as needed during outages. This flexibility means that sub-contractors are not kept waiting on-site, thereby minimising costs."

#### **75% faster**

Obviously, Minac can be used outside of power stations for bolt loosening applications. One prime example of the versatility of Minac is the case of Sulzer Elbar B.V., part of Sulzer Turbo Services. Based in Lomm in The Netherlands, Sulzer Elbar specializes in gas and steam turbine refurbishment, component manufacture and field service and gas turbine relocation. The company also offers inventory management and maintenance service agreements.

Previously, Sulzer Elbar used a gas bolt heater. But according to Rob Bormans, loosening one bolt took on average 12 minutes. So when Björn Rosvik, an EFD Induction application engineer, organized a demonstration of Minac, Bormans and his colleagues

were "absolutely impressed" when "bolts were loosened in a record time of only three minutes per bolt."

Rosvik is deservedly thrilled with the outcome of the work together with Sulzer Elbar: "This case really illustrates the potential of Minac for this demanding application. Thankfully, it seems more and more companies—especially those concerned about costs and quality—are realizing that they don't have to continue with outmoded gas and inefficient resistance heaters. Induction is a viable, proven alternative."

Rosvik first demonstrated Minac to Sulzer Elbar more than one year ago. Since then cooperation has developed, and the company has acquired two Minacs, a Minac 50–80, and a 25–40 model. Comments Bormans in conclusion: "I'm sure we will find new applications within our company for induction heating. I'm happy for Sulzer Elbar that we chose the right partner for solving our bolt heating problems!"

► *Weldac makes the grade, continued from page 1*

manufacturer, and test facility, offering part development and prototype services. Recently, EFD Induction worked with CRI on a prototype development contract for a mutual customer.

The job demanded CRI's roll-tooling and pre-production expertise. With only a couple of weeks to produce the prototypes, they had to set up a roll-forming machine according to the customer's specification and incorporate a welder unit. An EFD Induction Weldac 150 kW G2 solid-state welder was chosen for its high-quality design, quick delivery, local service, and competitive price. The possibility for an on-site upgrade to 300 kW was also a real winner.

And with the single-cabinet design, installation was quick. Bill Schubert, the Sales Engineering Manager for CRI, recalls, "My technician said that setting the weld parameters was easier than on other units he is already familiar with."

On schedule, the prototype line was up and running, producing acceptable prototypes in a matter of minutes. Schubert was delighted with the Weldac and EFD Induction's cooperation, "We are very impressed with the unit. CRI and the customer appreciated the support."

It's great to get such approval from industry experts. With its many technical advantages, upgradeable power,

and unique single-cabinet design, the Weldac is a perfect choice for roll-formers competing in the growing welded-shape market.



*The satisfaction of a job well done—Bill Schubert of CRI.*

► *Hägglands Drives on the road to faster production, continued from page 1*



*Florian Ciampini (left) of EFD Induction and Per Edvarsson of Hägglands Drives in front of the new 1600 kW induction hardening system that has slashed cycle times by 85% for large cam rings, and 45% for small rings.*

assure optimum hardening results. The new solution also had to facilitate supervision of the complete hardening process.

The hardening solution designed and installed by EFD Induction operates in a frequency range of 10–25 kHz, and has a maximum output power of 1600 kW. For small cam rings (<700 mm diameter) stationary hardening is used. The system uses scanning for larger rings, the largest of which have a diameter of more than one meter.

#### **Shorter cycles**

The new system has to date resulted in hardening cycle times that are 85% shorter for large rings, and 45% shorter for smaller rings. The system works by first placing the rings on an inlet conveyor. The rings are marked and roughly localized by a vision system. A manipulator then lifts the cam rings into the working station. Each ring is placed on a controlled center and is exactly positioned prior to hardening. The finished rings are then lifted onto the outlet conveyor.

## Bigger and better than ever

In October last year, EFD Induction supplied an 1800 kW Weldac to SAFA in Iran. During the factory acceptance test, the unit was tested at 1918 kW/100 kHz into calorimetric load.

Small single-cabinet welders ranging from 150 kW to 300 kHz are also available using the same patented IGBT technology. But this marked the

first delivery of a welder above one megawatt. "It's evidence that the technology fulfils the specs at all power sizes," says Inggard Torvik, Managing Director of EFD Norway. "Based on our experience from 20 different welders at over 800 kW, it also shows the EFD Induction stronghold on high power welders," says Torvik.

EFD Induction has already received the next order for 1800 kW Weldac units, to be installed at Baoshan Steel in China. Together with these welders, EFD Induction will supply complete seam annealing equipment with orbital seam tracking and temperature supervision.





Erik Kjønnørød of NLI A/S enjoying a production process in full swing.

# A profitable investment

EFD Induction's Minac induction heating equipment and services save the production process of Norwegian customer NLI A/S, and provide a rapid return on investment.

Production at NLI A/S was close to failure without the effective heat produced by induction. The process of welding copper and steel together is very difficult due to the difference in heat absorption. To make this possible with a profitable welding speed the copper detail needs to be pre-heated and reach a temperature of approximately

600°C within the time frame specified.

It became clear that induction heating would support the temperature during welding and result in high quality welding every time.

Minac induction heating equipment was chosen for flexibility and easy adaptability as well as for high efficiency, accurate control, great repeatability

and environmental benefits. And as Erik Kjønnørød, Production Manager at NLI A/S, remembers, "Good assistance from EFD Induction during installation and production start-up reduced the installation time to a minimum."

The investment in EFD Induction equipment and services helped NLI across the board. Kjønnørød sums it up, "Our investment in induction equipment from EFD Induction enabled us to complete a critical project with good profitability and gain a considerable improvement in quality."

# Hot off the press from India

## Soldering application development

EFD Induction India has improved the soldering application with units recently supplied to the TVS Motor company. Designed for brazing and soldering the inlet caps and outlet pipes of fuel tanks, the new machines now offer fully automatic operation.

Controlled by a Siemens PLC S7200, pneumatics raise and lower

the coil and move the components into position. The inlet caps and outlet pipes are soldered automatically and the operator only needs to lift away the completed tank. TVS is very happy with the new units and is placing further orders.

## Advances in camshaft hardening

The team at EFD Induction India has

just pioneered the development of an induction hardening machine for truck camshafts. The customer, Ashok Leyland India, is the second largest truck manufacturer in India.

The new development succeeds in giving a uniform pattern at the base and nose of the camshaft. The customer is delighted with the unit and is planning a similar order for another facility.

## Going to great lengths

Earlier this year EFD Induction India made its first delivery of an HardLine VL 2500 unit to an Indian customer. The unit is used for the hardening of shafts up to 2500 mm in length—from printing press ink rollers to truck axles.

A Fanuc CNC system was used with the HardLine VL 2500. Together they give the operator much greater control over speed, position and accuracy and a better quality to the finished piece.



# Fasten seat belts—induction means safe production at Autoliv

Autoliv Spring Dynamics, an automotive parts manufacturer based in the UK, demands quality and reliability throughout their operation. And it has to—because the company makes the flat-strip steel springs that retract car safety belts. During their search for the best service standards, they met with Paul Evans from EFD Induction UK, and the cooperation began immediately. Two years later and EFD Induction's services, products and personnel have become trusted components of Autoliv's operation.

Chris Cowell, Engineering Manager at Autoliv looks back on that meeting: "To say we were fortunate in making contact with Paul and EFD Induction, so soon after making the decision to find a replacement service company,

would be an understatement." Chris was particularly impressed with EFD Induction's field service engineers, and the skills they used to service Autoliv's 14 induction units purchased from different manufacturers and with a range of power outputs.

So when the time came to look at installing new production cells, there was no hesitation in asking EFD Induction to specify the induction equipment. A unit was loaned and a technical team was on hand to set up the initial cell. "The team was excellent," says Chris. "Their assistance in matching the coil design to our stringent specifications was invaluable." Eighteen months later, these EFD Induction Sinac 5SH and Sinac 12SH converters have proven "totally reliable." No service calls have been

required.

This reliability is important for production efficiency, but the experience of working with EFD Induction products and services has given everyone confidence and security. Chris explains: "The EFD Induction converters fire every 6-7 seconds and are in operation 24 hours a day, 7 days a week. The operators have learnt how reliable, repeatable and efficient induction heaters can be."

Chris sums it up: "We could not run our operation as confidently and efficiently as we do without the excellent service, support and advice that EFD Induction provides."

Autoliv's Lee Thompson and Chris Cowell (right) in front of an EFD Induction Sinac 5SH converter.





# How to get the most out of your induction coils

Kristian Berggren of EFD Induction has some simple tips on how to boost the productivity—and lifetime—of your induction coils.

Induction coils are crucial components. They are, after all, what actually delivers heat to the workpiece during the heating process. But all too often basic coil maintenance is neglected. The results? Sub-standard performance, off-grade products, unnecessarily high costs and acute production crises. Yet ensuring your coils work optimally during a long life is relatively easy—provided you follow some basic guidelines.

Induction coils are normally

made from copper tubing. The coil is shaped to match the desired heating zone. Other factors influencing coil shape are the requirements for current/water cross areas, and matching to the frequency converter. Heat is produced by electrical currents that are induced in the workpiece; the current path in the workpiece following that of the coil.

Maximum coil efficiency is assured by adjusting and improving the coil design to produce the optimal heating

result. Following the desired heat pattern, the ideal coupling distance of 2–3 mm is then set to give the best and most efficient results. The second common solution is to add flux concentrators, produced from thin plate metal or from a special metallic powder set into plastic.

Both methods can be used in conjunction but once installed, the performance of the flux concentrators needs to be maintained; the plates can short-circuit or be dislodged and the plastic composite concentrators are sensitive to heat radiation.

It is also important to check whether any detergents or fluids

remain from previous cutting operations. Environmentally friendly fluids have a particular tendency to cover the coil with a conductive coating to reduce performance. And the quench medium itself must remain free from impurities to prevent additional coating of the coil and a blocked quench circuit.

Of course, no matter how good the maintenance, your coil only has so long a life span. According to the current, frequency, cooling system, and the size and shape of the copper tube the lifetime will vary. It's a good idea to be alert and replace a fatigued coil before it causes you production prob-



Regular maintenance of induction coils ensures high-quality production.

lems. Whatever the make of your induction heater, EFD Induction will be happy to help with that. Just call and we'll be on our way.

## New EFD Induction factory opened in Shanghai



From the opening ceremony at EFD Induction in Shanghai. From left: Chen Jianping, Managing Director of Shanghai Xinzhuang Industry Park, Zhang Jianchen, Deputy Director of the People's Government of Minhang District, Shanghai Municipal City, Tor Chr. Hildan, Norwegian Ambassador to China, Eivind Jørgensen, Chief Executive Officer of EFD Induction Group and Qin Song, Managing Director of EFD Induction in Shanghai.

In 2002, EFD Induction chose Shanghai as the location of its first Chinese factory. In just three years EFD Induction has developed to be-

come one of the leading suppliers of induction heating equipment in China. Activity is largely concentrated on China's growing automotive

industry. And now 40–50 percent of all cars manufactured in the country have parts produced by equipment supplied by the EFD Induction group.

With this strong growth in sales, and the number of employees rising to 65 by the end of this year, the original premises have quickly become too small.

So on 24 May 2005 the latest EFD Induction Group factory was opened in Xin Zhuang Industrial Park, Shanghai. Many customers, partners, and dignitaries, including the Norwegian Ambassador to China and representatives of Chinese local and regional government, attended the opening ceremony. Chief Executive Officer Eivind Jørgensen and Qin Song, Shanghai Managing Director, were the principal EFD Induction representatives.

The new factory has a footprint of 4000 m<sup>2</sup> to keep up with the automotive sector growth, and to continue producing mechanical equipment for other heating processes. In addition, the Shanghai operation acts as a distributor for EFD Induction Group companies' products, and supports the sale and service of products delivered directly to Chinese customers.

## High praise for Minac

The performance levels of the Minac generators are well-documented, but in Spain that performance is reaching new heights – quite literally!

With 1800 wind power generators in the Navarra region, Gamesa, a world-leading wind turbine manufacturer, had to act to prevent wear on the toothed rings that support the

main propeller and hold its position in relation to the wind. The teeth needed to be hardened to preserve their operation over a longer life span. All very well until you realise that the only cost-effective solution way to do this was on-site—at a height of 60m! Add the remote and mountainous location of the wind power genera-

tors, and Gamesa needed converters that were easy to transport, easy to handle and easy to operate in extreme conditions. The Minac was the outstanding candidate and the choice was further vindicated during the preliminary testing. The toothed rings only needed a hardness of 45–50 HRC with Minac handling the

job using compressed air for cooling rather than impractical water cooling. During operation, two guiding bars mounted directly on the ring gear supported the hardening coil, and a PLC-controlled gear motor automatically drove the coil motion.

Gamesa is delighted with the results. We saw the flexible perform-

ance of the Minac being put to the test to provide a unique and cost-effective solution to a rather special problem. Through its performance capabilities and compact dimensions, the Minac solution demonstrated a clear technical and cost-effective advantage.

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