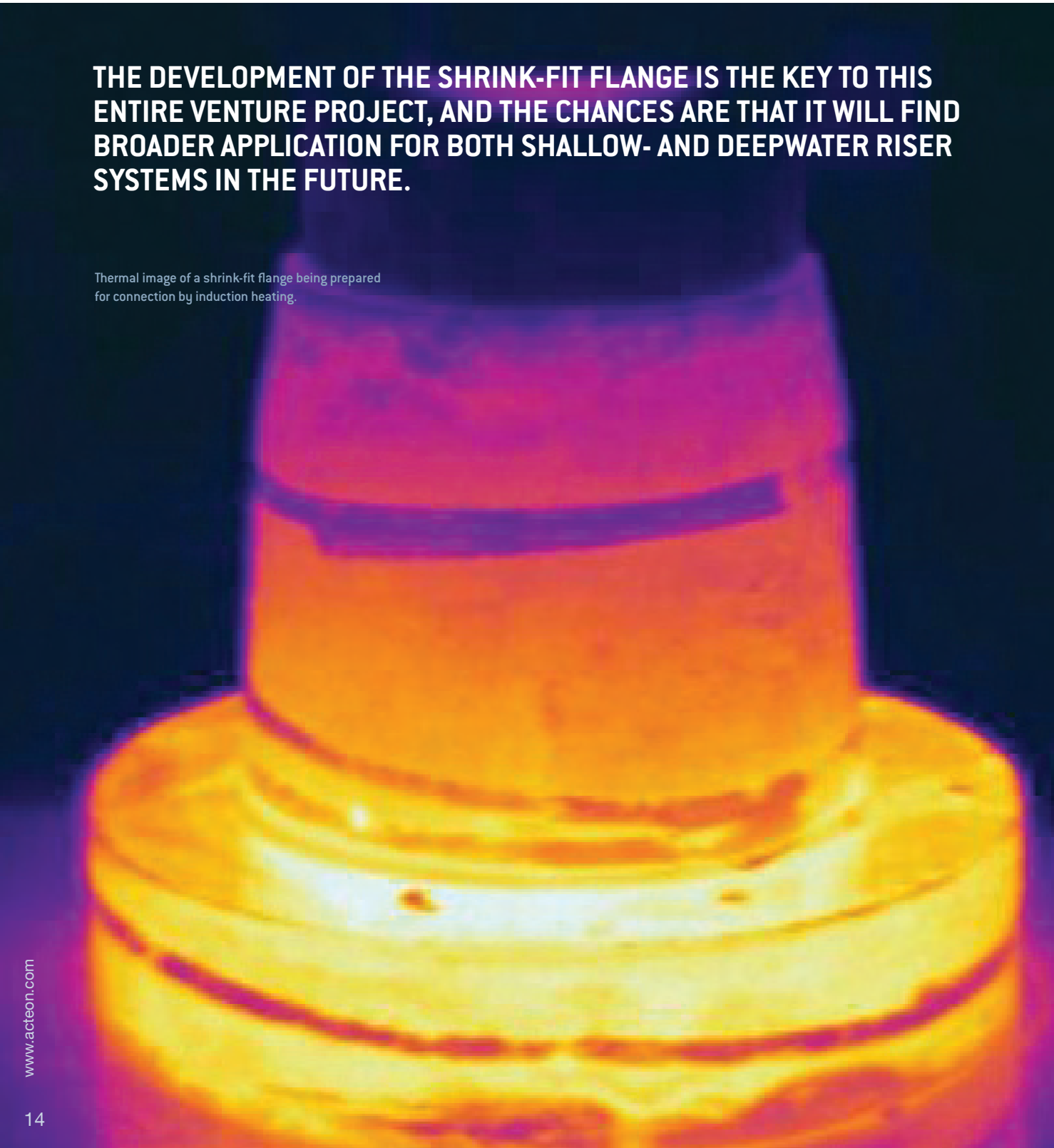
THE DEVELOPMENT OF THE SHRINK-FIT FLANGE IS THE KEY TO THIS ENTIRE VENTURE PROJECT, AND THE CHANCES ARE THAT IT WILL FIND BROADER APPLICATION FOR BOTH SHALLOW- AND DEEPWATER RISER SYSTEMS IN THE FUTURE.



Thermal image of a shrink-fit flange being prepared for connection by induction heating.

SHRINK-FIT SOLUTION

THREE ACTEON COMPANIES ARE WORKING CLOSELY TOGETHER TO DELIVER THE WORLD'S FIRST ULTRA-HIGH-PRESSURE, LARGE-BORE DRILLING RISER.

Venture Production, one of the UK's newer oil and gas operators, is planning a high-pressure, high-temperature (HPHT) drilling campaign in the North Sea later next year that looks set to break the industry mould. The company aims to use a jackup rig equipped with a surface blowout preventer (BOP) to drill a series of subsea wells across its central North Sea assets.

The surface BOP will provide cost and operational advantages. However, in order to complete the wells at the seabed, Venture will need a drilling riser that offers full-bore (18¾-in.) access and can withstand the full pressure of the reservoir, possibly in excess of 12,000 psi. The problem is that risers of this kind have simply not been available, at least until now.

Claxton Engineering, 2H Offshore and Subsea Riser Products have worked closely together to design a unique riser for the campaign. The riser is notable for its flange connections, which will be shrink fitted onto the individual pipes.

Shrink-fit flanges

Venture will be drilling in about 120 m of water. The riser will, therefore, have up to 13 main sections, each 9 m long, plus fatigue-critical, tapered stress and tension joints at either end. As is common practice, the pipe sections will be connected to each other using bolted flanges. The question in the case of this ultra-high-pressure riser was how to attach the flanges to the pipes.

Welding is not really an option. Using a weldable grade of steel, say 65 ksi, would require a pipe wall thickness of around 75 mm. Welding pipe of this thickness is extremely difficult, especially when the final weld properties are governed by NACE sour service requirements, as for this project. And welding is not the only problem: the weight of a complete riser string of this thickness would be enormous. Going to a high-strength steel would reduce the wall thickness, and the weight: a 110-ksi steel would come in at 30 mm. However, it is impossible to weld such steels successfully.

This problem has been resolved by using a shrink-fit process to attach the flange connectors to the pipes. Steve Hatton, founder of 2H Offshore and a vice president of Acteon, came up with the idea, which he believes will revolutionise the fabrication of higher-strength, lighter-weight risers with improved fatigue performance.

Development and testing

Shrink fitting is simple in principle. However, there are several issues that have to be understood to guarantee the performance demanded by critical riser applications. So, 2H conducted a thorough development programme to prove the process and confirm earlier finite element analysis work.

The programme involved preparing a series of shrink-fit test pieces at a UK forge. The machining of the component profiles and finishes was tightly controlled during the assembly process, as was the heating of the flange body using induction heating coils. Mating the two components was expected to present practical challenges; however, precise alignment when the pipe was stabbed into the flange body avoided any problems with the two parts jamming.

Rigorous tests were performed on a series of joints made using the 80-ksi steel eventually chosen for this project. There is no reason why the shrink-fit process cannot be applied to 110-ksi steels. In this specific case, however, the designers were keen to avoid an excessive hardness rating, which would have put the riser outside the NACE limits imposed by the operator.

The joints completed hydrostatic pressure testing up to 13,500 psi under various external tension and bending loads. In addition, gas pressure testing was performed to 12,200 psi.

Full-scale manufacture

Responsibility for the shrink-fit process and manufacturing the Venture riser is now with Subsea Riser Products. Forging the main pipe sections has already commenced at two plants in France and Italy. The flanges will be forged once the main pipes are finished, and then extensive machining will be required before the flanges are shrink fitted to the pipes. Detailed quality control checks will be carried out before the riser is delivered to Venture in September 2009.

The lead contractor on the project is Claxton Engineering, which specialises in supplying drilling risers to the offshore industry. Dannie Claxton, the company's engineering director, is proud of the fact that the riser is the first of its type in the world and represents a cost-effective step change in drilling practice. Claxton will provide a range of ancillary equipment, including an umbilical; wellhead and BOP connectors; a tensioning ring; and a hydraulic power and control system. In addition, a team from Claxton will be responsible for running and pulling the riser on the rig, and for its inspection and maintenance.

Beyond the current project

The development of the shrink-fit flange is the key to this entire Venture project, and the chances are that it will find broader application for both shallow- and deepwater riser systems in the future. The three Acteon companies are already focused on HPHT applications in deep water in the Gulf of Mexico, which may require risers capable of working at even higher pressures than the Venture system. The companies are also promoting the process as a way of reducing the cost of producing the tapered stress and tension joints for riser systems, which are normally manufactured complete with flanges by machining necessarily massive forgings. Other applications being mentioned involve riser joints with complex non-ferrous metallurgy such as titanium and aluminium.