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Evaluation of Welding Procedures and Consumables for Hyperbaric GMAW for Diverless Retrofit Tee Hot-Tap Applications

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The use of fully remotely installed retrofit tees for hot-tapping applications is an extremely attractive economic option for maximising the potential of oilfields. A diverless hot-tap tee system is in the process of being built and commissioned, with hyperbaric GMA welding selected as the internal saddle seal welding method. Process capability has previously been demonstrated in the range of 145 to 1,000 m using a specially developed 1.0-mm metal-cored wire. This paper considers the performance and application of a 0.9-mm Inconel 625 wire for hot-tap welding. A direct comparison of the performance of the 2 wires is made: process and electrical stability; metallurgical analysis; and macro quality and mechanical properties.

INTRODUCTION

Hot-tap technology has for many years been used onshore and in process plant applications in order to connect branch pipelines to production pipeline systems without stopping production. The majority of hot-taps is based on welding the branch pipe onto the pipeline and then tapping by hydraulically operated drilling machines. Retrofit tees are being developed for diverless subsea installation onto existing pipelines. This paper describes the hyperbaric GMA (gas metal arc) welding development required for the internal seal weld between the retrofit tee and the mother pipe. To date, a steel metal-cored wire has been selected and qualified as the consumable of choice for the seal weld. This paper goes on to consider and describe the potential use of an Inconel 625 filler wire, a material known for its good corrosion resistance and weld metal ductility characteristics.

SUBSEA HOT-TAP TECHNIQUE

In the North Sea fewer than 10 hot-taps have been carried out on subsea pipelines so far, of which 2 were on the Statpipe system. These have provided very cost-effective solutions, but they are based on an approach using divers and thus limited to water depths where diving is possible. Fig. 1 shows a typical layout of a hot-tap connection.

Over the last few years, installed pipelines have been prepared for future connections by pre-installed tee assemblies of which some require hot-tapping to allow product flow. Some of these pre-installed tees and planned tees are at water depths requiring diverless technology. Statoil have then launched a development project to establish technology and tooling systems for remote hot-tapping so that the pre-investments done may be utilised within realistic time frames. The development project also covers the required technology and equipment for hot-tapping into unprepared pipelines, i.e. the use and application of retrofit tees.

The basic principle of hot-tapping is to establish a new branch pipeline connection to an existing pipeline while the mother pipeline is under full pressure. The method involves connecting the branch pipe including a valve to the mother pipeline, usually by means of welding or a mechanical clamp connection, and then cutting a hole in the pipe wall by a cutting machine which is connected to the valve and can undertake full pipeline pressure. After cutting is finished, the cutting head is retracted, the valve is closed, and the cutting machine disconnected. The pipe branch may now be extended by spools and tie-in to a new pipeline in a normal way. This methodology has shown itself to be very cost-effective compared to alternative methods such as shutdown and tie-in at ambient pressure conditions.

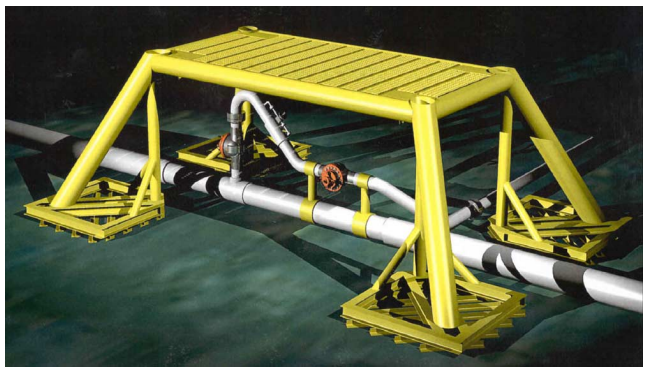

Fig. 1 Typical subsea hot-tap connection

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