Analysis and Burst-test of a Full-scale Welded Pipeline Repair Sleeve

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ABSTRACT

A new technique for sub-sea pipeline repair involves the installation of a sleeve over the joint and performing a sub-sea, remotely-operated fillet weld between the pipe and each end of the sleeve.

This paper concerns the burst limit state: the presence of the sleeve repair shall not reduce the pipe burst pressure. The results of a burst test conducted on a 42” sleeve-repaired pipe are presented and compared with FE-analysis.

Good agreement between the test and the FE-analysis is found for the development of strains in the pipe and the sleeve, and for the pressure at which burst occurs. The presence of the sleeve does not influence the burst pressure.

KEY WORDS: Pipeline; repair; welding; sub-sea; remote; burst; testing.

INTRODUCTION

A new technique for sub-sea pipeline repair using remotely operated welding without the use of divers has recently been developed. The technique involves the installation of an oversized pipe segment (sleeve) over the joint by threading the pipe ends through the sleeve and performing a sub-sea fillet weld between the pipe and each end of the sleeve. The technique is described in Apeland et al. (2006) and Berge et al. (2004), where a general description of the technique is given together with summaries of the equipment developed and of the qualification of the structural strength and design, weld, welding system and installation system. The hyperbaric welding technology is fully remote controlled and has been proven by simulating conditions down to 2500 msw (250 bar) in a hyperbaric chamber. The welding qualification is described in Woodward et al. (2004 and 2005).

The design of the sleeve has to take into account a number of potential failure limit states; bursting, global yielding (collapse), local overstraining of the pipe, sleeve or weld, collapse, fracture and fatigue. A number of analyses and tests have been conducted to investigate these limit states behaviour and develop a robust design methodology that will satisfy all limit states. These analyses and tests are briefly described in Apeland et al. (2006) and Berge et al. (2004).

The paper first presents the burst test conducted on a 42” sleeve-repaired pipeline and the results of that test. Thereafter FE-analysis conducted to simulate the tests is presented together with the results of the FE-analysis and a comparison with the full-scale burst test results. Finally conclusions are drawn with respect to the implications of the test for the viability of the welded sleeve repair technique.

BURST TEST

Test Configuration. A sketch of the test configuration is shown in Fig. 1 (note that the pipe lengths are not to scale, each having a length of approx. 6m).

The pipe used for the burst test was a 12m joint of spare pipe from the Åsgard Transport Pipeline with nominal wall thickness 29.8mm, cut into two 6m lengths which were then “repaired” using one of the