LIMIT STATE DESIGN BASED ON EXPERIMENTAL METHODS FOR HIGH PRESSURE SUBSEA PIPELINE DESIGN

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ABSTRACT

The design of offshore subsea pipelines is facing new challenges as the pipeline industry is moving into environments requiring high pressure design. Conventional pipeline design codes such as ASME B31.4 and B31.8 establish pressure limits based on percentage of the pipe material's minimum specified yield strength. While this has traditionally worked for relatively thin-walled pipe at moderate pressures, there are concerns that full utilization of the material's capacity is not being realized when designing for high pressure conditions. Additionally, there are concerns regarding the ability to achieve high quality manufacturing and consistently fabricate welds in thick-wall pipes.

This paper presents details on a testing program that incorporated full-scale burst testing to qualify the design pressure for an 18-inch x 0.75-inch, Grade X65 subsea gas pipeline using the methodology of API RP 1111. A lower bound burst pressure was established based on the recorded burst pressures to which a design margin of 0.72 was applied to determine a design pressure. Had the pipeline been conventionally-designed using ASME B31.8, the design pressure would have been 3,900 psi. However, using the experimentally-based design option in API RP 1111 the resulting design pressure was 4,448 psi. This results in a net increase in the design pressure of 14 percent.

When one considers either the potential cost savings in material requirements at construction or the additional throughput associated with higher design pressures for a given pipeline system, it is not difficult to demonstrate the economic benefits derived in performing a more rigorous material qualification and limit state design process based on experimental methods as presented in API RP 1111.

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