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Solving Pipeline Technology Challenges in the GoM by Innovation, Advanced Analysis Tools, and Engineering Competency

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Abstract

The paper presents an overview of solving pipeline technology challenges, such as Deepwater, High Pressure/High Temperature (HP/HT), Flow Assurance, Thermal Buckle Management, and Large Spans Management, in the Gulf of Mexico (GoM) by innovation, advanced analysis tools, and engineering competency. The combination of these capabilities allows for solving some of the most complex engineering problems and in some cases has allowed significant cost reductions to be expedited in the engineering.

Advanced analysis tools, such as 'Simulator' which is an 'in-house' proprietary piece of be-spoke software, used to design, model and simulate pipelines is briefly described. The software is a highly non-linear Finite Element (FE) program, and uses ABAQUS as the FE engine, and can take account of material non-linearity, pipe-soil interaction, and large displacements. A world wide perspective of innovation pipeline and subsea engineering experience is given from projects all around the world, such as, the North Sea, GoM, Angola, South Africa, Europe and Australia. These projects have demonstrated novel solutions such as Pipe-in-Pipe (PIP), optimized pipeline design, advanced analysis tools, Limit State Based Design (LSBD), and Three Dimensional (3-D) route selection. Also much experience has been gained by using subsea equipment such as High Integrity Pipeline Protection Systems (HIPPS) on Projects in both the North Sea and Australia, with the ability to introduce significantly engineering advantages and cost savings in the GoM.

Finally, the future engineering challenges that face the industry as a whole are described, and it is shown that Technology and Advanced Engineering are key to competitive advantage and sustainability in solving some of the most complex engineering challenges.

Introduction

The world is consuming oil and gas at an ever increasing rate and, as a result, there is demand to exploit new opportunities and make projects that were once not technically or commercially feasible, now viable in a cost-effective manner. For many years some Projects have been put 'on-hold' due to technology gaps that exist, and the inability to bridge that gap due to technology either being unavailable, or just too expensive to implement. However, in recent times there is a greater requirement for pipeline and subsea design companies to tackle these engineering challenges in a cost-effective manner. Also the ability to solve the most complex engineering problems is key to the success of an organization in this very competitive and dynamic market, and this will allow competitive advantage, and long term sustainability to occur.

In the GoM there are many oil and gas fields and reserves that need to be utilized, and these opportunities put demands on present and future projects and engineers. For example, in certain cases, water depths may be too deep to allow pipelines to be installed to transport the oil and gas, or temperatures of the oil and gas may just be too high to allow it to be transported using conventional pipelines. If these types of technology gaps can be bridged, then this will open the doors to greater opportunities in the development of new fields.

However, due to challenges such as deepwater and high temperatures, this increases the level of complexity in designing subsea pipelines. Hence there is a need to design, install, and operate pipelines to transport the oil and gas for very onerous conditions, but first there are engineering challenges that need to be addressed and overcome so that it will be possible to capitalize on field development. This paper looks at some of the major design challenges that are presently faced by the oil and gas Industry in the GoM, such as Deepwater, HP/HT, Flow Assurance, Thermal Buckle Management, and Large Spans