

A Survey of ABAQUS Simulations in Technip USA Deepwater Pipeline Engineering

B.W. Duffy

Technip

Abstract: The production of hydrocarbons from deepwater reservoirs requires the fabrication and installation of massive infrastructure. As the global energy industry targets hydrocarbon reservoirs in ever deeper water, the use of remote subsea wells to access the reserves and deepwater flowlines to transport the produced hydrocarbons back to floating production platforms will increase. Technip pipeline engineers utilize a number of simulation tools, including ABAQUS, to ensure that the deepwater pipelines and subsea equipment are designed, fabricated and installed to meet the demanding environmental and operating conditions. Some of the various simulations Technip performs with ABAQUS include: global pipeline thermal buckling and fatigue simulations; analyses of the installation of the pipeline end termination (PLET) structure and its connection to the suction piles that restrain the pipeline (these simulations provide the highly nonlinear force deflection curve for use as the boundary conditions in the global pipeline thermal buckling simulation); cavity radiation simulations of the heat transfer between multiple flowlines/umbilicals in the turret of floating production platforms; and thermal management simulations to ensure that the pipelines insulation design will maintain adequate hydrocarbon temperatures during shut-down conditions.

Keywords: Buckling, Fatigue, Pipes, Pipeline, Submarine Pipeline, Cavity Radiation, Transient Heat Transfer, Pipeline Flow Assurance, Pipe-Soil Interaction, Soil-Structure Interaction, Reliability.

1. Introduction

The production of hydrocarbons from deepwater reservoirs requires the fabrication and installation of very expensive infrastructure. The cost just to drill a deepwater well can easily exceed \$70-100 million. The various components needed to support long-term production of deepwater hydrocarbons (the production platform, subsea wellheads, pipelines, and control systems) can be a \$1 to \$3 billion (or more) investment. Given this huge capital expenditure and the volatility of hydrocarbon pricing, there is tremendous pressure in the energy industry to deploy highly reliable and cost effective equipment for such deepwater projects.

Advanced simulations help ensure that the designs of deepwater equipment can withstand the severe environmental and operating conditions and that the installation procedures can get the hardware on location safely. The variety of simulations Technip performs with ABAQUS include: global pipeline thermal buckling and fatigue simulations; analyses of the installation of