OTC 19118

Steel Catenary Riser Challenges and Solutions for Deepwater Applications

Hervé Quintin, Jean-Luc Legras, Kevin Huang, and Mason Wu, Acergy

Abstract

Recent years have seen the first uses of steel catenary risers with spread moored FPSOs for deep water field developments in West Africa. Acergy have been in charge of the design and installation of more than 20 Steel Catenary Risers (SCRs) on FPSOs in this area. The design, fabrication and installation of these risers have required many significant challenges to be overcome for the first time. Innovative solutions have been developed and implemented to overcome these challenges particularly in the areas of design, welding and installation. This paper presents some of these challenges and solutions with the applications of SCRs attaching to mono-hull floating production units. Strength and fatigue analysis, on bottom stability, interface with the FPSO, and fabrication issues are described in detail. Lessons learnt from previous projects as well as results of new developments /1/ to extend the suitability of Steel Catenary Risers to deeper developments and to turret-moored FPSOs are also presented.

Introduction

A steel catenary riser is a seemingly relatively simple system, when comparing to others, where the riser is in continuity with the flowline and is made up from welding a number of rigid steel pipe joints of standard length. The catenary riser is generally connected to a floating platform with a flexible joint, steel or Titanium stress joint to absorb the potentially large angular movement of the platform. The bottom end of the riser pipe rests on the seabed as a beam on elastic foundation. The main concerns for the design of steel catenary risers described in the following sections are:

- Interface management with the floater,
- Impact of as-built uncertainties on the static configuration of the riser,
- Dynamic behavior of the catenary riser,
- Welding requirements,
- Installation aids for the final transfer and pulling of the riser on the FPSO /2/.

The last section presents some results of new analyses performed by Acergy to improve the dynamic behavior of SCR's with the aim of using them for turret moored FPSO's in West Africa.

Interface with the floating vessel

Design of the SCR is strongly linked with the characteristics of the floater. Main interfaces are:

- Location of the hang-off point alongside the hull,
- Flexible joints designed to sustain great temperatures
- Stiffness of the floater mooring system and maximum excursion,
- 1st and 2nd order motions of the floater,
- maximum heel, yaw and pitch in extreme, damage and survival conditions,
- local structural detail design of hang-off supports and hull reinforcements,
- Integration of installation aids including transfer and pulling winches,
- Space and lifting equipment available for pre-commissioning activities.

This list is not exhaustive and a huge number of pieces of information have to be exchanged all along the design phase of the SCR and of the floater /3/. Clear definition of all these needs and requests with associated schedule, open relationship between Contractors and support of the Company when necessary are the key drivers for success of the project. Some of the main lessons learnt are the following /4/:

- Early identification of interface data: for instance, all hydrodynamic analyses are performed very early by the FPSO contractor. These studies in general include some model tests. If all the conditions and pieces of information necessary for the design of the SCR are not defined at this stage, schedule and cost may not allow performing additional tests later on.
- Include sufficient margin in the initial loads provided for the design of permanent structures. Cost impact of an increased plate thickness or an extra stiffener is negligible compare to the overall cost of the hull, when decision is taken early enough and does not modify the yard fabrication planning. But the same modification will have catastrophic impact when the block is already assembled and painted.
- Flexibility: selected solutions should minimize