ABSTRACT

Application of mechanical collet connector has become increasingly common in ocean engineering. Meanwhile, the locking mechanism of the mechanical collet connector has a direct impact on the reliability of the connector. In this paper, a locking mechanism design was proposed for a collet connector under the working condition of 1500-m depth and 5000-psi inner pressure. The interaction of some parameters associated with the structure design was also discussed. The actuator ring was first designed using a two-cylinder scenario: Outer cylinder and inner cylinder are assembled through interference fit. This scenario can not only increase the yield strength of the actuator ring, but also reduce the overall cost.

KEY WORDS: Collet connector; structure innovation design; parameters control

INTRODUCTION

Flange, as a common component in connecting pipeline and pipeline or subsea facilities (Christmas tree, manifold, etc), its application in shallow water mainly depends on the diver assistance. However, diver can’t work in deepwater, connector then be used in place of flange. According to its installation method and whether there are hydraulic systems on it or not, connector can be divided into mechanical connector and hydraulic connector. Also connectors can be divided into collet connectors and clamp connectors based on its structure. There are several kinds of connectors widely used in the market and shown in Fig.1, made by FMC, Cameron, Oil states, etc. Liwan3-1 gas field, jointly developed by CNOOC and Husky, is located at a water depth of 1425m in South China Sea and its natural gas reserves are estimated at more than 40 billions m3. Based on the development scenario designed for Liwan3-1, lots of connectors need to be used and the design life should be over 20 years. Mechanical collet connectors have been a prior choice for field operators mainly because:

1) Individual mechanical connector has a low cost relative to hydraulic connector. Although single mechanical connector has a high cost of installation, the number of connector is so large that the total cost will be lower than hydraulic connector.

2) Mechanical connector doesn’t leave any hydraulic components under water, which may reduce the risk of equipment failure.

3) Collet connector is applicable to the pipeline diameter at a large range and the depth is much deeper than clamp connector, whose applicable water depth is no more than 1000m.

The work we are doing now is focus on the design of mechanical collet connector. Locking mechanism, as the most important component of connector, includes fingers and actuator ring whose structure parameters need to be designed reasonably and efficiently to ensure the mechanism a high degree of reliability. There are many challenges while designing the locking mechanism such as the interaction between several parameters, improvement of the actuator ring performance while reducing material costs, etc. We attempt to suggest some solutions to deal with the above challenges.

LOCKING MECHANISM SOLUTION

The scenario of locking mechanism is shown in Fig.2. The male and female hubs will be welded to the pipe (jumper) and subsea facility (Christmas tree, manifold, PLET, etc.) respectively. There are 20 fingers around the male hub whose function is to make the male and female hub locked together (shown in Fig.2). Before locking, the gap between each finger is 2°, that means the radian of every finger sheared is 16°. Actuator ring can be moved upward and downward...