A Novel Underwater Horizontal Directional Drilling Platform Base on Coiled Tubing Technology

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ABSTRACT

This paper presents a novel underwater horizontal directional drilling platform which can be remotely operated in sub sea environment by using a submersible coiled tubing system. The submersible reel on which 150 meters of 2” coiled tubing are spooled can release or retrieve with the submersible injector simultaneously, that allows a horizontal distance of 100 meters in maximum for shallow horizontal drilling. The underwater mud jetting system consisting of mud pump, flexible mud containers and mud-seawater mixture equipment can provide continuous mud supply for the drilling tools. For the underwater drilling navigation, the IMU-7200 inertial measurement unit with high precision is applied to calculate the actual drilling trajectory. And the drilling parameter can be regulated in real-time according to the position and azimuth of the drill head to complete whole drilling and back-towing tasks. As all control systems working in a remotely operated manner, the complete underwater power units and plentiful underwater sensors are also carried on the platform systematically to facilitate drilling operations. This underwater horizontal directional drilling platform can be widely used in salvage operations, marine geology explorations, as well as some underwater installations.

KEY WORDS: Underwater drilling; horizontal directional drilling; remotely operated drilling; coiled tubing.

INTRODUCTION

On land, the Horizontal Directional Drilling (HDD) has experienced tremendous growth in recent years that has been widely used in trenchless pipeline construction, cable installation, geothermal exploration, and so on. HDD can reduce the impact of construction activities in urban areas and cross the rivers, mountains, and other big obstructions on the ground. With these evident advantages, it is expected to apply HDD technologies in offshore engineering, such as underwater drilling, salvage operation, geotechnical site investigation, subsea pipeline cleanout, and so on.

Trenchers equipped with plows or jetting swords are employed more and more often in the pipeline and cable burial operations in the offshore industry. All these operations need to create a temporary trench in the seabed, travelling with the vehicle, which allows the cable or pipeline to descend into the seabed before being buried under the re-depositing sand (Brown and Palmer, 1985; Vanden Berghe, Capart, and Su, 2008). These operations bring great impacts to the seabed environment and threaten the pipelines or cables previously buried. Utilizing HDD techniques, it would be the most appropriate method for these projects to minimize environmental impacts, reduce the quantity of potentially hazardous trench spoils, cross the buried cables or pipelines and cross obstacles on the seabed safely if encountered.

In the salvage field, the traditional salvage methods mainly depend on the divers or salvors with manual method to pass lifting wires under the sunken wrecks. It is a laborious task with great security risk for the operators may be buried by collapse mud or sand (Hu, Zhang, Zhu, Liu, and Li, 2005). A salvage project likely lasts for several weeks due to wire passing works, and even becomes unable to complete if the wreck depth exceeds 100 meters. Utilizing HDD technologies, the wire passing work can be completed by drilling transverse holes and passing the wires with drill bit without or with the least divers, whereby can save considerable costs and time on the projects.

The offshore drilling can be accomplished on the deck of stationary or floating platform, or on the deck of the ‘floating unit’, such as drill ship. It is inevitable for the surface drilling to due with the increasing weight and instability of drill string between the surface and seabed with increasing water depth. Additionally, the operation has to be interrupted by unexpected weather frequently, or increasing risk and investment of the operating cost would escalate. In recent years, the seabed drilling is proposed and used increasingly in marine geotechnical site investigations. The Seabed Drilling Rig (SDR) provides a practical and economic solution to reduce well construction costs, and its relative insensitivity to weather and water depth reduce the cost of drilling in deep water (Ayling, Jenner, and Neffgen, 2003). While the effective and totally automatic transportation and assembly of all drill rods is still a challenge for SDR, and the connection and disconnection of the drill string is bound to reduce the working