The First Use of Pipeline Plough on Subsea Pipeline Trenching in South China Sea

Huifeng Deng / Chunna Song / Wanbao Dai / Chunsheng Miao
1: COOEC Shenzhen Subsea Technology CO., LTD.
Shenzhen, China
2: COOEC Maintenance Company
Tianjin, China

ABSTRACT

The subsea pipeline trenching by a pipeline plough introduced to China for the first time is indicated in this paper, which was used in the Ledong 22-1/15-1 Field Development Project performed by COOEC. Proposed to achieve the trench depth of 1.8m, the pipeline plough succeeded trenching along the 24'' export pipeline over an approximate length of 54 km, which was launched in the depth up to 100m. Based on the Ledong project, the equipments, construction procedure and related highlights covered in the pipeline trenching are described herein.

KEY WORDS: Subsea pipeline trenching; pipeline plough; South China Sea; first use.

INTRODUCTION

In order to protect the offshore pipeline from potential mechanical damage possibly caused by wave, currents and other uncertain factors, the most effective solution is to make a trench that meets the depth requirements to bury the pipeline. Burial is used as protection to prevent external loading from fishing activity/snags or hydrodynamic loading and to prevent movement of the pipeline during thermal expansion on commissioning (Finch et al, 2000).

In 40s-60s of last century, the normal solution was to trench along the pipe with jet equipments when the offshore oil or gas explorations took place in shallow water zone near the coast. In the end of 1960s mechanical trench was introduced in the North Sea for pipeline trenching project. With the exploration activities going to deep water zone which is very complicated in sea situation, the pipeline plough appeared and took an important part in the offshore pipeline trenching project. The important aspects of plough performance are the velocity at which the plough can be dragged and the cover depth that is achieved (Cathie, D. N. and Wintgens, J. F., 2001).

Although after the 1980s a lot of pipeline plunges were used for offshore pipeline trenching over the world, a pipeline trenching by a pipeline plough was not carried out in China until a pipeline plough was introduced in the Ledong 22-1/15-1 Field Development Project performed by COOEC in South China Sea in 2009. This paper is aimed to introduce the pipeline trenching with a pipeline plough in the Ledong Project, mainly focusing on the project background, equipment & vessel, construction process, related highlights and so on.

LEDONG PROJECT BACKGROUND

The Ledong22-1/15-1 Field Development Project consists of two platforms, the LD 15-1 and LD 22-1, one 12'' Interfield Pipeline, one Submarine Complex Cable, one 24'' Export Pipeline and an extension to the existing Dong Fang Terminal Station. The LD 22-1 platform is approximately 130 km off the southern-west of Sanya City, Hainan Province and is located in water depths of approximately 93.5m. The LD 15-1 platform is approximately 103 km off Yinggehai Town, Ledong County, Hainan Province and is 110 km off Sanya City, Nanshan. Water depth at the LD 15-1 platform location is approximately 105.8m.

Based on soil sampling and testing results, and geophysical interpretation results, the near seabed shallow soils along the proposed pipeline routes can generally be vertically divided into three soil units namely as Unit I, Unit II and Unit III.

Unit I consists of the uppermost very soft olive gray muddy silty clays/sandy clays/clayey sand. The thickness of Unit I ranges from about 1m to 4m. The design undrained shear strength is 4kPa to 12kPa. Unit II consists of mainly soft to stiff olive gray/yellowish brown sandy clays/silty clays, locally comprise very soft olive gray silty clays.

The thickness of Unit II ranges from about 2.0m to 6.0m. The design undrained shear strength is normally 18kPa to 55kPa. However, remarkably between KP41 (the location which is 41 kilometers away from the pipe landing point along the pipeline) and the pipe landing point, the soils of Unit II consist of mainly stiff to very stiff yellowish brown silty clays/sandy clays. And the strength of the soils are generally high with an undrained shear strength ranging from 60kPa to 120kPa.

Unit III comprises predominantly firm to stiff olive gray silty clays. The design undrained shear strength ranges from 40kPa to 80kPa.

A pipeline plough was used to trench along the 24'' Export Pipeline over an approximate length of 54 km. The maximum water depth is about 100m and the maximum soil shear strength is about 120kPa along the pipeline route. The pipeline trench was performed by the plough which was put over the pipeline and dragged by the support vessel through a tow wire along the pipeline route. In fact the normal trenching speed was 400-500m/h, sometime as fast as 800m/h.