Multi-Core Subsea Power Cable for Mixed High and Low Voltage Transmission

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ABSTRACT

Based on the analysis of the existing subsea cables, this article introduces the development of multi-core, high and low voltage subsea cables which have been successfully applied to BZ34-3/5 oilfield in Bohai Bay. It has been proved to be a good model in reducing cost for small and marginal oilfield development.

KEY WORDS: Marginal oilfields; subsea cable; high and low voltage transmission; steel strap screen.

INTRODUCTION

In the development of small and marginal oil and gas fields, the small production platform in a marginal field is constructed compactly and supported by the existing main platform. Considering the cost and management of a power supply to a compact production platform, power is normally transmitted from a power-station-equipped main platform to the non-power-station-equipped compact platform via subsea cables. Apparently, the subsea cable is one of the essential facilities for power transmission in a marginal oil and gas field.

The power supply for wellhead facilities currently needs both high-voltage power, which is for electrical submersible pumps by applying high-voltage and a frequency conversion system, and low-voltage power, which is for navigation and instrumentation by applying a low-voltage and frequency conversion system.

Considering the situation of frequent fishing and anchoring in Bohai Bay which is mostly shallow water area, subsea cables laid in that area need to be buried. Therefore, these subsea cables not only need to meet the requirements of mechanical strength during cable-laying, but also need to meet the requirement of safe power supply.

With respect to the development of marginal oil and gas fields, especially the development of BZ34-3 and BZ34-5 which are small marginal oilfields and have a short life cycle, only around 6 years, it is not cost effective if applied with the conventional subsea cable or general cable. This is because that the conventional subsea cable is costly, and the general cable is not economical by considering its short life cycle and special and costly offshore construction. Therefore, with the limitation of development costs, both conventional subsea cable and general cable cannot meet the development requirement on reducing costs.

Considering the development costs and the rationality of production management, the development plan for BZ34-3 and BZ34-5 is to apply the control panel and transformer for the electrical submersible pump on the existing 2EP and 4EP platforms respectively. Meanwhile, in order to separately control each electrical submersible pump on the respective shelves, two pumps need to be supplied by two different power sources. Thus, it is important for us to research a new subsea cable, which can provide high-voltage and low-voltage mixing in power transmission, to apply to the marginal oil and gas fields and to meet the cost-effective requirement.

TECHNICAL ANALYSIS AND DEVELOPMENT OF SUBSEA CABLES

Technical Analysis Of Conventional Subsea Cables

The conventional subsea cables, which have a triple-core structure, can be divided into three phases, A, B and C. Each core line, consisting of several copper conductors, is wrapped by a conductor shield layer (2), a cross-linked polyethylene (XLPE) insulation layer (3), an insulation shield layer (4), a semi-conductive water-blocking tape layer (5), a lead sheathing layer (6) and a polyethylene (PE) sheathing layer (7).

The Polypropylene cushion layer (9), galvanized wire armor layer (10), asphalt cushion layer (11), polypropylene-robe-made armor coat (12) are used to wrap these triple-core lines as outer protection and sealing. In the meantime, the interspace of these triple-core lines is filled with polypropylene (8), which helps to make a perfect integrated subsea cable (Fig.1). This subsea cable, which is characterized by its simple structure of three core lines corresponding to three phases A, B and C, can only transmit one AC power at one time. As for the two well shelves of BZ34-3 and BZ34-5, three conventional subsea cables are needed in order to meet the power requirements. Among these three cables, two are needed to supply power for the high-voltage submersible pumps, while the other is needed to supply power for low-voltage devices.