Subsea Power Distribution of Lingshui 17-2 Gas Field in South China Sea

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ABSTRACT

Lingshui17-2/18-1/25-1 subsea production systems have a vast chained layout with complex future tieback demand, which brings a significant challenge to subsea power distribution design.

Although subsea control system power requirements are highly vendor specific, this paper gives an impartial design philosophy of subsea power distribution to meet the power demand of Lingshui 17-2 and future Lingshui18-1/25-1 gas fields. Feasibility of AC single phase with/without subsea transformer and DC power supply are studied. Umbilical conductor numbers and sizes, as well as topside supply voltages for each gas field are recommended based on study result. A workflow for complex chained subsea control system power distribution has been summarized with special attention highlighted.

KEY WORDS: Lingshui17-2; deep water; subsea control system; power distribution; AC single phase; DC.

INTRODUCTION

The subsea control system of Lingshui17-2 gas field (hereinafter referred to as LS17-2) is an electro-hydraulic multiplexed control system and capable of operating and monitoring the LS17-2 field, which initially comprises 11 subsea production trees and 5 future subsea production trees. Functionality shall be incorporated to allow for further expansion of the system, which includes future Lingshui18-1 (hereinafter referred to as LS18-1) and Lingshui25-1 (hereinafter referred to as LS25-1) gas fields.

When a SPS has a cluster layout and short power distance, it is easy to come up with a power distribution plan to meet a subsea control system power demand. Shi W et al. (2011), MAO JY et al (2014), HU YR et al (2016) presented relevant methodology. However, LS17-2 wells spread broadly on the seabed, with approximately 50km distance between the easternmost A12H well and the westernmost A15H well. The nearest Manifold EAST1 has only 3.9km power supply distance, while the farthest A12H well in east region has approximately 33km power supply distance. The chained layout of subsea production system brings a significant challenge to subsea power distribution design.

All the SCMs in LS17-2 SPS share one EPU output voltage, which need to, on the one hand, ensure input voltage of the nearest SCM not exceeding its upper limit, while on the other hand, guarantee input voltage of the farthest SCM not violating its lower limit.

In addition, tiebacks of LS25-1 and LS18-1 gas fields will share the same quad cables in the main umbilical between SEMI and SDU with LS17-2 SPS. LS25-1 is approximately 40km southwest away from Manifold WEST, and power supply distance will be about 70 km, which almost exceeds AC single phase low voltage power transmission distance limit for subsea production system. DC power supply might be needed for LS25-1 SPS. At the same time, LS18-1 is planned to tie back to LS17-2 Manifold EAST3, which further brings more complexity to the LS17-2 gas field umbilical cable reservation philosophy.

By using SimulationX and ETAP software, comprehensive comparison of potential power distribution plans are studied in order to design a reliable and cost-effective system.

SUBSEA CONTROL SYSTEM ELECTRICAL ANALYSIS

System Description

Figure 1 is a schematic diagram of subsea power distribution. 3 EPUs are considered on LS17-2 SEMI platform, which will be dedicated to providing power to LS17-2 SPS, LS18-1 SPS and LS25-1 SPS respectively.

The main umbilical from SEMI to SDU includes 8 quad cables, of which 5 quad cables (Q1–Q5) are for LS17-2 SPS, two quad cables(Q6, Q7) are reserved for LS18-1 SPS and LS25-1 SPS respectively, and Q8 is a spare cable in case any cable faults. Detailed cable pair assignment can be found in Table 1.