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Development of a Large Bore Umbilical for Deep Water Service

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ABSTRACT

The following paper discusses, in detail, the technical development of an umbilical system intended for dynamic service in deep water typical for installations in the Gulf of Mexico and Offshore West Africa. The document includes a review of design of a complex umbilical system containing a three inch central super duplex tube, electrical cables and fiber optics and focuses upon the challenges of the design and manufacture of the structure and in particular the challenges of design for fatigue strength.

Application of the API/ISO 13628-5:2008 standard to the development of the umbilical structure, from design through to manufacture and full scale qualification testing, is discussed together with the significant implications of applying the standard to a typical deep water project. Both the advantages and disadvantages with respect to the scope of engineering, testing and qualification are discussed to provide an insight into the effect of the standard as it is being introduced.

Qualification testing presented includes collapse and buckle propagation testing, component fatigue testing, full scale tensile, and fatigue testing together with component strain measurements and an analysis of the subsequent failure mechanisms. The qualification testing is assessed against the various design criteria outlined within the API/ISO 13628-5 standard from which conclusions are made on the applicability of the various utilization factors specified within the standard.

The paper concludes with design challenges imposed by deep water and dynamic operation and show how the updated API/ISO 13628-5 standard can be applied to maintain a justifiably high degree of quality of design and safety.

INTRODUCTION

An umbilical is defined as an assembly of fluid conduits, electrical and fiber optic cables, either on their own or with combinations of each other, cabled together for flexibility. In any offshore field development, the umbilical is a critical link in the recovery of hydrocarbons using subsea production systems (SPS). It provides electrical and hydraulic power, control and

signals to and from the subsea components in the system along with a means of supplying injection chemicals for flow assurance purposes or as a conduit for gas transportation.

As operational water depths continue to increase, with accompanying increases in installation and service loads, numerous and formidable challenges are presented to the umbilical provider in respect of the umbilical design, its manufacture and installation. These challenges are further compounded where more complex umbilical designs are required to satisfy

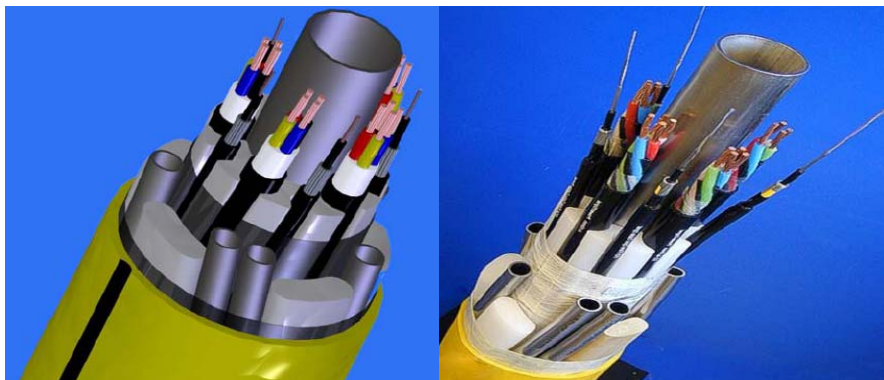


Figure 1: ISU Concept and Realisation

specific development requirements. In particular, incorporating a large bore centrally located steel tube as found in Integrated Service Umbilicals (ISU[®]), shown in Figure 1, presents the following considerations: