From the Longest to the Deepest Pipelines

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ABSTRACT

The gas to pipeline option can be proven as competitive for large volumes of natural gas over long offshore distances. The viability of (and sometimes preference for) an offshore pipeline, whether in deep or shallow waters, across mild or rough sea-bottom environments, is often linked to specific conditions of the region, often merely political (transit fees and security of supply). Offshore pipelines in service or under construction hardly exceed 1000 km in length, and the North Sea is the most ‘populated’ offshore district for long distance high pressure transportation of large volumes of gas. Nord Stream will be the longest and highest capacity gas pipeline system, soon in operation at full capacity of 55 billion std cu.m. per year. The two pipelines, OD 48” X70, are routed across the Baltic Sea over 1200 km between Russia-Vyborg and Germany-Greifswald. In different offshore districts, a few 300 to 2000 km offshore pipelines are at design stage or under construction, in some circumstances across very deep waters and/or harsh environments (Mediterranean, Barents and Black Seas, as well as offshore of the coasts of Brasil and North West Australia).

The aim of this paper is to provide a snapshot of the relevant technologies that are backing current pipeline development projects, as the Nord Stream Pipeline (NSP), in the light of upcoming challenges that offshore gas industry is going to tackle, sometimes in remote regions. In particular:
- Recent advances on material technology and relevant implications in present and near to come projects are presented;
- The capability of pipe lay vessels and equipment currently in force or under development are discussed;
- The increasingly narrower relationship between the pipe design for operation and construction in difficult environments, is commented;
- The topical issues of offshore pipeline projects, in relation to the long distance and the very deep waters, are introduced.

KEY WORDS: Offshore Pipelines, Long Distance Gas Transportation, Gas Monitization, Deep Waters, Harsh Environments, Line Pipe Material, High Grades, Pipe Lay Vessels, Welding etc…

INTRODUCTION

The sub-sea pipeline technology has rapidly progressed during the last three decades, developing technical capabilities to enable construction and operation into increasingly deeper waters (Ref. 1). Considerable R&D studies supported the effort, as motivated by the general consensus on offshore pipelines as competitive and reliable systems for transporting large quantity of hydrocarbons across straits and coastal waters, internal and open seas as well. The use of natural gas in the energy industry is currently looking forward very long distance and permanent transportation links between remote resources and market, (Ref. 2). The vulnerability of offshore pipelines laid across international waters, to political instabilities, is of minor concern, other from permanent links over hundreds of km across different countries, where transit fees significantly affect costs at market and political instability may impact on security of the supply (Ref. 3). Understanding submarine pipeline crossings, considered in the early days of offshore industry as merely belonging to offshore industry i.e. export lines from offshore fields, is definitely changed. Submarine pipelines between continents are now conceived, and new projects of long distance gas transportation infrastructures are under development (Ref. 4).

There are plans for huge investments to create a new permanent link for gas transportation from Middle East to India, in more than 3000 m water depth (Ref. 5). European Community is engaged to develop permanent links across the Black Sea from Caspian and Middle East regions to Central Europe (Ref. 6). The permanent link from giant gas reservoirs of Arctic Russia across the Baltic is under development (Ref. 7). The Mediterranean basin has provided over the last decades a reference framework for the sustainable development of strategic and competitive permanent gas links (Ref. 8).

Competitive transportation over long distances remains a crucial point of the gas energy economy in the next three decades. LNG is seen as an alternative to the gas to pipeline option over long distances. Offshore LNG technology is definitely promising from the viewpoint of supply security, however it is confirmed as more costly than the pipeline option. The comparison of the competitiveness of different options is based on the cost of the transported unit of energy to the end user, see in Fig.1 a comparison of gas monetization technologies as a function of source to market distance and annual volume of gas available. The final cost of gas at market includes gas cost at well, transit fees and cost of transportation. Recent economic studies show the cost of transportation via offshore pipeline is at 1.4 to 1.7 US$ per million of BTU, while LNG is claimed at 2.5 and more (Ref. 9).

Investment costs of long pipeline links are considerable, so reliability over time is the topical issue. Relevant factors are on one hand the capacity of pipe mills to supply large diameter and thick walls pipes able to withstand the impact of aggressive environments during installation and operation, on the other the installation equipment as far as available power, equipment technology, size and capacity, speed are concerned. The technical difficulties of construction and operation...