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Update on Subsea LNG Pipeline Technology

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Abstract

The increased interest and rapid development in the transportation of LNG world-wide has prompted a fresh look at how LNG is transferred to/from an LNG carrier that may be moored offshore in various locations. The traditional shore-side loading/unloading of LNG to/from marine carriers may be prohibited due to proximity to populated areas, safety and/or environmental concerns. Also, the extension of an offshore jetty structure to support the transfer pipelines with related seabed dredging to facilitate vessel access, may be prohibitively costly. This presentation discusses how new developments in high-strength Nickel alloy cryogenic pipelines and high-efficiency insulation systems have significantly improved the prospects for the installation of the first subsea cryogenic pipeline for LNG service.

Subsea cryogenic pipelines designs to date focus on the use of vacuum systems for insulation and Invar™ pipe materials to control growth and differential stress in the pipeline systems. This approach, while successful, has also resulted in high cost systems and welding issues. A new design approach using ambient pressure, high efficiency insulation and high strength Nickel alloys reduces the cost of the system and improves constructability. The design and installation techniques are based on proven systems used in operating high temperature pipelines.

This paper addresses the design, fabrication and installation of subsea cryogenic pipelines as well as possibilities for inspection, maintenance and real time monitoring of the installed system. The designs to be reviewed focus on the use of new developments in high-strength Nickel alloy cryogenic pipelines and high-efficiency insulation systems. The presentation also discusses the test program employed to certify a Fluor developed ambient pressure subsea LNG pipeline for commercial use.

Introduction

Terminals are required for both the loading and offloading of LNG into tankers. For locations with sufficient deep water access terminals may consist of jetty structures and breakwaters where tankers can be moored and offloading can take place via standard loading arms.

Several LNG facilities have the jetty terminal connected to an onshore facility by a short trestle structure, which supports the LNG and utility piping, and may in some cases support vehicular access to the loading terminal.

Location of the jetty terminal is dependant upon not only the requirements for the LNG tanker maneuvering and positioning with respect to water depths, currents and ship traffic, but also with prevailing winds which may influence the location from a safety view point.

In the design of the jetty terminal and trestle structure, a major consideration is the final location and layout to satisfy safety considerations from vapor plumes that may result from leaks or damage to the LNG piping on the jetty and along the trestle structure. [1] Special precautions must also be taken in the design of jetty piping for protection against damage that may result in leaks. This may include additional structural protection and block valves that isolate segments of the piping. In the U.S. handling requirements for LNG on jetty structures require full containment to be designed into the structure to contain a leak or spillage.

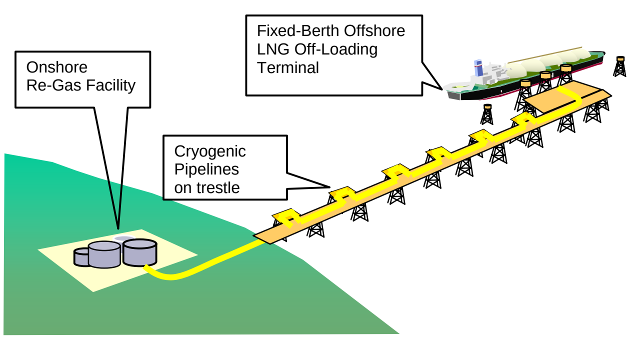

Figure 1- Typical LNG Unloading Jetty

Each of these provisions adds to the cost of the facilities. In addition, the length of the trestle to the end jetty terminal may need to be increased to move the end farther from a potential safety conflict. This too would increase the cost of the trestle structure.

When a trestle structure is used for LNG piping, the design must include provision for expansion or contraction