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Simulation and Comparison of Liquefaction Technologies for LNG Offshore Plant Design

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ABSTRACT

This study focuses on the comparisons of liquefaction technologies in LNG plant. And study findings suggest a strategy for effective liquefaction process design. The best process requires less power and handles larger capacity. One of the key challenges in LNG plant is to get the optimal design of liquefaction process according to the cost-benefit analysis for each process. To design the liquefaction process, our team changed main equipment conditions. Our team made models of various commercial liquefaction processes. In this paper, both modeling and optimization in liquefaction process were carried out to obtain liquefaction process efficiency improvement.

KEY WORDS: LNG; liquefaction; natural gas; simulation; refrigeration.

INTRODUCTION

Despite numerous attempts to develop alternative energy, oil is the most dominant source of energy in the global energy market. But, the global energy market structure has been changing sharply because of environmental restrictions. The natural gas is growing rapidly in the global energy market. Natural gas is a clean source of energy and is preferred because it offers a number of significant environmental benefits over other fossil fuels such as oil and coal. The global use of LNG is increasing sharply. World LNG demands expand from 159 million ton in 2006 to 500 million ton in 2030, achieving 3.6- fold growth.

Because much of the gas reserves in the world are found in offshore fields, gas found offshore is brought onshore to be processed and liquefied at about -160°C for export. Traditionally, natural gas trapped offshore is transported to the land by the local seabed pipelines, which become economically challenging in remote or deep water locations. In order to address such difficulties, Floating Production, Storage, and Offloading (FPSO) technology has become popular over years. FPSO is a floating vessel that is designed to receive oil or gas produced from nearby platforms or subsea template, to process it, and to store it until oil or gas can be offloaded onto a tanker or transported through a pipeline.

In this paper, the six processes are compared by simulation. The three processes are onshore liquefaction processes: Single Mixed Refrigerant (SMR), Propane Pre-cooled Mixed Refrigerant Process (C3-MR), Dual Mixed Refrigerant Process (DMR). And, the two processes are offshore liquefaction processes: Single Nitrogen Expander Process (Single N2 Expander), Methane-Nitrogen Dual Expander Process (Dual Expander C1-N2). And, we designed new hybrid process: Single Mixed Refrigerant-Nitrogen Expander Process (SMR-N2 Expander).

LIQUEFIED NATURAL GAS PLANT

The LNG plant consists of chiefly five processes, the receiving process, acid treating process, dehydration process, fractionation process and liquefaction process. LNG is produced by a sequence of processing step that transform the natural gas from the gas phase to the liquid phase while getting rid of undesirable species. Natural gas is liquefied to reduce its volume, increase its energy content per unit volume and facilitate energy transport in large quantities. The main idea in LNG plant is the condensation of natural gas.

LNG FLOATING PRODUCTION STORAGE OFFLOADING

The LNG FPSO is becoming increasingly attractive, especially because they can 1) easily move from one gas reserve to another, 2) adapt to a wide range of sea conditions, 3) shorten cycle time from discovery to the first production of liquefied natural gas (LNG), and also 4) bring great economic benefits. While LNG FPSO can have such advantages over onshore plants, they must meet high design criteria for size, weight, inherent safety, vessel motion, eases of operation, ability for quick start-up and shut-down, and constraints placed in the marine environment. Hence, only a limited number of liquefaction technologies that satisfy the above standards are practically used in LNG FPSO today.

MINIMUM TEMPERATURE APPROACH