STATE OF THE ART IN LIQUEFACTION TECHNOLOGIES FOR NATURAL GAS
Ways of providing LNG for Transit Countries

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Abstract: LNG has been in practical use for more than fifty years - especially in the United States and Japan - and is attracting increased interest from the European energy sector. Owing to substantial improvements in large-scale liquefaction technology over the last twenty years, LNG is now gaining acceptance as an alternative energy carrier for a variety of applications. At the same time the production cost has decreased considerably, and so have the expenses for transport and storage. In several events the distribution of condensed natural gas - LNG - is being conceived as an economical alternative to developing new firm pipeline capacity.

Transit countries are usually given the option of receiving compensation for their land lease in kind. A relevant question is how the option gas should be used and distributed, and how infrastructure that should be developed. In this context LNG offers some advantages over natural gas that should be further looked at.

This paper deals with modern technologies pertaining to the production of LNG from natural gas. Experience is drawn from large scale LNG production to applications of medium to small scale. Special attempts are made to describe actual technologies in some detail in order to show the true diversity in modern LNG production.

Key words: LNG, natural gas, liquefaction, technology

1. INTRODUCTION

Despite Norway is a major exporter of natural oil and gas it has no infrastructure for domestic gas distribution. The reason is partly the large extent of hydroelectricity (99.4%) and its remote population. However, since the 1980-ies until present time, specific knowledge on liquefied natural gas (LNG) has been developed owing to substantial targeted research. In 1984 SINTEF/NTNU1 entered a strategic co-operation with Statoil on liquefaction. Under the State R&D Program for the Utilization of Natural Gas, SPUNG (1987-1993), the thermodynamic properties of natural gas mixtures were subjected to fundamental and experimental research financed by the Norwegian Research Council [1].

Figure 1 User-interface of CryoPro.

Long-term strategic R&D has enabled SINTEF and NTNU to develop advanced tools like CryoPro for LNG plants design and evaluation. This includes propane pre-cooling and the dual-mixed process, and advanced correlations for heat transfer and pressure drop. It also incorporates the corresponding state equations for thermodynamic properties, multi-variable optimisation of refrigerant composition, pressure and cryogenic heat exchanger layout, and furthermore, the user-interface system as shown on Figure 1. Extensive laboratory experiments were carried out on thermodynamic properties and spiral-wound heat exchangers. Beyond 13 Ph.D. and 45 M.Sc. theses [2,3,4,5,6,7] the most tangible result of this work

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