ABSTRACT

Natural Gas Liquid (NGL) extraction facilities are used to produce NGL products in compliance with commercial specifications, higher heating values and NGL content specifications. There are three main NGL extraction Processes. It can be identified by the refrigeration method: a J-T valve expansion process, a turbo expander process, and a scrub column process using external refrigeration reflux. It is required to evaluate these NGL extraction processes for the application to FLNG (Floating Liquefied Natural Gas Plant). The different NGL extraction processes have different equipment and process conditions. Therefore, it is difficult to compare processes based on only their efficiencies such as production yields, energy consumptions, etc. To evaluate the processes, the criteria for NGL extraction processes and their application to FLNG are suggested. The weighting factors of these criteria are determined according to their importance. The evaluation result shows that the NGL process using the turbo expander expansion is ranked highest owing to significant advantages in propane recovery, lower energy consumption, and higher operating flexibility. This study suggests a useful procedure to evaluate alternatives of the extraction process in many aspects.

KEY WORDS: FLNG (Floating Liquefied Natural Gas Plant); FPSO (Floating Production Storage Offloading); NG (Natural Gas); NGL (Natural Gas Liquids) extraction; Process evaluation; J-T valve expansion; Turbo expander expansion; Scrub column; Process design selection

INTRODUCTION

The process which dominates NGL extraction facility design is the turbo expander process. This process produces needed refrigeration by expanding feed gas across a turbo expander. The turbo expander also recovers useful work from this gas expansion. Typically the expander is linked to a centrifugal compressor to recompress the gas to the liquefaction process. Because the expansion is near isentropic, the turbo expander lowers the gas temperature significantly more than one across a J-T valve. The principal function of a J-T valve is to obtain isenthalpic cooling of the gas flowing through the valve. These offer an attractive alternative to turbo expanders for small-scale gas-recovery applications.

The use of a scrub column is an interesting alternative to the turbo expander process. This process has been widely used in LNG processing and used a lesser extent in NGL extraction. The features of the process are as follows: the scrub column is operated at the liquefaction pressure. Low temperatures can be achieved totally with mechanical refrigeration. The refrigeration is provided by a single mixed refrigerant system designed to provide the necessary low temperature conditions. Alternatively, the turbo expander can be eliminated and the total stream cooled in the main exchanger and fed to the scrub column. A mixed refrigerant processing can be an economic alternative to turbo expanders.

In this paper, we focused on the criteria relevant to an NGL extraction process of an FLNG and evaluated the processes by weighing these criteria as order of priority for NGL extraction processes using J-T valve expansion, turbo expander expansion, and scrub column.

SYSTEM OUTLINE

Design Basis

NGL extraction processes comprise heat exchangers, J-T valves, turbo expanders, columns, re-boilers, pumps, compressors, associated valves, piping and instrumentation. The system configuration of instruments can vary as the technologies and a target of products recovery ratio.

The dry and treated feed gas (temperature 20.5 °C and pressure 60.7 bara) was chilled to -45 °C using the vapor stream from the NGL column and C3 mixed refrigerant (MR). The feed gas turned to a two-phase mixture of vapor and liquid were split in the cold separator. The vapor stream was sent to the top part of NGL column and the liquid...