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Detailed exergy analysis of full scale LNG plant

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Sustainability is one of the major challenges faced by the industrial sector as it is driven by both environmental and economic factors. Energy demands are increasing and, to date, most of the supply is generated via fossil-fuel combustion, such as coal, gas or oil. However, these processes release greenhouse gases, mainly CO2, that contribute to global warming and other environmental issues. Of the three fossil fuels, for a given amount of energy released, natural gas produces the least amount of CO2, making it the most vital energy source. The most practical way of transporting this natural gas over long distances is via liquefaction. However liquefied natural gas (LNG) plants consume substantial amounts of energy; thus, releasing significant amount of CO2. Therefore, enhancing the efficiencies of LNG plants is essential especially for large producer such as Qatar. As of today, Qatar is the largest producer of LNG in the world, with a capacity of near 78 Million tons per annual (MTA). Since the LNG industry in Qatar is a major contributor to the country's economy and development, there is a continuous need to improve and optimize existing LNG systems to extract more value out of them. Optimization of such complex system is; however, not a straight forward technique requiring different expertise ranging from engineering/ process oriented insights to mathematical and thermodynamics techniques. Thus, it is deemed essential to identify plant sections that must be given priorities for optimization. This requires quantifying losses and efficiencies and one of the effective tools is exergy analysis. Identifying the areas of exergy losses within LNG plants emphasizes the areas where optimization is necessary. This project aims to foster the transition to cleaner LNG plants that operate more efficiently, in terms of energy consumption, towards an active contribution to the protection of the environment. The primary focus of the study is to identify exergy losses across a baseload LNG plant producing more than 3 MTA of LNG. In this research, a rigorous

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and detailed exergy analysis was performed on an entire actual LNG process that was simulated using ProMax® and Aspen Plus® simulation software. In order to carry out the thermodynamic analysis, exergy loss across each component of the entire plant was determined. Exergy analysis was not limited to process units, as it was extended to quantify exergy loss across the utility section. Results revealed that the main contributors to the exergy loss are the utility section, accounting for 49% of the total exergy loss. Within the LNG process, significant amounts of losses were found to occur in the liquefaction, sweetening and sulfur recovery units; corresponding for 37%, 30% and 21% of the total exergy loss, respectively. Components responsible for the highest exergy consumption were also highlighted, with the main consumers being the compressors and their drivers, stream generators, LNG flashing and storage, columns (absorbers, distillations) and heat exchangers. The contribution to the total exergy loss provided some insight on locations where improvements are needed to translate into more environmental and energy benefits. For example, most of the losses within the liquefaction section was attributed to compressors and the drivers responsible for the generation of the required shaft work; almost 19MW exergy loss in the gas turbine corresponds to 1 MW exergy loss in the associated compressor. Thus, significant energy savings can be achieved via minimizing the compression energy. *Corresponding author. +974 44034148 Eamil address: e.almusleh@qu.edu.qa (E. Al-musleh) References

[1] «2016 World LNG Report - International Gas Union,» Chevron, USA2016, Available: www.igu.org/download/file/fid/2123.