In the traditional C3MR process (T-C3MR), the boiling gas (BOG) output from the last stage of the gas-liquid separator is directly discharged, in which the excellent low-temperature capability is not utilized, and the system efficiency is decreased. In liquefied natural gas (LNG), single-objective optimization methods are commonly used to optimize system parameters, which may result in incomplete system analysis. To solve the above problems, this paper proposes a multi-objective optimization strategy for the improved C3MR process(I-C3MR) based on a new multi-objective optimization algorithm called EHR-GWO-GA. Compared to the T-C3MR, the improved C3MR based on EHR-GWO-GA(E-C3MR) has an approximate 8% increase in liquefaction amount--a roughly 23% decrease in unit energy consumption and a decrease of nearly 24% in exergy loss. Secondly, an optimization strategy of the I-C3MR with the maximization of liquefaction amount, minimization of unit energy consumption and minimization of exergy loss as objective functions are proposed. Finally, a detailed exergy analysis of the equipment used is made, and the results show that the main exergy losses come from the water coolers and compressors, accounting for 32% and 34%, respectively. Based on the optimization results, the influence of decision variables on liquefaction amount, unit energy consumption and exergy loss are analyzed, and the results show that the decision variables have good adaptability. Firstly, the main work proposes an I-C3MR structure.