Electricity and power produced from waste heat is particularly relevant in shipping because fuel expenses constitute the majority of the cost of operating the ships; however, the cost-benefit aspect limits the widespread implementation of waste heat recovery power units on ships. This paper presents the thermodynamic analysis of a concept that aims at reducing the cost of an organic Rankine cycle unit by using one of the cylinders in a large diesel engine as expansion device. Numerical models were used to optimise the process parameters and thereby determine the power potential for this concept. The evaluation of 104 working fluids points to cyclopropane, R245fa and R1234ze(z) as the most promising. The results suggest that the power produced by the organic Rankine cycle cylinder is at least equivalent to that of the cylinders operating with the diesel process. This enables potential fuel savings and emissions reductions of about 8.3% in the studied scenario.