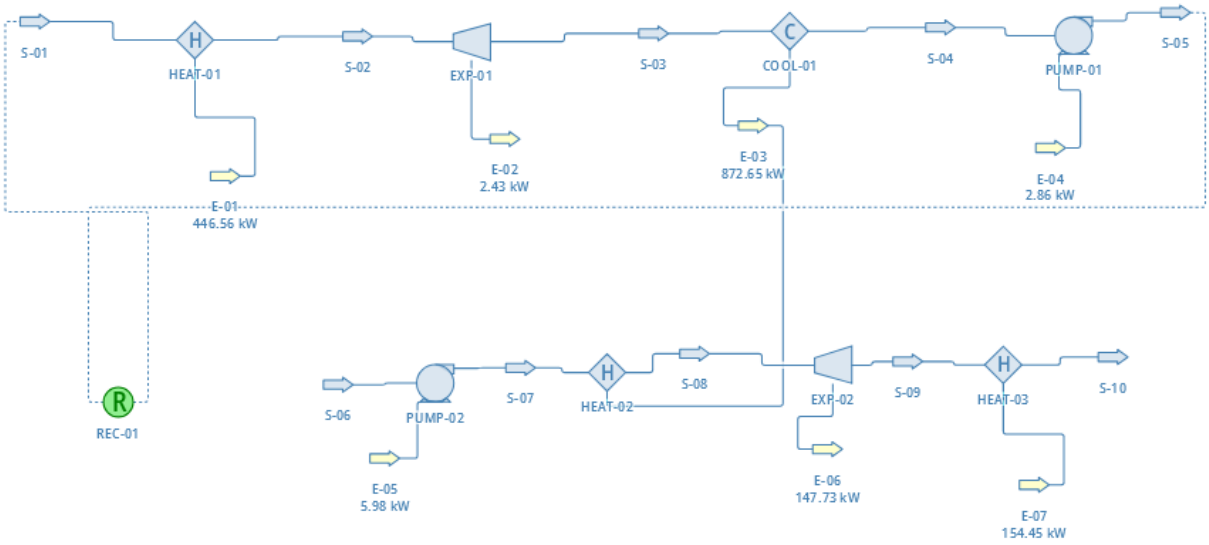
Power cycle based on cold energy of liquefied natural gas and low-grade heat source

Background and description

Natural gas has been widely used in many areas for a sustainable environment. It is the third-biggest energy resource. In this process, natural gas is used in the form of liquid. Natural gas is liquified and stored under cryogenic conditions. This liquefaction process is energy intensive. This results in LNG having plenty of physical cold exergy. This cold exergy can be recovered by power generation cycles. In this work, a combined power cycle using cold energy of LNG and the low-grade heat resources has been investigated. The power cycle which includes 2 parts. The left side of the cycle indicates the Rankine cycle which contains a pump, heat exchanger, a turbine and an evaporator. The right side of the cycle indicates the open cycle for expanding natural gas which contains a pump, evaporator, heat exchangers, turbine. Heat exchangers are used to gasify the liquid propane and LNG with the heating of a low-grade heat source.

1. Rankine cycle working with propane as medium
2. Open cycle with Natural gas directly expanding



Power Cycle

Results:

PROPERTIES TABLE			
S-01	Temperature	-71.3577	C
S-01	Pressure	4	MPa
S-02	Temperature	70	C
S-02	Pressure	4	MPa
S-03	Temperature	68.0945	C
S-03	Pressure	3	MPa
S-04	Temperature	-72	C
S-04	Pressure	3	MPa
S-05	Temperature	-71.3577	C
S-05	Pressure	4	MPa
S-06	Temperature	-161.13	C
S-06	Pressure	0.1	MPa
S-07	Temperature	-160.003	C
S-07	Pressure	1.9	MPa
S-08	Temperature	25	C
S-08	Pressure	1.9	MPa
S-09	Temperature	-52.0616	C
S-09	Pressure	0.4	MPa
S-10	Temperature	20	C
S-10	Pressure	0.4	MPa

PROPERTIES TABLE			
COOL-01	Outlet Temperature	-72	C
EXP-01	Adiabatic Efficiency	80	%
EXP-02	Adiabatic Efficiency	80	%
HEAT-01	Outlet Temperature	70	C
HEAT-02	Outlet Temperature	25	C
HEAT-03	Outlet Temperature	20	C
PUMP-01	Efficiency	70	
PUMP-02	Efficiency	70	

Components used: Propane and LNG

Composition of LNG- Methane- 95%
Ethane- 5%

References:

https://www.sciencedirect.com/science/article/abs/pii/S1359431103003077