GMI4322 Refrigeration and HVAC Systems
TERM PROJECT
Due date: April 8, 2020

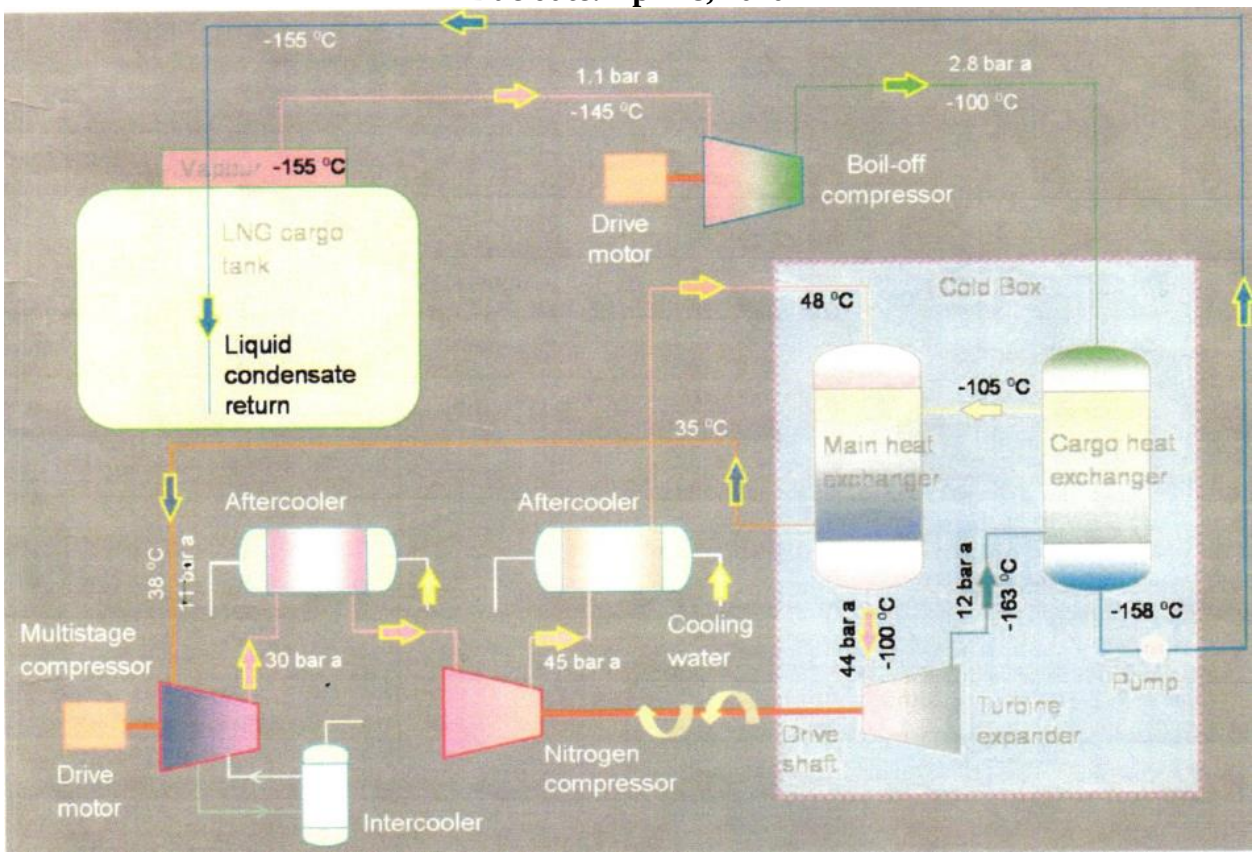

Figure: LNG re-liquefaction plant schema

In an LNG terminal at the port, mass flow rate of boil-off gas in the tank is 25000 Nm^3/h. Boil-off gas is re-liquefied by a re-liquefaction plant of which working fluid is nitrogen. LNG re-liquefaction plant is shown in the Figure. The nitrogen is recirculated by closed cycle and is cooled by seawater aftercoolers (see figure). The first nitrogen compressor in the nitrogen cycle is a multistage type with intercoolers. With reference to numeric values (pressures and temperatures at intermediate points) given in the figure,

- Determine number of stages in multistage compressor of nitrogen.
- Plot *T-s* and *P-h* diagrams of LNG cycle.
- Plot *T-s* and *P-h* diagrams of nitrogen (N_2) cycle.
- Calculate the mass flow rate of nitrogen.

- Set inlet and outlet temperatures of seawaters in two *aftercoolers*. Calculate mass flow rates of cooling seawater through *the aftercoolers*.
- Calculate powers of two compressors and one turbine in the nitrogen cycle.
- Calculate powers of the boil-off gas compressor and the pump in the LNG cycle.
- Calculate the net power consumption in the re-liquefaction plant.

Relevant remaining data

- All compressors, turbine, pump and aftercoolers are well-insulated.
- *Isentropic efficiencies* of compressors, turbine, and pump are 80%, 85% and 80%, respectively.
- Since LNG contains approximately 90% **methane**, use thermodynamic properties of methane for LNG.

Outline of the Project Report

- ✓ Abstract
- ✓ Introduction and Literature Survey
- ✓ Introducing the re-liquefaction plant
- ✓ Calculations
- ✓ Results with presentation with figures and tables when necessary
- ✓ Comments on the results and Discussion
- ✓ References
- ✓ Appendix