**Input:**

, Total Ship #

, Timestamp arrival of

, Ship volume of

, Total onboarding pipe # = Jetty #

, Total offboarding pipe # = Tank #

, Total transmission pipe # = pump #

, each pump capacity in unit time (15 mins)

, the maximum timestamp that allowed for pumping any ship

, big M for Boolean value comparison

**Decision Variables:**

three-dimensional binary matrix of dimension , each variable in the matrix represents if a ship is pumping from jetty at time ;

three-dimensional binary matrix of dimension , each variable in the matrix represents if a ship is pumping from pump at time ;

three-dimensional binary matrix of dimension , each variable in the matrix represents if a ship is pumping to tank at time ;

, one dimensional matrix of dimension , indicates the timestamp to start pumping for each ship;

, one dimensional matrix of dimension , indicates the timestamp to stop pumping for each ship;

two-dimensional binary matrix of dimension , each variable in the matrix represents if a ship is pumping at time ;

two-dimensional binary matrix of dimension , each variable in the matrix represents if a ship is pumping at time ;

two-dimensional binary matrix of dimension , each variable in the matrix represents whether ship docks at jetty ;

two-dimensional binary matrix of dimension , each variable in the matrix represents whether ship exports to tank ;

**Objective Functions:**

**Constraints:**

1. Start to pump after arrival
2. Jetty, pump and tank are activated if and only if within pumping time
3. Total pump capacity through time is equal to the total volume of each ship
4. Pumping time should equal to the summation of time variable; Jetty docking time will be pumping time with additional logistic time 2
5. Pumping/docking time should be within start to stop
6. Each jetty, pump and tank can be only used by maximum one ship at any timestamp
7. During product transfer time, the ship i must dock at a jetty. The jetty must be the same throughout product transfer time. Same logic for tank.
8. The logic between and , and

Additional Constraints:

1. Logistic time, 1 before and 1 after
2. Maintenance with random off-time of valve or pump in the excel format –

|  |  |  |
| --- | --- | --- |
| Valve ID | Maintenance StartTime | Maintenance StopTime |
| (4,3, ) | 13 | 21 |
| ( ,7,2) | 45 | 65 |

|  |  |  |
| --- | --- | --- |
| Pump ID | Maintenance StartTime | Maintenance StopTime |
| 7 | 12 | 14 |
| 18 | 23 | 30 |

1. Each jetty/tank pipe will have capacity limit of
2. The ship will be bi-directional, and the tank will have a capacity limit of with dimension
3. Goods category differentiation, which means tank differentiation as well as pump flushing