# Role of PSUs in making Chemical Industry Atma Nirbhar

Novenmber 27, 2020

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Indian Chemical News

# Encouraging Modularization and Smart Design Solutions

**Novenmber 27, 2020**

**By**
**Rakesh Verma**
**CEO & ED, Simon India Limited**

# ABOUT US ..

- We are an Engineering Oriented EPC Company
- A Part of …… adventz
- Inception of JV between 'Simon Carves' and the 'Zuari Group' in the year 1995
- Now a 100% subsidiary company of 'Adventz' Group (since 2004)

# ADVENTZ GROUP

- US$ 3.0 billion Group led by Mr. Saroj Kumar Poddar
- Comprises of 26 companies in various business verticals
- Significant presence in :
  - **Agriculture**
  - **Engineering**
  - **Infrastructure**
  - **Real Estate**
  - **Consumer Durables**
  - **Financial & Insurance Services**
- Largest Fertilizer Company in the private sector.

**Mr. S. K. Poddar**
**Group Chairman**

# GROUP HOLDINGS

## AGRI-BUSINESS

- Zuari Agro Chemicals
- Paradeep Phosphates
- Zuari Spl. Fertilizers
- Zuari Agri Sciences
- Zuari Fertilisers & Chemicals
- Zuari Maroc Phosphates
- Gobind Sugar Mills
- Mangalore Chemicals & Fertilizers

## ENGG & INFRASTRUCTURE

- **Simon India Ltd**
- Texmaco Rail & Engg
- Texmaco Infra & Holdings
- Texmaco Hi-Tech Pvt Ltd
- Wabtech Texmaco Pvt Ltd
- Touax Texmaco Railcar Leasing
- Zuari Indian Oiltanking
- Kalindee Rail Nirman

## EMERGING LIFESTYLE

- Zuari Infraworld India
- Indian Furniture Products
- Hettich India


## SERVICES

- Zuari Global
- Zuari Investments
- Zuari Management Services
- Adventz Finance
- Adventz Securities Enterprises
- Adventz Industries India
- Lionel India
- Globex Limited

# BUSINESS SECTORS






PSUs are playing a very significant role in building Atmanirbhar Bharat through

- Growth in strategic sectors and creating value hubs
- Huge and increasing Capital expenditure
- Strategic  Global collaborations
- Investments and Focus on developing MSMEs

# PSUs' contribution … toward Atmanirbhar Bharat Contd……..

- Encouraging Technology & R&D, Innovation in designing and Project Life Cycle
- Enhanced CSR focus
- Improved profitability and efficiency through integration of operations with Global standard Safety, Energy efficiency, Human factor engineering, Green energy and working environment

# Potential ….. The specific suggestions

- Funding Technology and R&D activities
- Relaxing projects Techno-commercial qualification norms thus allowing middle sized EPC companies and MSMEs
- Funding projects resulting into faster execution and wider participation
- Incentivize use of innovation & Technology
- Incentivize Safety, Energy efficiency, Human factor engineering, Green energy and working environment

# Potential ….. The specific suggestions Contd…

- Identifying strategic potential areas supporting self reliance while curbing imports
- A few examples in Fertilizer sector are production of Di-Calcium Phosphate (Animal Feed grade) and Sulphuric Acid

# Modular Construction

# Advantages of Modular construction

- Faster fabrication / erection reduces overall construction time period
- Quality work due to better working conditions at Fabrication yard
- Lower labour cost
- No weather downtime
- Much lesser material wastage

# Gas Dehydration & Manifold Modules

# Production Manifold

# Central Pipe Racks

# Boiler Module

# Booster Gas Compressor Module

# Reciprocating Gas Compression Modules

# HP & MP Gas Compression Modules

# HP Gas Compression Module

# Oil Separation Module

# Chemical Injection Module

# Oil Stabilization Module

# Power Generation Modules

# Water Injection Module

# Smart Design Solutions

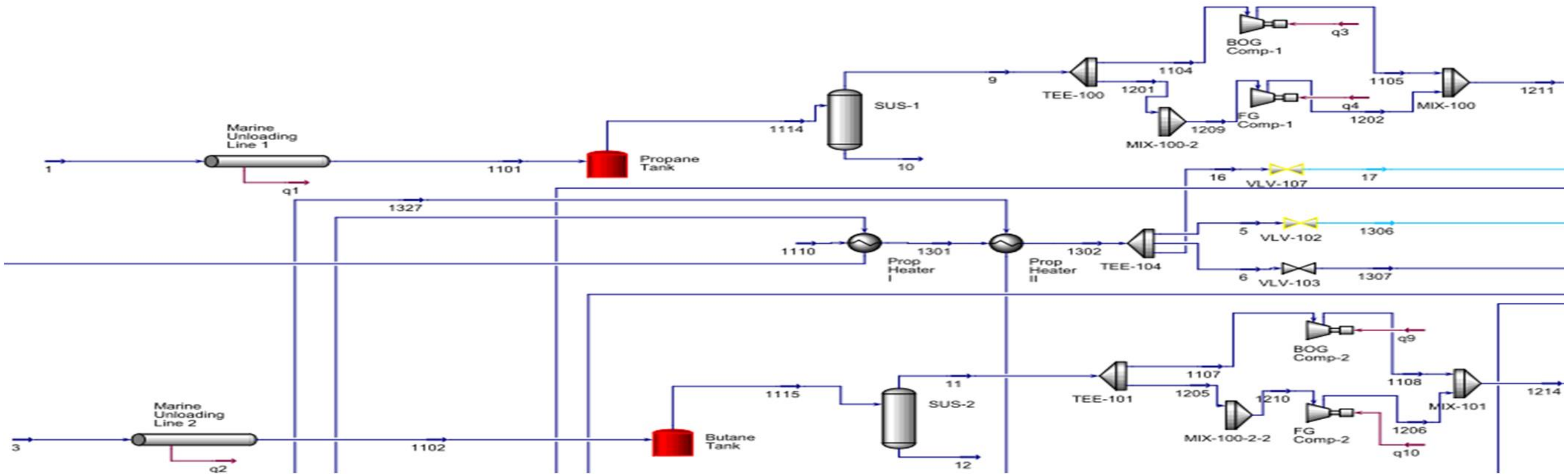
## Integration of Digital tools (Hysis) with Process Design for optimized solutions

# PFD and HEAT & MATERIAL BALANCE REPORT

- PFD and Heat & Material Balance is the first activity carried out during detail engineering.
- HYSYS is used for carrying out the process modelling and simulation.
- Deliverables generated thereof are PFD and Heat & Material Balance Report
- Setting up the model and configuring the process model is time taking activity.
- Replicating the results manually can lead to errors on one hand and adds to man hours on the other hand.
- Flow scheme with proper stream numbers can be configured on HYSYS.
- PFD for attaching in Simulation Report can be extracted from HYSYS.
- Man hours for Heat and Material Balance report can be optimized by configuring the report format in HYSYS.
- Heat and Material Balance Report can be  extracted directly from HYSYS.
- With minor changes/ modifications the error free report is available.

# PFD






Flowsheet Case (Main) - Solver Active | Depressuring - Dynamics-1 | Model Summary Grid

Copy | Open Input

Template: <Default> | Save | Save as new | Reset | Paste | Send to Excel/ASW

To export H&MB as EXCEL

Case - Material Stream | Feed Stream | Product Stream | Cooler | Heat Exchanger | Tank | Pump | Compressor | Valve | Pipe Segment | BLOWDOWN Analysis | TPL1 - Material Stream | Separator | TPL2 - Material Stream | BLOWDOWN Vessel | BLOWDOWN Pipe | BL(

| Name | 1 | 1101 | 3 | 1102 | 1114 | 1110 | 1115 | 1111 | 9 | 10 | 11 | 12 | 1104 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pressure [kg/cm2_g] | 8 | 6.61738 | 8 | 6.605 | 0.07 | 23.6 | 0.07 | 23.6 | 0.07 | 0.07 | 0.07 | 0.07 | |
| Temperature [C] | -42.67 | -42.6843 | -2.9 | -2.91831 | -43.02 | -44.27 | -2.94 | -4.17 | -43.02 | -43.02 | -2.94 | -2.94 | |
| Mass Flow [kg/h] | 500000 | 500000 | 500000 | 500000 | 9244 | 230400 | 10274 | 153600 | 9244 | 0 | 10274 | 0 | |
| Std Ideal Liq Vol Flow [m3/h] | 995.199 | 995.199 | 870.688 | 870.688 | 19.1057 | 458.588 | 17.9877 | 267.477 | 19.1057 | 0 | 17.9877 | 0 | |
| Vapor / Phase Fraction | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | |
| Molar Enthalpy [kJ/kgmole] | -126620 | -126626 | -154210 | -154219 | -105527 | -126713 | -132815 | -154299 | -105527 | -126729 | -132815 | -154248 | |
| Utility Type | | | | | | | | | | | | | |
| Stream Price | | | | | | | | | | | | | |
| Stream Price Basis | Molar Flow | Molar Flow | Molar Flow | Molar Flow | Molar Flow | Molar Flow | Molar Flow | Molar Flow | Molar Flow | Molar Flow | Molar Flow | Molar Flow | Molar Flow |
| Cost Rate [Cost/s] | | | | | | | | | | | | | |

# Heat & Material Balance Simulation Report



| Stream | Unit | 1101 | 1102 | 1104 | 1105 | 1107 | 1108 | 1110 | 1111 | 1112 | 1113 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| From | | Jetty | Jetty | Suction Separator-I | Boil-Off Compressor-I | Suction Separator-II | Boil-Off Compressor-II | Storage Tank-I | Storage Tank-II | Condensate Pump-I | Condensate Pump-II |
| To | | Storage Tank-I | Storage Tank-II | Boil-Off Compressor-I | Condenser-I | Boil-Off Compressor-II | Condenser-II | Propane Heater-I | Butane/ Propylene Heater-I | Boiler | Boiler |
| Vapour Fraction | | 0.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Temperature | C | -42.68 | -2.92 | -43.02 | 95.00 | -2.94 | 53.68 | -44.27 | -4.17 | 44.74 | 44.50 |
| Pressure | kg/cm2_g | 8.00 | 8.00 | 0.07 | 20.00 | 0.07 | 4.50 | 23.60 | 23.60 | 24.20 | 9.70 |
| Molar Flow | kgmole/h | 11444.44 | 8604.44 | 56.87 | 56.87 | 46.38 | 46.38 | 5273.59 | 2643.33 | 45.05 | 32.63 |
| Mass Flow | kg/h | 500000.00 | 500000.00 | 2384.00 | 2384.00 | 2684.00 | 2684.00 | 230400.00 | 153600.00 | 1888.33 (Note-14) | 1888.33 (Note-14) |
| Mass Enthalpy | kcal/kg | -692.719 | -634.306 | -600.657 | -552.304 | -545.492 | -524.482 | -693.195 | -634.643 | -647.625 | -610.487 |
| **Vapour Phase** | | | | | | | | | | | |
| Mass Flow | kg/h | --- | --- | 2384.00 | 2384.00 | 2684.00 | 2684.00 | --- | --- | --- | --- |
| Actual Volume Flow | m3/h | --- | --- | 972.68 | 68.68 | 926.90 | 204.33 | --- | --- | --- | --- |
| Molecular Weight | <none> | --- | --- | 41.92 | 41.92 | 57.87 | 57.87 | --- | --- | --- | --- |
| Mass Density | kg/m3 | --- | --- | 2.451 | 34.711 | 2.896 | 13.136 | --- | --- | --- | --- |
| Mass Heat Capacity | kcal/kg-C | --- | --- | 0.3436 | 0.5390 | 0.3746 | 0.4550 | --- | --- | --- | --- |
| Viscosity | cP | --- | --- | 0.0064 | 0.0114 | 0.0066 | 0.0084 | --- | --- | --- | --- |
| Thermal Conductivity | Kcal/m-hr-C | --- | --- | 0.0103 | 0.0242 | 0.0112 | 0.0163 | --- | --- | --- | --- |
| Z Factor | <none> | --- | --- | 0.9671 | 0.8139 | 0.9624 | 0.8797 | --- | --- | --- | --- |
| Cp/Cv (Gamma) | <none> | --- | --- | 1.1808 | 1.2362 | 1.1157 | 1.1333 | --- | --- | --- | --- |
| **Liquid Phase** | | | | | | | | | | | |
| Mass Flow | kg/h | 500000.00 | 500000.00 | --- | --- | --- | --- | 230400.00 | 153600.00 | 1888.33 | 1888.33 |
| Liquid Volume Flow | m3/h | 860.92 | 837.62 | --- | --- | --- | --- | 394.21 | 255.77 | 4.28 | 3.52 |
| Mass Density | kg/m3 | 580.776 | 596.932 | --- | --- | --- | --- | 584.47 | 600.54 | 441.106 | 537.202 |
| Mass Heat Capacity | kcal/kg-C | 0.5217 | 0.5271 | --- | --- | --- | --- | 0.5161 | 0.5221 | 0.8130 | 0.6174 |
| Viscosity | cP | 0.1958 | 0.2159 | --- | --- | --- | --- | 0.1998 | 0.2192 | 0.0737 | 0.1376 |
| Thermal Conductivity | Kcal/m-hr-C | 0.1150 | 0.0857 | --- | --- | --- | --- | 0.1158 | 0.0861 | 0.0686 | 0.0712 |
| Surface Tension | dyne/cm | 15.35 | 14.36 | --- | --- | --- | --- | 15.5669 | 14.5060 | 3.9347 | 8.6971 |
| Composition | | | | | | | | | | | |
| Propane | Mole fraction | 0.97 | 0.01 | 0.84 | 0.84 | 0.02 | 0.02 | 0.97 | 0.01 | 0.84 | 0.02 |
| Ethane | Mole fraction | 0.03 | 0.00 | 0.16 | 0.16 | 0.00 | 0.00 | 0.03 | 0.00 | 0.16 | 0.00 |
| n-Butane | Mole fraction | 0.00 | 0.58 | 0.00 | 0.00 | 0.48 | 0.48 | 0.00 | 0.58 | 0.00 | 0.48 |
| i-Butane | Mole fraction | 0.00 | 0.41 | 0.00 | 0.00 | 0.50 | 0.50 | 0.00 | 0.41 | 0.00 | 0.50 |
| n-Pentane | Mole fraction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Propene | Mole fraction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| E-Mercaptan | Mole fraction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| H2O | Mole fraction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

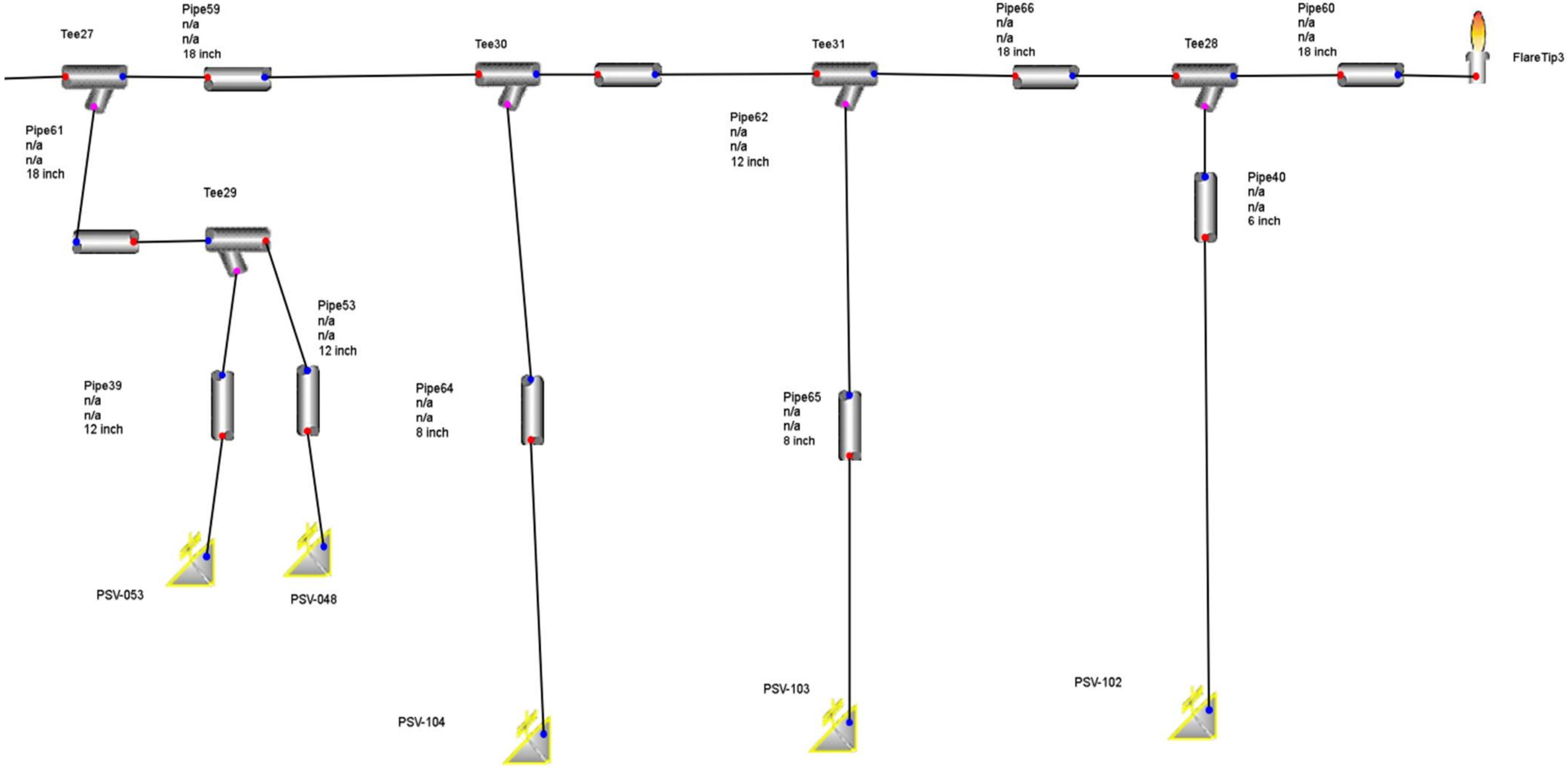
| Stream | Unit | 1204 | 1205 | 1206 | 1207 | 1208 | 1209 | 1210 | 1211 | 1212 | 1213 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| From | | Bullet-I Pump | Suction Separator-II | Flash Compressor-II | Condensate Pump-II | Bullet-II Pump | Stream No: 1201/1205 | Stream No: 1201/1205 | BOG-I & FG Compressor-I/II | Condenser-I | Condensate Pump-I |
| To | | Propane Header | Flash Compressor-I/II | Condenser-I/II | Bullet-II | Propylene / Butane Header | Flash Compressor-I | Flash Compressor-II | Condenser-I | Condensate Receiver-I | Bullet-I / Boiler |
| Vapour Fraction | | 0.00 | 1.00 | 1.00 | 0.00 | 0.00 | 1.00 | 1.00 | 1.00 | 0.00 | 0.00 |
| Temperature | C | 44.82 | -2.94 | 53.68 | 44.51 | 46.25 | -43.02 | -2.94 | 95.00 | 44.00 | 44.74 |
| Pressure | kg/cm2_g | 23.30 | 0.07 | 4.50 | 4.90 | 24.00 | 0.07 | 0.07 | 20.00 | 19.80 | 24.20 |
| Molar Flow | kgmole/h | 220.50 | 131.16 | 131.16 | 177.54 | 177.54 | 163.64 | 131.16 | 220.50 | 220.50 | 220.50 |
| Mass Flow | kg/h | 9244.00 | 7590.00 | 7590.00 | 10274.00 | 10274.00 | 6860.00 | 7590.00 | 9244.00 | 9244.00 | 9244.00 |
| Mass Enthalpy | kcal/kg | -646.532 | -547.694 | -527.466 | -610.487 | -609.262 | -599.956 | -547.694 | -554.4091546 | -647.937 | -647.625 |
| **Vapour Phase** | | | | | | | | | | | |
| Mass Flow | kg/h | --- | 7590.00 | 7590.00 | --- | --- | 6860.00 | 7590.00 | 9244.00 | --- | --- |
| Actual Volume Flow | m3/h | --- | 2621.15 | 577.81 | --- | --- | 2798.90 | 2621.15 | 266.31 | --- | --- |
| Molecular Weight | <none> | --- | 57.87 | 57.87 | --- | --- | 41.92 | 57.87 | 41.92 | --- | --- |
| Mass Density | kg/m3 | --- | 2.896 | 13.136 | --- | --- | 2.451 | 2.896 | 34.711 | --- | --- |
| Mass Heat Capacity | kcal/kg-C | --- | 0.3746 | 0.4550 | --- | --- | 0.3436 | 0.3746 | 0.5390 | --- | --- |
| Viscosity | cP | --- | 0.0066 | 0.0084 | --- | --- | 0.0064 | 0.0066 | 0.0114 | --- | --- |
| Thermal Conductivity | Kcal/m-hr-C | --- | 0.0112 | 0.0163 | --- | --- | 0.0103 | 0.0112 | 0.0242 | --- | --- |
| Z Factor | <none> | --- | 0.9624 | 0.8797 | --- | --- | 0.9671 | 0.9624 | 0.8139 | --- | --- |
| Cp/Cv (Gamma) | <none> | --- | 1.1157 | 1.1333 | --- | --- | 1.1808 | 1.1157 | 1.2362 | --- | --- |
| **Liquid Phase** | | | | | | | | | | | |
| Mass Flow | kg/h | 10274.00 | --- | --- | 10274.00 | 10274.00 | --- | --- | --- | 9244.00 | 9244.00 |
| Liquid Volume Flow | m3/h | 23.48 | --- | --- | 19.17 | 19.09 | --- | --- | --- | 20.95 | 20.96 |
| Mass Density | kg/m3 | 437.578 | --- | --- | 535.982 | 538.169 | --- | --- | --- | 441.34 | 441.11 |
| Mass Heat Capacity | kcal/kg-C | 0.8284 | --- | --- | 0.6203 | 0.6137 | --- | --- | --- | 0.8249 | 0.8130 |
| Viscosity | cP | 0.0727 | --- | --- | 0.1374 | 0.1359 | --- | --- | --- | 0.0741 | 0.0737 |
| Thermal Conductivity | Kcal/m-hr-C | 0.0681 | --- | --- | 0.0712 | 0.0706 | --- | --- | --- | 0.0689 | 0.0686 |
| Surface Tension | dyne/cm | 3.8187 | --- | --- | 8.6960 | 8.4887 | --- | --- | --- | 4.0034 | 3.9347 |
| Composition | | | | | | | | | | | |
| Propane | Mole fraction | 0.84 | 0.02 | 0.02 | 0.02 | 0.02 | 0.84 | 0.02 | 0.84 | 0.84 | 0.84 |
| Ethane | Mole fraction | 0.16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.00 | 0.16 | 0.16 | 0.16 |
| n-Butane | Mole fraction | 0.00 | 0.48 | 0.48 | 0.48 | 0.48 | 0.00 | 0.48 | 0.00 | 0.00 | 0.00 |
| i-Butane | Mole fraction | 0.00 | 0.50 | 0.50 | 0.50 | 0.50 | 0.00 | 0.50 | 0.00 | 0.00 | 0.00 |
| n-Pentane | Mole fraction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Propene | Mole fraction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| E-Mercaptan | Mole fraction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| H2O | Mole fraction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# Flare Network Study Report



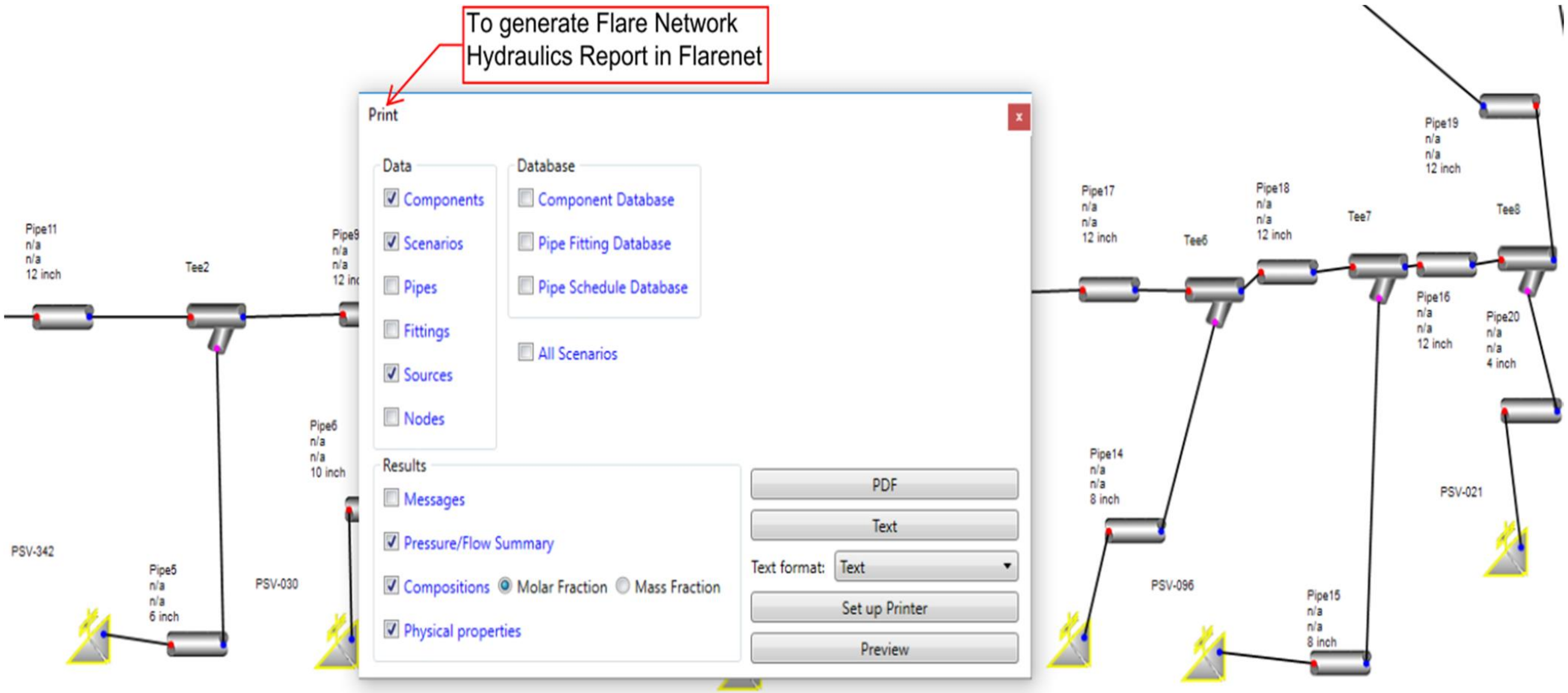
- Flare Network hydraulics is a major detail engineering activity as FEED package always leaves it to be closed during detail engineering.
- Relief scenarios for the entire unit/plant are to be generated, relief loads for each scenario are to be calculated.
- Relief Valve datasheets are to be generated.
- Based on the relief load estimation flare network including the flare header and PSV tail pipes are to be sized.
- Layout of flare network is modeled in ASPEN Flare Analyzer.
- Various scenarios with constraints are built into the model.
- All the scenarios are run in the ASPEN Flare Analyzer and the optimum flare header / tail pipe sizes are arrived at.
- Flare header calculation report can be generated from ASPEN Flare Analyzer.
- Refer following slides for details.

# Flare Network PFD



# Flare Network Report Generation





## Aspen Flare System Analyzer V10 - aspenONE

Version 36.0.0.249

User Name : Simon India Ltd.
Job Code : I-30027
Project : Mundra LPG Terminal
Description : Fire-Jetty Drain Pot
Scenario : FIRE-JETTY DRAIN POT

### Source Data

| Name | Location | Outlet Pipe | Type | Ignored | Inlet Pressure (bar) | Inlet Temp. Spec. (C) | Allowable Backpressure (bar) |
|---|---|---|---|---|---|---|---|
| PSV-061 | EA-08 Shell | Pipe22 | Relief Valve | Yes | 42.75723 | 94.70 | 4.44558 |
| PSV-029 | EA-05 Shell | Pipe25 | Relief Valve | Yes | 33.26441 | 80.20 | 3.66105 |
| PSV-026 | FA-03 | Pipe45 | Relief Valve | Yes | 5.16637 | 43.67 | 1.35648 |
| PSV-027 | EA-06 shell | Pipe14 | Relief Valve | Yes | 33.26441 | 80.16 | 3.66105 |
| PSV-060 | FA 04 | Pipe37 | Relief Valve | Yes | 5.16637 | 43.67 | 5.00000 |
| PSV-070 | EA-07a tube | Pipe13 | Relief Valve | Yes | 42.75723 | 94.70 | 4.44558 |
| PSV-020 | EA-08A shell | Pipe27 | Relief Valve | Yes | 33.26441 | 80.20 | 3.66105 |
| PSV-095 | EA-08A tube | Pipe26 | Relief Valve | Yes | 42.75723 | 87.12 | 4.44558 |
| PSV-021 | EA-08A shell | Pipe20 | Relief Valve | Yes | 33.26441 | 80.20 | 3.66105 |
| PSV-096 | EA-10A Tube side | Pipe15 | Relief Valve | Yes | 42.75723 | 87.12 | 4.44558 |
| PSV-030 | EA-04 SHELL | Pipe6 | Relief Valve | Yes | 25.82408 | 71.40 | 3.26878 |
| PSV-062 | FA-06 | Pipe33 | Relief Valve | Yes | 28.30516 | 125.40 | 3.26878 |
| PSV-035 | EA-03 SHELL | Pipe7 | Relief Valve | Yes | 25.82408 | 71.40 | 3.26878 |
| PSV-032 | FA-06 | Pipe67 | Relief Valve | Yes | 28.30516 | 125.40 | 3.26878 |
| PSV-102 | JETTY DRAIN POT | Pipe40 | Relief Valve | No | 42.54444 | 85.12 | 4.44558 |
| PSV 501 | FG Comp. GB-03A | Pipe35 | Relief Valve | Yes | 25.82408 | 71.40 | 3.26878 |
| PSV-341 | EA-11 SHELL SIDE | Pipe21 | Relief Valve | Yes | 42.75723 | 85.12 | 4.44558 |
| PSV-342 | FA-09 | Pipe5 | Relief Valve | Yes | 42.75723 | 85.20 | 4.44558 |
| PSV 601 | FG Comp. GB-04A | Pipe44 | Relief Valve | Yes | 25.92541 | 71.40 | 3.26878 |
| PSV 701 | BOG Comp. GB-01A | Pipe31 | Relief Valve | Yes | 25.82408 | 69.10 | 3.26878 |
| PSV 801 | BOG Comp. GB-02A | Pipe42 | Relief Valve | Yes | 25.82408 | 69.10 | 3.26878 |
| PSV-344 | FA-09 TO BOILER | Pipe30 | Relief Valve | Yes | 9.74443 | 55.50 | 1.79778 |
| PSV-053 | MOUNDED BULLET | Pipe39 | Relief Valve | Yes | 30.89112 | 130.30 | 3.46491 |
| PSV-048 | MOUNDED BULLET | Pipe53 | Relief Valve | Yes | 30.67834 | 130.30 | 3.46491 |
| PSV-104 | BUTANE DRAIN POT | Pipe64 | Relief Valve | Yes | 3.94034 | -3.79 | 1.25516 |
| PSV-103 | PROPANE DAIN POT | Pipe65 | Relief Valve | Yes | 3.94034 | -0.24 | 1.25516 |

## Aspen Flare System Analyzer V10 - aspenONE

Version 36.0.0.249

User Name : Simon India Ltd.
Job Code : I-30027
Project : Mundra LPG Terminal
Description : Fire-Jetty Drain Pot
Scenario : FIRE-JETTY DRAIN POT

### Source Data

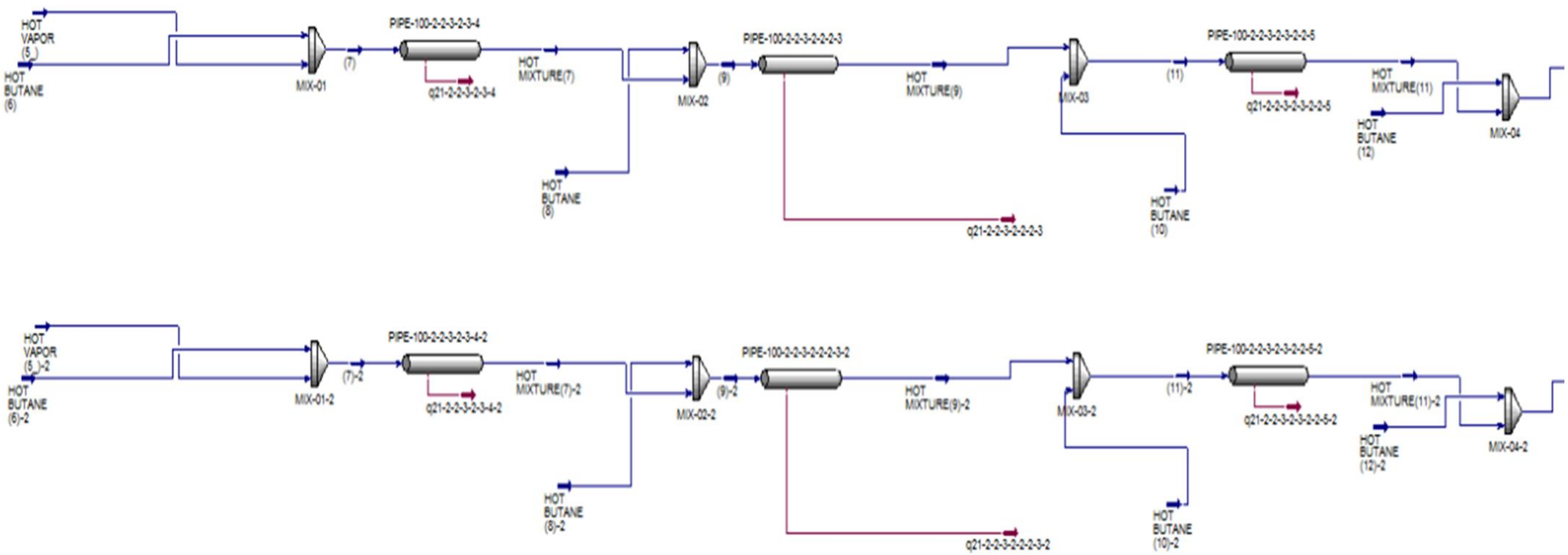
| Name | Outlet Temperature (C) | Mass Flow (kg/hr) | Rated Mass Flow (kg/hr) | Volumetric Flo (m3/hr) | Outlet Flange Diameter (mm) | Valves | Relief Valve Type | Orifice Area (mm2) | Orifice |
|---|---|---|---|---|---|---|---|---|---|
| PSV-061 | -2.89 | 36305.0 | 42926.6 | | | 1 | Conventional | 2322.581 | api_M |
| PSV-029 | 69.89 | 10369.0 | 10494.3 | | | 1 | Conventional | 830.323 | api_J |
| PSV-026 | 38.11 | 3390.0 | 3548.7 | | | 1 | Conventional | 1185.806 | api_K |
| PSV-027 | 69.85 | 10507.0 | 14991.3 | | | 1 | Conventional | 1185.806 | api_K |
| PSV-060 | 25.00 | 3390.0 | 3548.7 | | | 1 | Conventional | 1185.806 | api_K |
| PSV-070 | -2.89 | 14685.0 | 15346.3 | 5.677e+001 | | 1 | Conventional | 830.323 | api_J |
| PSV-020 | -9.13 | 6400.0 | 6401.0 | | | 1 | Conventional | 506.452 | api_H |
| PSV-095 | 35.21 | 10266.0 | 14152.5 | | | 1 | Conventional | 830.323 | api_J |
| PSV-021 | 69.89 | 7565.0 | 10494.3 | | | 1 | Conventional | 830.323 | api_J |
| PSV-096 | 35.21 | 3443.0 | 5531.2 | 1.037e+001 | | 1 | Conventional | 324.516 | api_G |
| PSV-030 | 27.83 | 19650.0 | 77599.6 | | | 1 | Conventional | 830.323 | api_J |
| PSV-062 | 28.68 | 14731.0 | 13865.3 | 5.743e+001 | | 1 | Conventional | 830.323 | api_J |
| PSV-035 | 27.83 | 19650.0 | 77599.6 | | | 1 | Conventional | 830.323 | api_J |
| PSV-032 | 28.68 | 14731.0 | 21522.2 | 5.743e+001 | | 1 | Conventional | 830.323 | api_J |
| PSV-102 | -7.09 | 15817.0 | 19448.9 | 5.470e+001 | | 1 | Conventional | 830.323 | api_J |
| PSV 501 | 27.83 | 8349.0 | 11817.8 | | | 1 | Conventional | 126.452 | api_E |
| PSV-341 | -7.12 | 7258.0 | 9112.9 | | | 1 | Conventional | 506.452 | api_H |
| PSV-342 | 38.79 | 1705.0 | 8932.8 | | | 1 | Conventional | 70.968 | api_D |
| PSV 601 | 27.83 | 8349.0 | 11856.4 | | | 1 | Conventional | 126.452 | api_E |
| PSV 701 | 27.80 | 2952.0 | 6759.1 | | | 1 | Conventional | 70.968 | api_D |
| PSV 801 | 27.80 | 2952.0 | 6759.1 | | | 1 | Conventional | 70.968 | api_D |
| PSV-344 | 43.66 | 4658.1 | 5017.4 | | | 1 | Conventional | 506.452 | api_H |
| PSV-053 | 30.77 | 37994.0 | 37994.0 | 7.885e+002 | | 1 | Conventional | 1840.645 | api_L |
| PSV-048 | 30.77 | 61662.0 | 61662.0 | 2.743e+002 | | 1 | Conventional | 7129.032 | api_Q |
| PSV-104 | -9.41 | 7972.0 | 9321.3 | | | 1 | Conventional | 2322.581 | api_M |
| PSV-103 | -5.46 | 8146.0 | 9383.0 | | | 1 | Conventional | 2322.581 | api_M |

# Jetty Unloading Line Evacuation Report



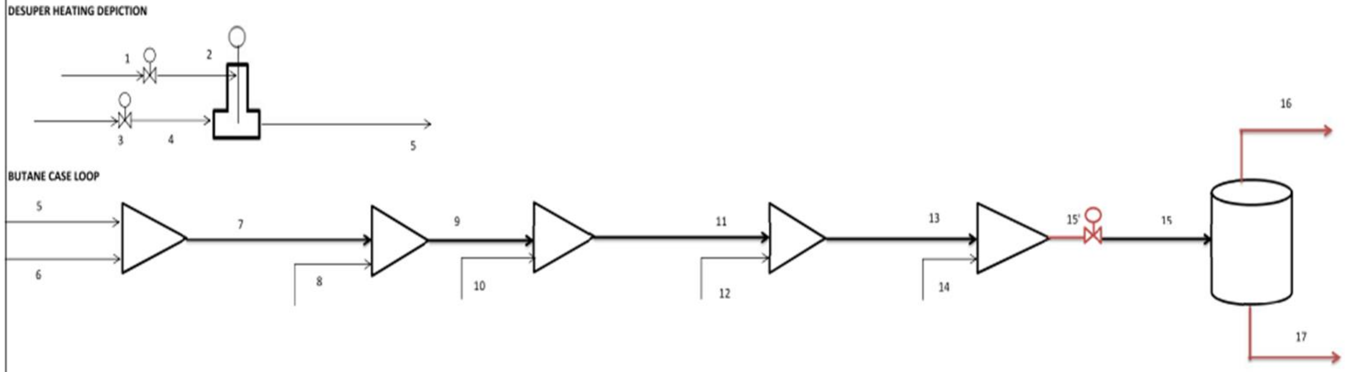
- For one of the projects, the evacuation of product ship unloading lines is envisaged after completion of each unloading. Evacuation of unloading line using hot vapor is to be carried out.
- It was required to estimate the flow of hot vapors required for carrying out the Jetty line evacuation.
- A steady state simulation was run to estimate the flow of hot vapors to the line and the time required for evacuating the line considering the tank does not get pressurized during this operation.
- The entire unloading line was divided into small sections of 200 m length to simulate a condition of vapor pushing liquid hold up to the tank.
- Vapor was introduced in the first section and liquid (equal to the hold up in each 200 m section) was introduced at an equal rate in each section to replicate the plug flow like scenario.
- The model was run as 13 similar small models to simulate/estimate the hourly evacuation rate and flash gas generation. The model is depicted in slides below.

# Jetty Unloading Line Evacuation Flow Scheme



## BUTANE AND PROPANE JETTY EVACUATION SCHEME (Annexure-1)

**BUTANE JETTY LINE EVACUATION SCHEME AND SUMMARY**




| STREAMS | | 1 | 2 | 3 | 4 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | |
| DESCRIPTION | | BUTANE LIQUID FROM RECEIVER THOUGH | BUTANE LIQUID @3 KG/CM2G | BUTANE VAPOR FROM COMPRESSOR | BUTANE LIQUID @3 KG/CM2G | BUTANE LIQUID IN THE UNLOADING LINE | BUTANE VAPOR LIQUID MIXTURE | BUTANE LIQUID IN THE UNLOADING LINE | BUTANE VAPOR LIQUID MIXTURE | BUTANE LIQUID IN THE UNLOADING LINE | BUTANE VAPOR LIQUID MIXTURE | BUTANE LIQUID IN THE UNLOADING LINE | BUTANE VAPOR LIQUID MIXTURE | BUTANE LIQUID IN THE UNLOADING LINE | BUTANE VAPOR LIQUID MIXTURE |

**BUTANE CASE: 2000 kg/hr Butane vap & 8000 kg/hr Butane liquid unloading**

| Summary table 1 st Hour | | 1 st Hour | | 2nd Hour | | 3rd Hour | | 4th Hour | | 5th Hour | | 6th Hour | | 7th Hour | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream No. | | U/S HV-004 | Tank | U/S HV-004 | Tank | U/S HV-004 | Tank | U/S HV-004 | Tank | U/S HV-004 | Tank | U/S HV-004 | Tank | U/S HV-004 | Tank |
| Temperature | °C | 27.2 | -4 | 30 | -4 | 30 | -4 | 30 | -4 | 30 | -4 | 30 | -4 | 30 | -4 |
| Pressure | kg/cm2(g) | 2.1 | 0.06 | 2.4 | 0.06 | 2.4 | 0.06 | 2.4 | 0.06 | 2.4 | 0.06 | 2.4 | 0.06 | 2.4 | 0.06 |
| Mass Flowrate | kg/hr | 10300 | 10300 | 10300 | 10300 | 10300 | 10300 | 10300 | 10300 | 10300 | 10300 | 10300 | 10300 | 10300 | 10300 |
| | | | | | | | | | | | | | | | |
| **Vapor Phase** | | | | | | | | | | | | | | | |
| Mass Flowrate | kg/hr | 1245 | 3136 | 2587 | 4539 | 2630 | 4580 | 2630 | 4580 | 2630 | 4580 | 2630 | 4580 | 2630 | 4580 |
| | | | | | | | | | | | | | | | |
| **Liquid Phase** | | | | | | | | | | | | | | | |
| Mass Flowrate | kg/hr | 9054 | 7164 | 7713 | 5760 | 7670 | 5719 | 7670 | 5720 | 7670 | 5720 | 7670 | 5720 | 7670 | 5720 |
| | | | | | | | | | | | | | | | |

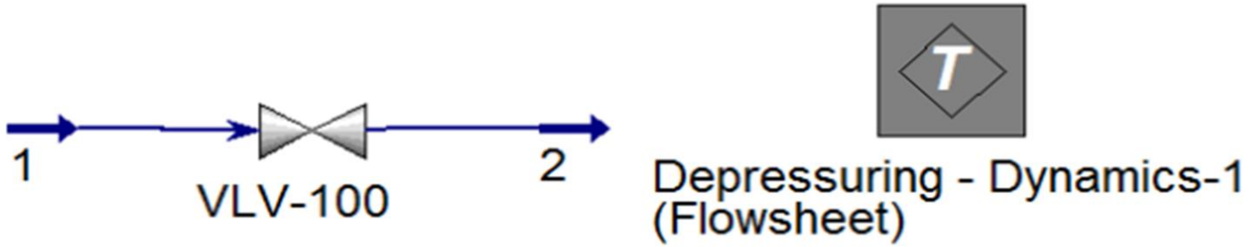
| Summary table 1 st Hour | | 8th Hour | | 9th Hour | | 10th Hour | | 11th Hour | | 12th Hour | | 13th Hour | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream No. | | U/S HV-004 | Tank | U/S HV-004 | Tank | U/S HV-004 | Tank | U/S HV-004 | Tank | U/S HV-004 | Tank | U/S HV-004 | Tank |
| Temperature | °C | 30 | -4 | 30 | -4 | 30 | -4 | 30 | -4 | 30 | -4 | 30 | -4 |
| Pressure | kg/cm2(g) | 2.4 | 0.06 | 2.4 | 0.06 | 2.4 | 0.06 | 2.4 | 0.06 | 2.4 | 0.06 | 2.4 | 0.06 |
| Mass Flowrate | kg/hr | 10300 | 10300 | 10300 | 10300 | 10300 | 10300 | 10300 | 10300 | 10300 | 10300 | 10300 | 10300 |
| | | | | | | | | | | | | | |
| **Vapor Phase** | | | | | | | | | | | | | |
| Mass Flowrate | kg/hr | 2630 | 4580 | 2630 | 4580 | 2630 | 4580 | 2630 | 4580 | 2630 | 4580 | 2630 | 4580 |
| | | | | | | | | | | | | | |
| **Liquid Phase** | | | | | | | | | | | | | |
| Mass Flowrate | kg/hr | 7670 | 5720 | 7670 | 5720 | 7670 | 5720 | 7670 | 5720 | 7670 | 5720 | 7670 | 5720 |
| | | | | | | | | | | | | | |

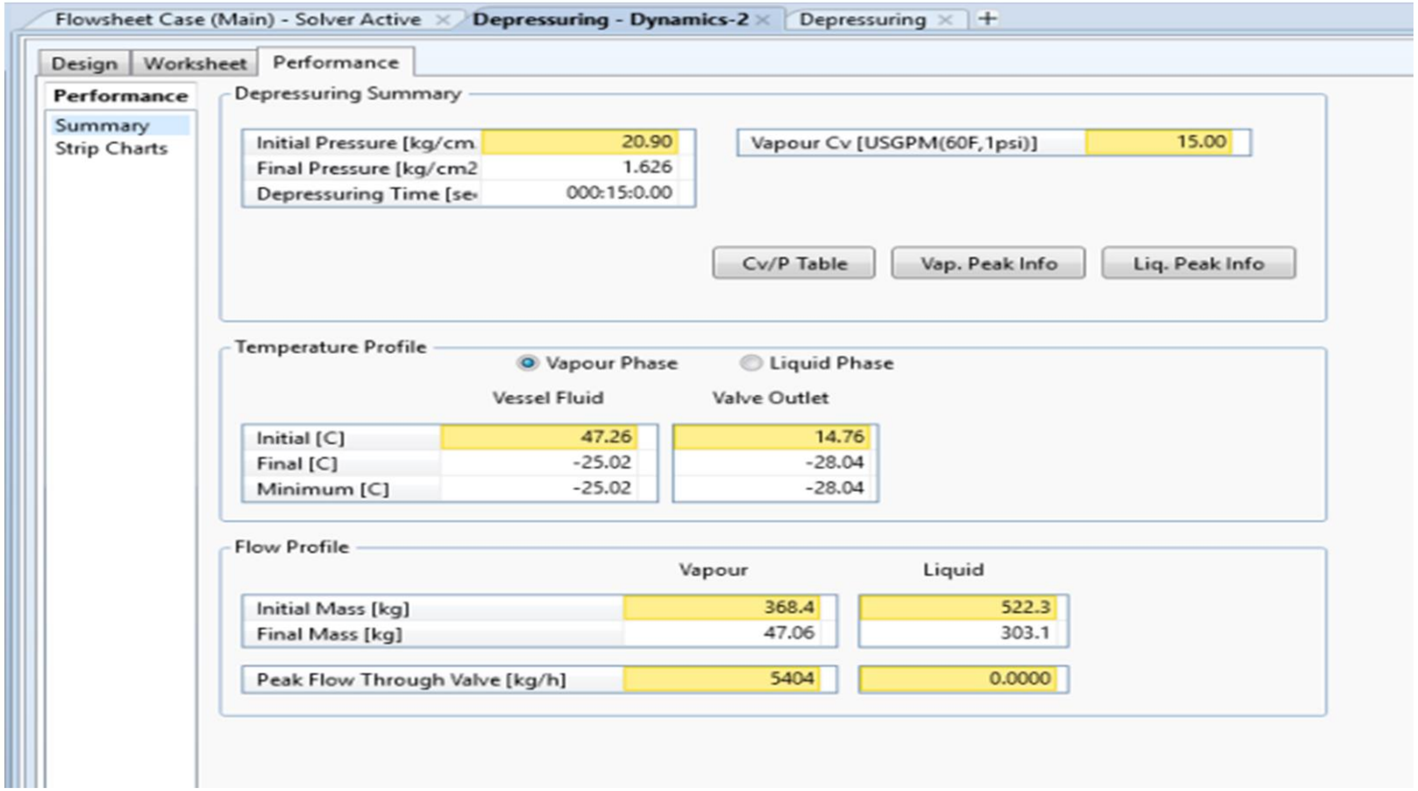
# Depressurization Study for Material Selection

- Depressurization study is carried out during detail engineering to arrive at the minimum design metal temperature.
- One such report is attached in the slides below.
- Depressurization study report can be directly extracted from HYSYS and submitted for client review.

# Depressuring Study for Material Selection





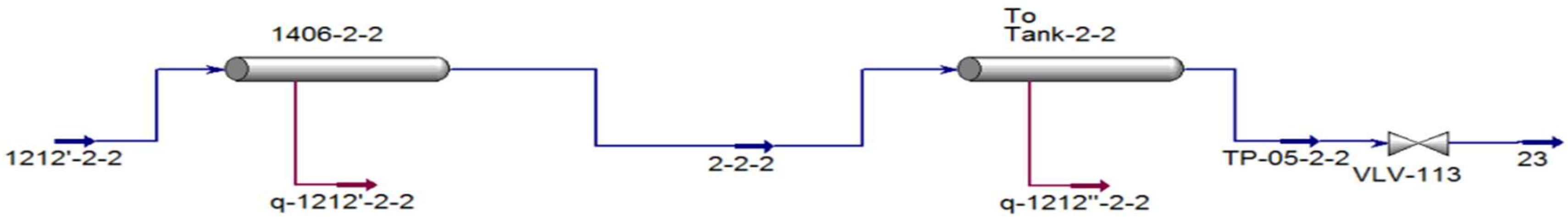



# 2-Phase Line Hydraulics Report

- Hydraulics is carried out to optimize the line sizes, pressure drop across the line and flow profile.
- Hydraulics for single phase line is carried out with in-house software.
- Two phase lines are modeled in HYSYS.
- The piping routing with length, fittings, valves and elevation differences are fed into the HYSYS.
- The results / report can be extracted from HYSYS.
- Slug flow results can also be obtained from HYSYS and provided to piping for stress analysis.
- One such report is attached in the slides below.

# 2-Phase Line Hydraulics

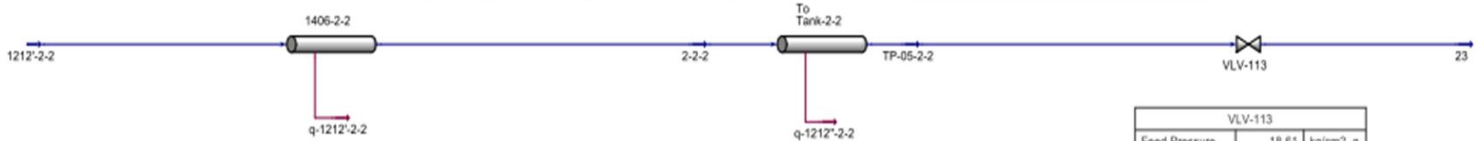





| 2-2-2 | | |
|---|---|---|
| Temperature | 44.03 | C |
| Pressure | 19.90 | kg/cm2_g |
| Molar Flow | 422.6 | kgmole/h |
| Total Mole Fractions | 1.0000000 | |
| Sx Mole Fraction | <empty> | |
| Vapour Fraction | 0.000000 | |
| Units | Mole Fraction | |
| Total Component Mole Flows | 4.225934e+02 | kgmole/h |
| Vap Frac on a Mole Basis | 0.000000 | |
| Vap Frac on a Volume Basis | 0.000000 | |
| Total Component Mass Flows | 1.771600e+04 | kg/h |

| TP-05-2-2 | | |
|---|---|---|
| Temperature | 41.73 | C |
| Pressure | 18.61 | kg/cm2_g |
| Molar Flow | 422.6 | kgmole/h |
| Total Mole Fractions | 1.0000000 | |
| Sx Mole Fraction | <empty> | |
| Vapour Fraction | 0.027058 | |
| Units | Mole Fraction | |
| Total Component Mole Flows | 4.225934e+02 | kgmole/h |
| Vap Frac on a Mole Basis | 0.027058 | |
| Vap Frac on a Volume Basis | 0.026944 | |
| Total Component Mass Flows | 1.771600e+04 | kg/h |

| 23 | | |
|---|---|---|
| Temperature | -46.20 | C |
| Pressure | 6.000e-002 | kg/cm2_g |
| Molar Flow | 422.6 | kgmole/h |
| Total Mole Fractions | 1.0000000 | |
| Sx Mole Fraction | <empty> | |
| Vapour Fraction | 0.572779 | |
| Units | Mole Fraction | |
| Total Component Mole Flows | 4.225934e+02 | kgmole/h |
| Vap Frac on a Mole Basis | 0.572779 | |
| Vap Frac on a Volume Basis | 0.571413 | |
| Total Component Mass Flows | 1.771600e+04 | kg/h |




| 1212'-2-2 | | |
|---|---|---|
| Temperature | 44.00 | C |
| Pressure | 19.68 | kg/cm2_g |
| Molar Flow | 422.6 | kgmole/h |
| Total Mole Fractions | 1.0000000 | |
| Sx Mole Fraction | | |
| Vapour Fraction | 0.000000 | |
| Units | Mole Fraction | |
| Total Component Mole Flows | 4.225934e+02 | kgmole/h |
| Vap Frac on a Mole Basis | 0.000000 | |
| Vap Frac on a Volume Basis | 0.000000 | |
| Total Component Mass Flows | 1.771600e+04 | kg/h |

| 1406-2-2 | | |
|---|---|---|
| Inside Diameter(1) | 154.1 | mm |
| Inside Diameter(2) | 206.4 | mm |
| Inside Diameter(3) | 206.4 | mm |
| Inside Diameter(4) | 206.4 | mm |
| Inside Diameter(5) | 206.4 | mm |
| Outside Diameter(1) | 168.3 | mm |
| Outside Diameter(2) | <empty> | mm |
| Outside Diameter(3) | <empty> | mm |
| Outside Diameter(4) | <empty> | mm |
| Outside Diameter(5) | <empty> | mm |
| Pipe Length(1) | 30.00 | m |
| Pipe Length(2) | 81.45 | m |
| Pipe Length(3) | 4.391 | m |
| Pipe Length(4) | 8.145 | m |

| To Tank-2-2 | | |
|---|---|---|
| Inside Diameter(1) | 206.4 | mm |
| Inside Diameter(2) | 206.8 | mm |
| Inside Diameter(3) | 206.8 | mm |
| Inside Diameter(4) | 206.8 | mm |
| Outside Diameter(1) | 219.1 | mm |
| Outside Diameter(2) | <empty> | mm |
| Outside Diameter(3) | <empty> | mm |
| Outside Diameter(4) | <empty> | mm |
| Pipe Length(1) | 250.0 | m |
| Pipe Length(2) | 77.42 | m |
| Pipe Length(3) | 16.59 | m |
| Pipe Length(4) | 33.18 | m |
| Elevation(1) | 31.00 | m |
| Elevation(2) | 0.0000 | m |

| VLV-113 | | |
|---|---|---|
| Feed Pressure | 18.61 | kg/cm2_g |
| Product Pressure | 6.000e-002 | kg/cm2_g |
| Molar Flow | 422.6 | kgmole/h |

# 2-Phase Line Slug Flow Analysis

Pipe Segment: To Tank-2-2

Design | Rating | Worksheet | Performance | Flow Assurance | Dynamics

**Flow Assurance**
- CO2 Corrosion
- Erosion
- Hydrates
- Slug Analysis
- Wax Deposition

Slug Tool Calculation Options

| | |
|---|---|
| Translational Model | **Bendikson** |
| Velocity Parameter C0 | <empty> |
| Velocity Parameter U0 | <empty> |
| Holdup Model | **Gregory et al** |
| Holdup Parameter | <empty> |
| Friction Factor Model | **Colebrook** |

Slug Tool Frequency Options

| | |
|---|---|
| Frequency Model | **Hill & Wood** |
| Frequency | <empty> |

☑ Do Slug Calculations

Slug Tool Results

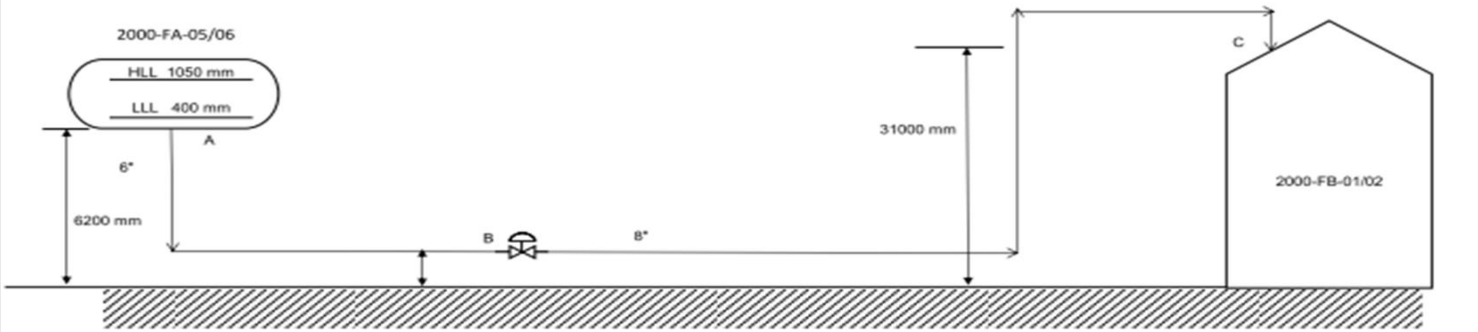
| Position [m] | Status | Frequency [1/seconds] | Frequency Bound | Slug Length [m] | Bubble Length [m] | Film Holdup | Velocity [m/s] | Pressure Grad. [kPa/m] | Len Ratio S/B | Liquid Density [kg/m3] | Liquid Viscosity [cP] | Vapour Density [kg/m3] | Vapour Viscosity [cP] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | Single Ph | | - | | | | | | | 441.3 | 7.403e-002 | | |
| 50.00 | Slug Flow | 1.122e-002 | - | 105.1 | 0.3539 | 0.6783 | 1.179 | 0.5333 | 296.8 | 441.6 | 7.416e-002 | 42.90 | 1.029e-002 |
| 100.0 | Slug Flow | 1.153e-002 | - | 100.9 | 3.235 | 0.3925 | 1.199 | 0.5258 | 31.18 | 442.8 | 7.460e-002 | 42.29 | 1.026e-002 |
| 150.0 | Slug Flow | 1.183e-002 | - | 97.79 | 5.623 | 0.3311 | 1.219 | 0.5181 | 17.38 | 444.0 | 7.504e-002 | 41.67 | 1.022e-002 |
| 200.0 | Slug Flow | 1.212e-002 | - | 94.90 | 7.839 | 0.2972 | 1.239 | 0.5104 | 12.10 | 445.2 | 7.548e-002 | 41.07 | 1.018e-002 |
| 250.0 | Slug Flow | 1.241e-002 | - | 92.11 | 9.937 | 0.2747 | 1.260 | 0.5027 | 9.264 | 446.4 | 7.593e-002 | 40.47 | 1.015e-002 |

# 2-Phase Line Hydraulics Report

| | |
|---|---|
| Project : Mundra LPG Terminal | Document No.: 2321-E-BOP-GEN-DP-R-E-010 |
| Document Title: Hydraulic Summary Report | Revision No.: C |

## Hydraulic Report for Condensate receiver to Storage Tank

| | | | | | |
|---|---|---|---|---|---|
| **Owner** | : | MLTPL | **Job No.** | : | **2321** |
| **Employer** | : | - | **Location** | : | **Mundra** |
| **Loop** | : | BOG/ Flash Gas Condensate receiver to Storage Tank | | | |




| Line No. | Line size | | ΔP/100m bar (For Max.Flow) | Velocity m/s (For Max. Flow) | Estimated Equivalent Length (meter) | Description | Maximum case | |
|---|---|---|---|---|---|---|---|---|
| | inches | SCH / THK (mm) | | | | | ΔP | Inlet Pressure |
| | | | | | | | kg/cm2 | kg/cm2(g) |
| **Propane Case** | | | | | | | | |
| | | | | | | BOG / FG Condensate Receiver (Source) Saturation Condition @ 44 deg C (EL - 6.5 m) | | 19.68 |
| 6-2000-PRL-8049-B1T2 | 6 | Sch 40 | -0.141 | 0.55 | 156 | **Line loss A-B (including static gain) Upstream of Control Valve One Phase Flow** | **-0.220** | 19.68 |
| 8-2000-PRL-1406-B1T2 | 8 | Sch 20 | 0.401 | 1.16 | 324 | **Line loss B- C (including static loss) Downstream of Control Valve Two Phase Flow** | **1.300** | 19.90 |
| | | | | | | **Pressure to be throttled at RO** | | 18.48 |
| | | | | | | **Pressure at Storage Tank** | | 0.12 |


рахмат
danke
謝謝
ngiyabonga
spas
teşekkür ederim
Баярлалаа
mersi
kia ora
barka
welalin
tack
mahalo
tapadh leat
спасибо
faafetai lava
vinaka
спасибі
blagodaram
dank je
misaotra
matondo
paldies
grazzi
nanni
nandri
kiitos
dankie
dhanyavad
maururu
köszönöm
thank you
akun
dankon
ačiū
gracias
хвала
asante
manana
obrigada
murakoze
tenki
bedankt
bayarlalaa
gràçie
hvala
enkosi
dziękuję
djiere dieuf
tau
mochchakkeram
дякую
mamnun
chokrane
chnorakaloutioun
gratias ago
gràcies
sulpáy
taiku
go raibh maith agat
sobodi
dĕkuji
sagolun
sukriya
kop khun krap
arigatô
takk
dakujem
trugarez
obrigado
mèsi
didi madloba
najis tuke
ありがとう
tanemirt
grazie
rahmet
shukriya
mercé
мерси
kam sah hamnida
rahmat
terima kasih
diolch
dhanyavadagalu
তোমাকে ধন্যবাদ
감사합니다
xièxie
ευχαριστώ
merci