

# Flow assurance assignment design engineering essay



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## **INTRODUCTION**

This report describes about the design of subsea pipeline that transfers condensate from satellite platform to processing platform. Designing of subsea pipeline and compiling this report exclusive design programme called Pipesim from Schlumberger is used. This programme used for designing and analyses for oil and gas production. And also analysis flow line and surface facility performance to produce complete production system analysis.

## **OBJECTIVES**

Avoid the formation of hydrate;

Screen the pipeline for severe riser slugging to avoid its occurrence;

Size a slug catcher;

Optimise the insulation of the pipelines

Carry out an corrosion and erosion analysis

Provide engineering data

## **PIPELINE EXPLANTION**

The pipeline begins from satellite platform. From that platform it goes down to 400 feet into sea bed. Then pipeline laid for 6. 8 miles on the sea floor.

Pipeline is connected to riser and taking upto platform surface. Here that will be connected to water seperator and multiphase pump. The water seperator has to be 90 % efficiency and about multiphase pump there has three

choices of 50, 100, and 200 HP with efficiency of 80 %.

After multiphase pump comes down with riser about 400 feet and connected to pipeline. This <https://assignbuster.com/flow-assurance-assignment-design-engineering-essay/>

horizontal pipeline laid for 5 miles. End point of this pipeline connected to riser and taken upto platform. From that platform, pipeline travels over the sea to processing platform for 8 miles. Every technical datas are provided in appendix 2. Schematic sketch of pipeline is given below from Pipesim:

## **Pipeline Design**

### **Selection of Internal Diameter of Pipeline**

In this project, we have choice of pipeline ID size 8", 10" and 12". Condensate should have to reach in processing platform terminal with minimum pressure of 1000 psia. By doing analysis with three unlike IDs only a combined pipe size of 10" and 12" achieved minimum pressure at processing platform. For 11, 000 stb/d and 6000 stb/d, minimum arrival pressure is 1425 psia and 1, 109 psia respectively got from graph. For multiphase pump decided to choose 50 HP. After selection of pump and pipeline size, these have to be checked in pressure temperature profile analysis for ensuring arrival pressure at processing platform above 1, 000 psia ( Shown in appendix 1).

### **Pipeline Insulation**

Minimum arrival temperature of condensate is 750F at processing platform. For attaining this value, the pipeline has to be insulated due to heat transfer loss. For finding out how much insulation have to use in pipeline done through by using pressure temperature analysis. For this insulation analysis is started with thickness of 0. 25" and if it's not satisfied, hence we have to increment 0. 25" continuously. Thickness selection can be done through by clicking in pipeline and enter values in heat transfer tab. There we can enter pipe conductivity, ambient temperature and burial depth. After entering all

these values we will get an insulation thickness of 6" and minimum arrival temperature as 81.50F. These arrival temperature satisfy's both processing platform temperature and formation of hydrate ( Shown in appendix 1, figure 4).

## **Formation of Hydrate**

Hydrates are formed at high pressure and low temperature with combination of water and gas. Usually hydrates are formed inside subsea pipelines like plug formation. This can create major issues in oil and gas industry and resultant will be damaging of pipelines as well as processing facility. To hinder hydrates, inhibitors are used in pipelines. Widely used inhibitor is methanol. Hydrate formation condition provided in notes as follows:

Temperature < 80 0F when pressure < 1500 psia

Temperature < 90 0F when pressure > 1500 psia

After taking amount of insulation in account for getting an arrival temperature above 750F is satisfied from above results. And keeping temperature and pressure in limited figures can control formation of hydrates in pipeline. From graph values (Shown in appendix 1, figure 4) above conditions are satisfied:

Liquid flow rate corresponding pressure and temperature 6, 000 stb/d: 1425 psia & 81.5 0F respectively.

Liquid flow rate corresponding pressure and temperature 11, 000 stb/d: 1109 psia & 100 0F respectively.

## Screening for severe riser slugging

Number of factors is caused due to slug formation in riser. Some of them are given below.

1. When Pipeline elevation is slightly downward before riser connection
2. If fluid flow pattern is segregated

By using PI-SS number riser slugging can be determined. Riser slugging can be conformed when number is less than 1. Then slug catcher have to be designed by using pipesim. PI-SS number can be calculated through report from pipesim. By using this simulation software can be generate two reports. Out file can be obtained from report file and flow map. Then re-run model and from that out file obtained. Low PI-SS numbers are highlighted in out file. Riser slugging happens in flow line 1. This shows that slug catcher have to be design.

## Design of Slug Catcher

The slug catcher size is determined based on following three criteria. They are

The essential to hold the major slug in future

Necessity for handling liquid comes out from pig

Required for store the slug where production rate is increased to 6000 to 11000 stb/d

Following values are calculated from design. The output file is shown in Appendix and biggest one in one thousand slug size is originated. In this report it is calculated to 2211. 168 feet. From the value we have got slug volume 2892. 93 ft<sup>3</sup>.

For second value taken from the liquid cleaned in front of a pig can be checked. It is clear that the minimum flow gives larger volume about 1801. 512 bbl or 10114. 73 ft<sup>3</sup>. Now calculated is liquid delayed when flow is increased 6000 to 11000 stb/d. This is dissimilarity in total delay between the two flow rates. That means 3201. 99 bbl - 2459 bbl = 742. 25 bbl = 4164. 0225 ft<sup>3</sup>.

Therefore the pigging volume is 10114. 73 ft<sup>3</sup> (Appendix 1, Figure: 6, 7, 8)

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## **Corrosion and erosion analysis**

Corrosion and erosion are main concern in pipelines and this have to be kept very low. When erosion occurs, it reduces pipeline diameter. This has to be replaced before when it reaches to minimum value. Corrosion is occurred due to many reasons. This is major problem in oil and gas industry. The erosion analysis is done through following steps. Software analysis is done and the plot is got from erosion velocity ratio in Y axis and total distance from X axis. From graph flow is not exceeding value one which shows that there will be no erosion occurring in pipeline. ( Appendix 1, Figure : 2)

## **Engineering Data**

Flowline 1

Flowline 2

Flowline3

Size of Pipeline ( Inches)

10

10

10

Insulation Thickness

6

6

6

Riser size: 10 inches

Multiphase pump: 50 HP

Slugging: Yes

Size of Slug Catcher: 10114. 73 ft<sup>3</sup>

Erosion or Corrosion: No

## **Conclusion**

Pipesim is tool used for designing pipeline and for getting exact performance in system. In this project, for flowline 1 and flowline 2 are used 10 inch

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pipeline size. For flowline 3, pipeline size is 12 inch. After considering flowlines sizes we will achieve minimum arrival pressure and temperature at processing platform. Formation of hydrate was eliminated by proper insulation and multiphase pump power. Slugging is found in simulation for that reason we have provided slug catcher. Analyzing erosion and corrosion proved that there will be no erosion in pipeline. Generally project is successfully designed according to requirement.



**REFERENCE:****Pipesim Help****Class notes from Dr Shuisheng. He****<http://www.easycalculation.com/unit-conversion/volume-unit-converter.php>****[http://www.slb.com/services/software/production\\_software/prod\\_analysis\\_diagnostics/pipesim.aspx](http://www.slb.com/services/software/production_software/prod_analysis_diagnostics/pipesim.aspx)****E. D. Sloan, “Clathrate Hydrates of Natural Gas”****<http://en.wikipedia.org/wiki/Hydrate>****APPENDIX 1****Figure 1: Pressure – Temperature****Figure 2 : Erosional velocity ratio- Total distance****Figure3 : Pressure Vs Total distance****Figure 4 : Temperature Vs Total distance****Figure 5 : Pressure Vs Total distance ( without flow rate)****Figure 6 : PI-SS Number****Figure 7: Largest 1/1000 slug length****Figure 8: Liquid by sphere number**