wjert, 2020, Vol. 6, Issue 2, 76-93. *Original Article* ISSN 2454-695X

World Journal of Engineering Research and Technology

WJERT

www.wjert.org SJIF Impact Factor: 5.924

# ANALYSIS OF SUBSEA FLOWLINE SIZING FOR SLUG MITIGATION

**Ugochukwu H. Ilonze[1] and Tobinson A. Briggs[2*]**

[1,2]Offshore Technology Institute, University of Port Harcourt, Port Harcourt, Nigeria.

**Article Received on 12/01/2020** **Article Revised on 02/02/2020** **Article Accepted on 23/02/2020**

***Corresponding Author**
**Dr. Tobinson A. Briggs**
Offshore Technology Institute, University of Port Harcourt, Port Harcourt, Nigeria.

## ABSTRACT

Slug flow has proven to be a menace in the production of Oil and Gas; from cyclic loading of pipelines, which could cause fatigue, to water overflow in the separator. This work established the presence of slugging in a typical Field A and created a prototype that could mitigate it. In work, the diameter of the existing subsea flowline was varied from 0.3715m to 0.05m and observed using OLGA 2016 software after which the optimal configuration was obtained. The obtained prototype created a constriction towards the riser-base, making the flowline to have a varied internal diameter. Liquid hold up, Pressure, Oil volume factor and Water volume factor were simulated and plotted against time, and these plots showed the slug was mitigated with the application of the prototype. The Sensitivity analysis on the mass flow rate with simulation ran from 20kg/s to 40kg/s after which it was confirmed that the mass flow rate does not affect the prototype. A parametric study was also run on the pipeline span to observe its effects on slug mitigation. The pipeline span was increased from 100m to 400m after which the 300m liquid hold up against simulated time plot showed slug flow for only 250 seconds and then stabilised, which made its selection possible. This prototype if applied to a subsea flowline close to the riser base, would mitigate slug flow and its accompanying problems.

**KEYWORDS:** Slug flow, OGLA software, Pipeline sizing, Riser, simulation, Sensitivity analysis.

## INTRODUCTION

Slug flow has proven to be a menace in the production of Oil and Gas. From cyclic loading of pipelines which could cause fatigue to water overflow in the separator. Introducing a constriction along the flow path close to the riser-base by decreasing the internal diameter of a particular portion should be able to allow the mixture of the phases present and then switch from slug flow to stratified flow.

To extensively study the effect of a constriction along the flowline, close to the riser-base, on slugging. To achieve this aim, the following objective was observed -

i. Replicate the existing field development using a transient flow simulation software (OLGA)
ii. To check the effect of pipe sizing on the effect of the slug.
iii. To run a parametric study on the effect of sectional diameter on slug mitigation.
iv. To run a sensitivity analysis on the effect of mass flow rate with the proposed prototype
v. To run a sensitivity analysis on the effect of sectional diameter span on the slug.

To show that most with a little modification of the flowlines, slug could be mitigated, and cost also saved when compared to the current industry slug mitigation modes. This study is limited to a generic Field A. In this study, parameters (reservoir, fluid and well) gathered will be taken as constant, OLGA software will be used for the simulation studies.

i. The constant temperature will be assumed for the column of seawater
ii. The thickness of the pipeline is assumed to be uniform
iii. Insulation of the pipeline is of uniform thickness and the same composition
iv. All simulations were run for 2 hours
v. Due to the absence of a computer with high processing power and constant power supply, the work ran for 2 hours.

## 2.0 MATERIAL

There exist programs that can be engaged for simulating multiphase flow, and one of them is OLGA. OLGA is mostly used in the oil and gas sector for simulating transient flow (Bendixen *et al*., 1991). OLGA got its name from "Oil and Gas Simulator" and it is used for simulating well networks, pipeline network, risers and process equipment. It is utilised for reproducing processing frameworks from the bottom hole to the topside.

OLGA comes in a basic version; it also has several additional modules namely FEMTherm, Rocx, Multiphase Pumps, Drilling, Pigging, Process, Pump, Corrosion, Wells, Slug tracking, Wax deposition, inhibitor tracking etc. There are also several additional programs in terms of functionality like the OLGA. Figure1 shows the OLGA flowchart, which will be discussed in the following subsections.

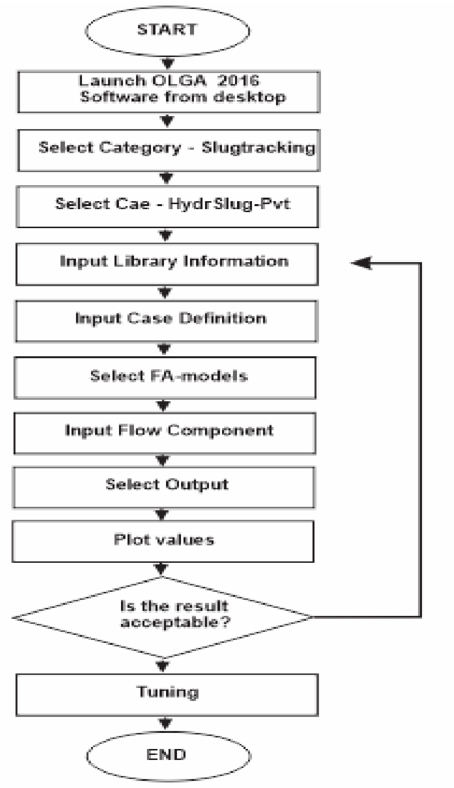


**Figure 1. OLGA Flowchart.**

### 2.2 How to Use OLGA 2016

i. Launching OLGA 2016 - Install OLGA 2016 software on the computer following the rules given by the manual. Upon successful installation, the OLGA is launched by double-clicking its icon located on the desktop.

ii. Select Category - Slugtracking

iii. Select Case - Hydroslug-PVT - Hydrodynamic slugging problem using compositional tracking is modelled here. The work centres around on modelling hydrodynamic slugging using the PVT lookup table. The lookup table file is based on a PVT analysis and calculation of thermodynamic properties of a fluid with the constant total composition. A table file is usually generated by using a fluid property package with a specialised OLGA table file generator.

**iv. Input Library Information**

The model browser windows contain several elements; these elements are - the library, case definitions, FA-models, flow component and output. Upon selecting the library, the table submenu is presented. This contains the lookup table data with the dependent and independent fluid properties.

v. Input Case definition

The case definitions contain the following submenu

CASE - The Author, Date, Project and Title are specified

a. Author - Ugochukwu Ilonze
b. Date - 30/9/2018
c. Project - Analysis of subsea flowline sizing for slug mitigation
d. Title - Analysis of subsea flowline sizing for slug mitigation

vi. FILES - Depicts the project file name. In this case, "OTI Project."

vii. INTEGRATION - Integration parameters are specified. These parameters include

a. DSTART = 0.01s Initial time
b. STARTTIME = 0s: Simulation start time is zero
c. ENDTIME = 2h: Simulation End time is 2 hours
d. MINDT = 0.01s: Simulation time-step for integration is 0.01s
e. MAXDT = 1s: Largest time-step for integration is 1s
f. RUNTIMESTEPAGAIN = TRUE To instruct the computer to recompute the time step if the 1st stage solution is unsatisfactory

viii. OPTIONS

a. COMPOSITIONAL = OFF No compositional slug tracking, PVT Lookup table is used
b. DEBUG = OFF: The simulator reports only essential warnings
c. DRILLING = OFF: Drilling process is not modelled
d. ELASTICWALLS = OFF: Turns off the effects of elastic or expanding walls
e. FLASHMODEL = WATER: Mass transfer occurs between gas-oil and gas-water
f. FLOWMODEL = OLGAHD: Indicates the type of flow model used for the dynamic flow
g. HYDSLUG = ON: Hydrodynamic slugging is present
h. MASSEQSCHEME = $1^{st}$ ORDER Indicates that the discretisation scheme used for solving the mass equations is 1st order
i. NOSLIP = OFF Slip between phases is calculated
j. PARTICLEFLOW = NO: Assumes no flow of solid particles
k. PHASE = THREE: Indicates that the quantity of phases present is three

l. SLUGTRACKINGMODEL = OLGA16: Indicates the type of slug tracking model used for hydrodynamic slug initiation and slug evaluation
m. SLUGVOID = SINTEF: Selects correlations for determining gas volume fraction in liquid slugs
n. STEADYSTATE = ON: Toggles the initial value (steady state) pre-processor
o. TABLE TOLERANCE = OFF: Defines that the upper and lower limits of pressure and temperature allowed in the simulation are those specified in the fluid tables
p. TEMPERATURE = ADIABATIC: No energy exchange with the walls
q. TRACERTRACKING = OFF: No tracer tracking approach
r. UDPLUGIN = OFF: User-defined phase is turned off
s. WAXDEPOSITION = OFF: Indicates whether to assumes wax deposition or not

ix. Input FA - models

For this case, the FA-model used is SLUGTRACKING. The various properties of SLUGTRACKING submenu include -

a. DELAY CONSTANT = 150: Pipe span a slug needs to propagate before the next hydrodynamic slug is initiated
b. GASENTRAINMENT = VOIDINSLUG: Gasentrainment is based on correlation for the void in slug
c. HYDRODYNAMIC = ON: Hydrodynamic slugs are present
d. LEVEL = OFF: No initiation and detection of level slugs

x. Flow Components

This submenu contains the physical composition of the components of the pipeline-riser system. It has three major components, namely - FLOWPATH, INLET and OUTLET.

The FLOWPATH component models the pipeline-riser configuration. it comprises of the following:

Boundary and Initial conditions which contains the SOURCE items where the accompanying elements are specified; namely: The Gas mass flow pressure differential, liquid mass flow pressure differential, Water mass flow differential; gas mass fraction, gas-oil ratio, water cut and water-gas ratio read from the PVT Table, the mass flow (36.466667 kg/s) and temperature (72.2$^{o}$C).

FA - models which contain Slug-illegal as the only submenu. Elements contained therein are:

a. ILLEGALSECTION = ON: Specifies that slugs are not allowed in sections defined by pipe and section

b. PIPE = TO-SEP Specifies that slug is illegal at the pipe section from riser-top and the separator

c. OUTPUT: The OUTPUT, SERVER DATA and TREND DATA variables are specified. Four important positions selected for analysis are INLET, RISERBASE and RISERTOP. The variables selected for analysis include:

a. PT Pressure

b. TM Fluid Temperature

c. HOL Holdup (liquid volume fraction)

d. HOLHL Oil volume fraction

e. HOLWT Water volume fraction

xi. PIPING

The pipeline has an approximate length of 7700m and a riser length of 200m. The configuration is noted in Table A.1 in Appendix A.

xii. POSITON

The position of the INLET, RISERBASE and RISERTOP in the pipeline geometry are specified.

xiii. Output

Here, output selections and preferences already specified are shown for user confirmation and modification. These include ANIMATE, OUTPUT, PROFILE, PROFILEDATA[1], TREND and TRENDDATA[1]. All the variables to be plotted are listed in their own plot pattern.

xiv. Plot Values

Having completed the information required in the model browser, the model was run by selecting the run batch icon on the toolbar. The model can only be run when the status bar indicates “ready to simulate” with a green pointer. The user is expected to resolve all the errors.

Having run the model successfully, the trend plot button on the toolbar was used to plot the values.

**2.3 Procedure**

Using given Field information create a model on OLGA, develop a plot of liquid hold up against time and pressure variation against time was and compared with the Fields live data to ensure the Field has been reproduced.

Run parametric study on a change in sectional pipe diameter and pipe length in order to establish the optimal, compare the results and then establish your result.

Run Parametric study on mass flow and establish a relationship.

### 2.3.1 Physics

At the upstream of the contraction due to sudden decrease in diameter, there would be a forceful mixture of the different phases passing by. This would change the flow regime from slug to dispersed bubble flow, thereby mitigating slug flow. It is also worthy of note that optimisation is crucial here for pressure and velocity of the flow will be impeded at this region.

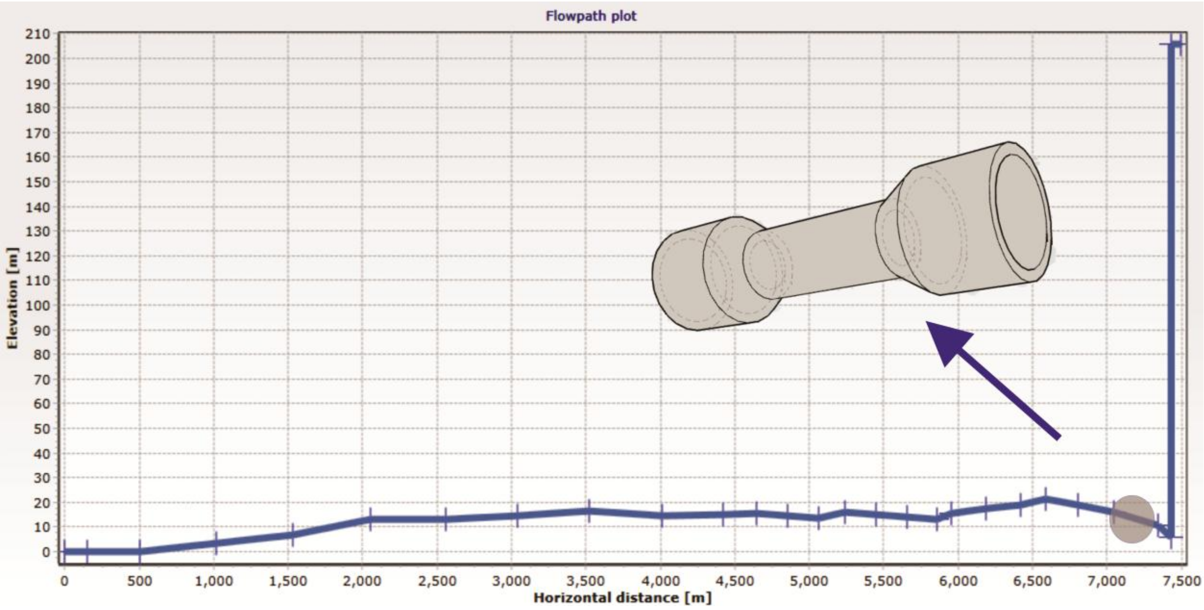


**Figure 2. Visual representation of the proposed prototype.**

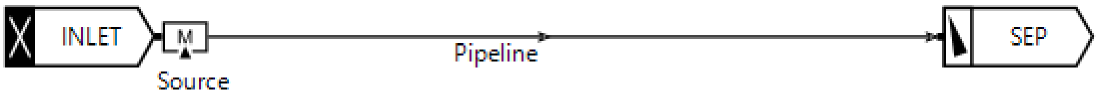


**Figure 3. OLGA representation of the field configuration.**

## 3. RESULTS AND DISCUSSION

Field A was modelled in OLGA 2016, after which Simulations was run for 2 hours to establish the fact that the current configuration is prone to severe slugging. Graphs were generated for visualisation of this concern - Liquid holdup against time, Pressure against time, Oil volume factor against time and water volume factor against time.

The proposed configuration of the field was modelled and further optimised, after which sensitivity analysis was run and the graphs included.

### 3.1 Results

#### 3.1.1 Liquid holdup

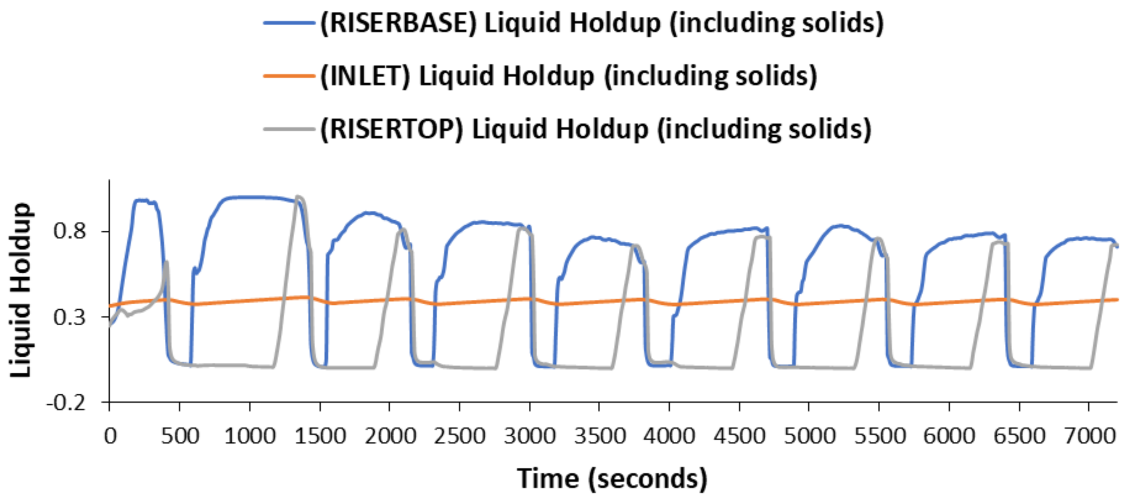


**Figure 4. A plot of liquid holdup variation with time (For the existing configuration).**

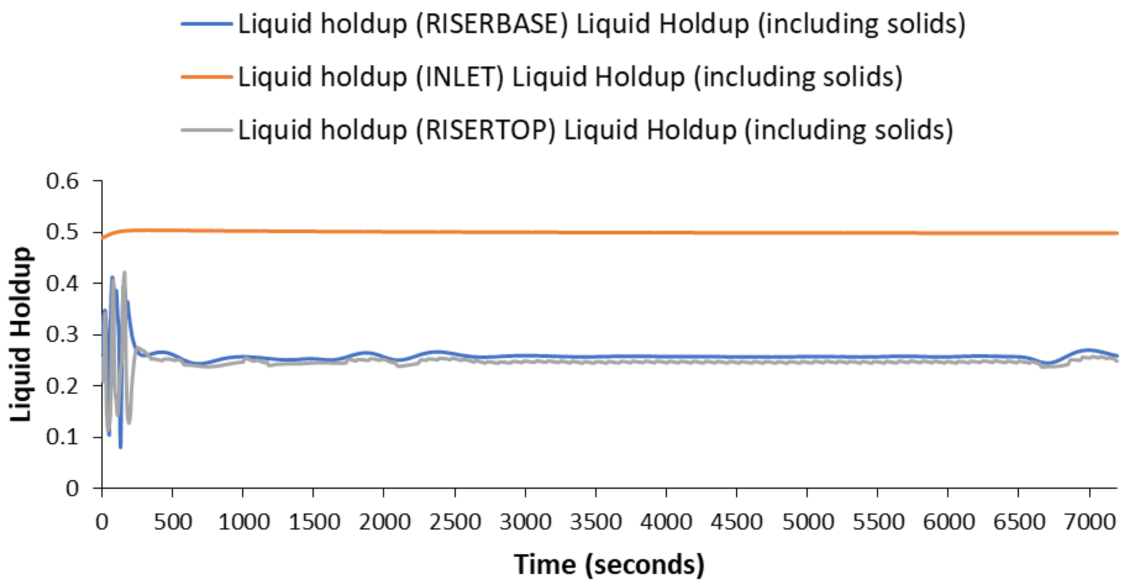


**Figure 5. A plot of liquid holdup variation with time (For the proposed configuration).**

### 3.1.2 Pressure

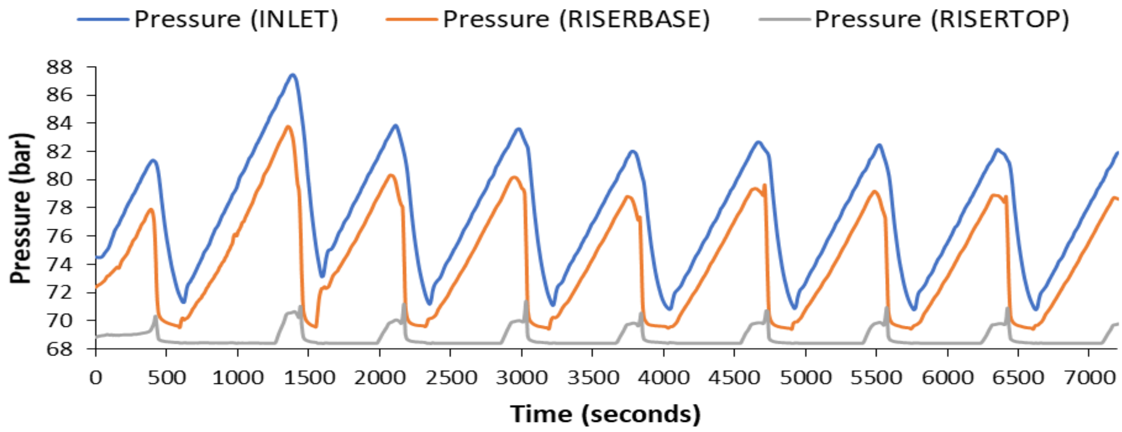


**Figure 6. A plot of pressure variation with time for the existing field configuration.**

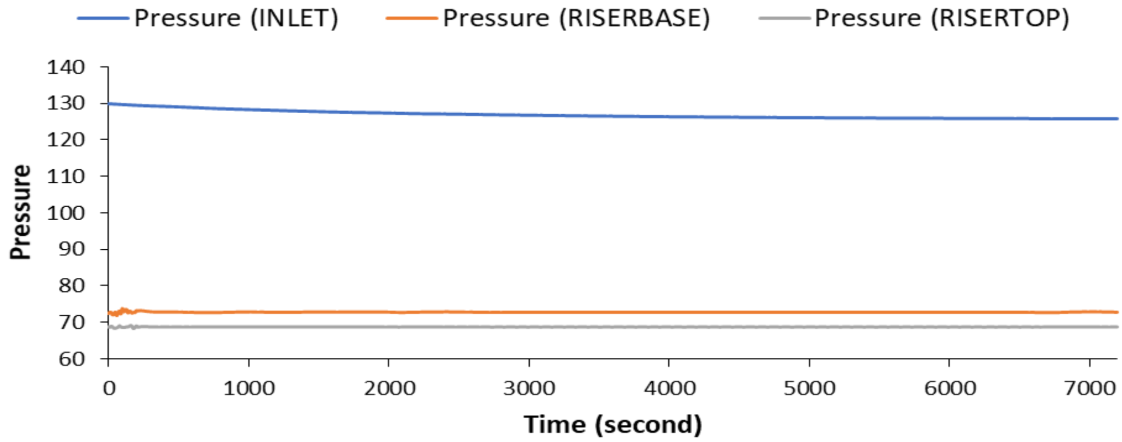


**Figure 7. A plot of pressure variation with time for the proposed field configuration.**

### 3.1.3 Oil volume factor

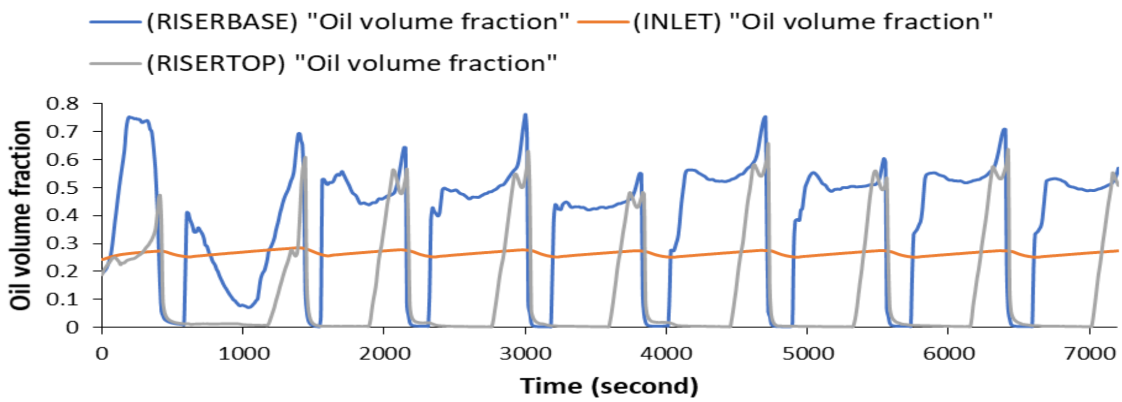


**Figure 8. A plot of oil volume factor variation with time for the existing field configuration**.

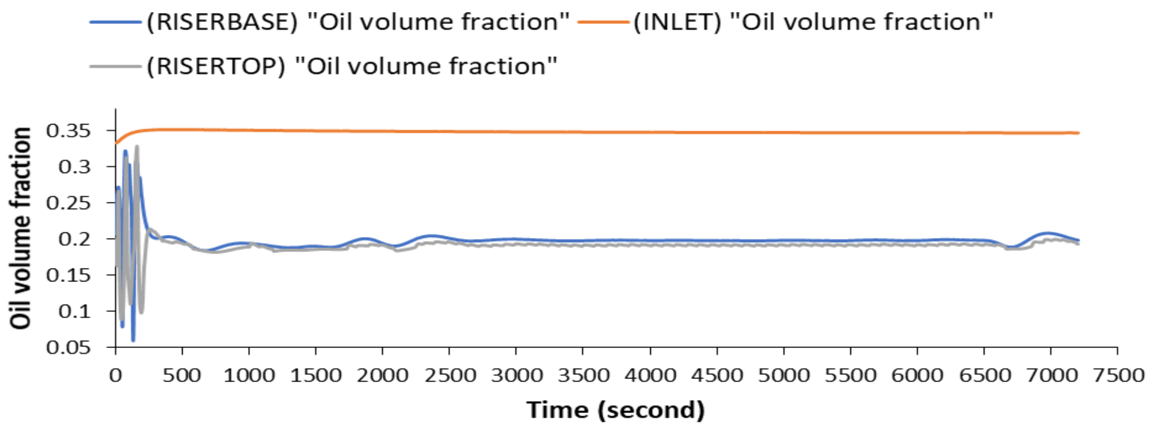


**Figure 9. A plot of oil volume fraction variation with time for the proposed field configuration.**

### 3.1.4 Water volume fraction

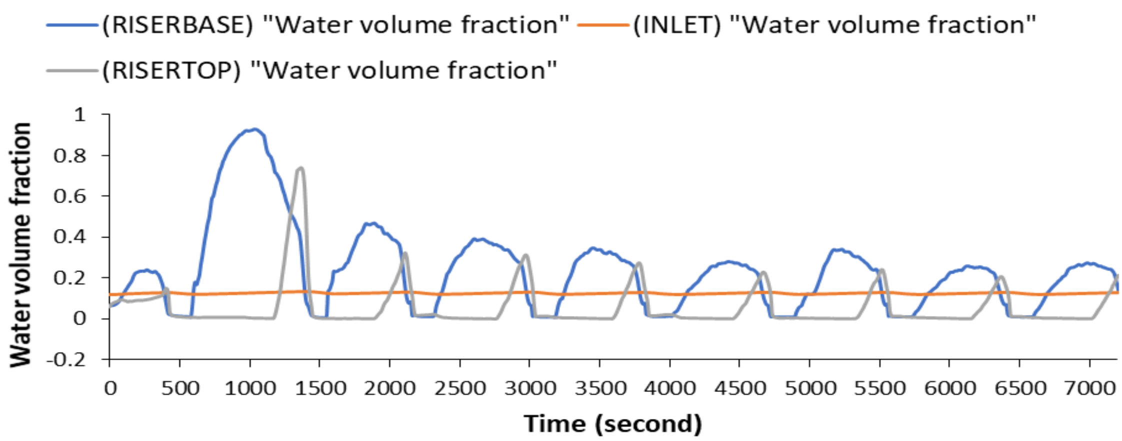


**Figure 10. A plot of water volume fraction variation with time for the existing field configuration.**

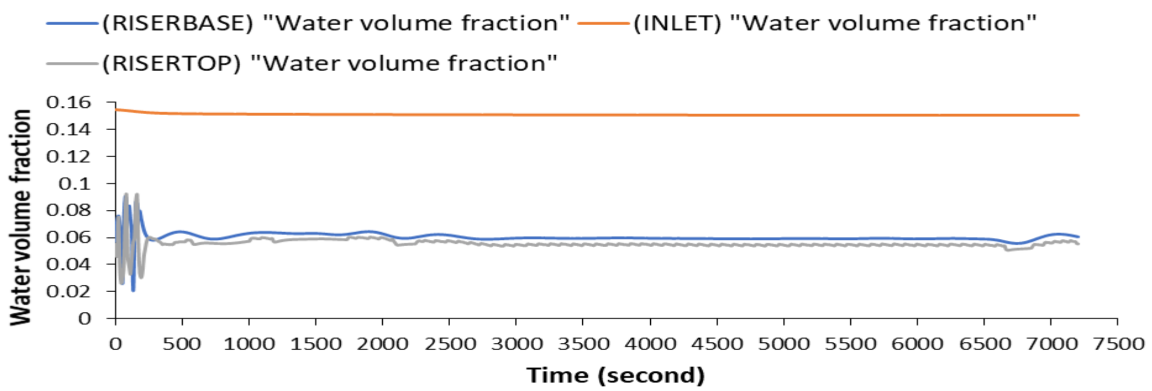


**Figure 11. A plot of water volume fraction variation with time for the proposed field configuration.**

### 3.1.5 Sensitivity analysis on the effect of mass flow rate

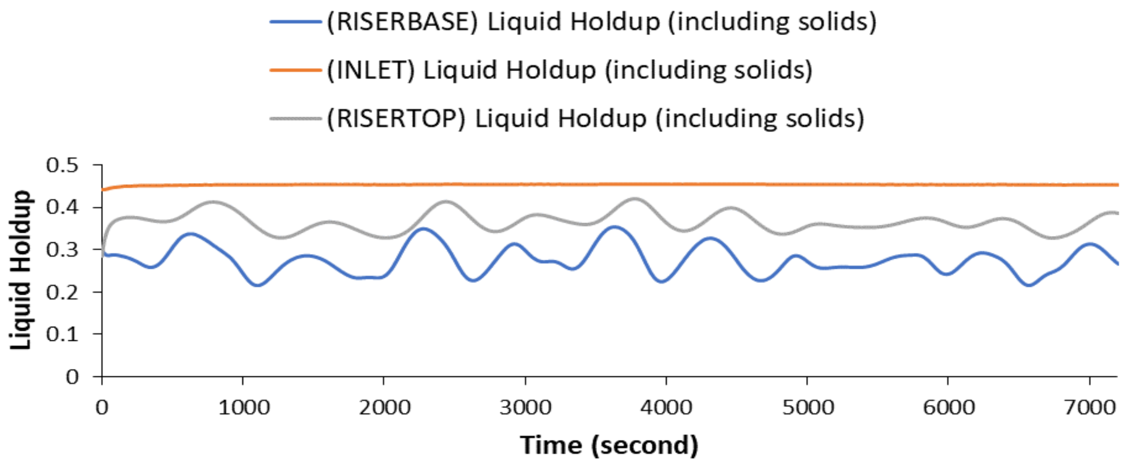


**Figure 12. A plot of Liquid Holdup against time at a mass flow rate of 20kg/s.**

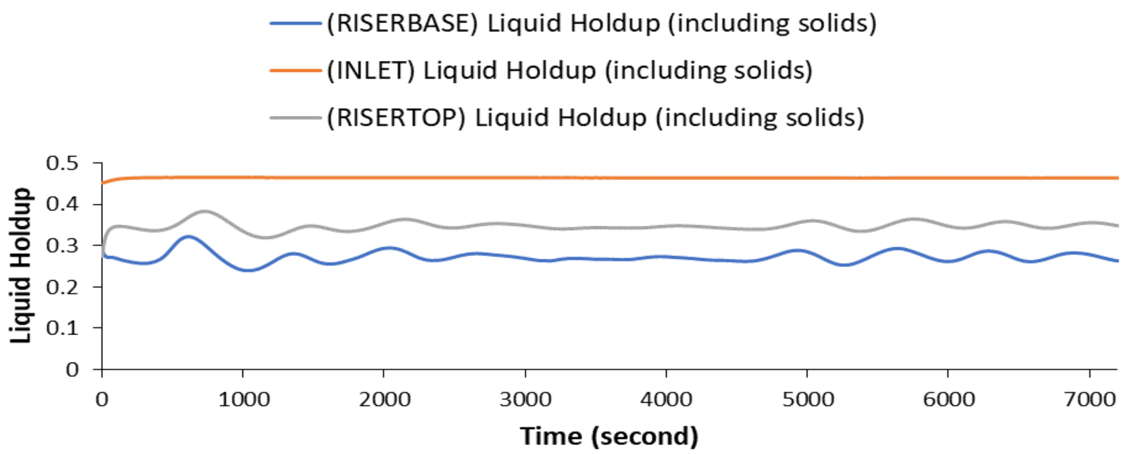


**Figure 13. A plot of Liquid Holdup against time at a mass flow rate of 25kg/s.**

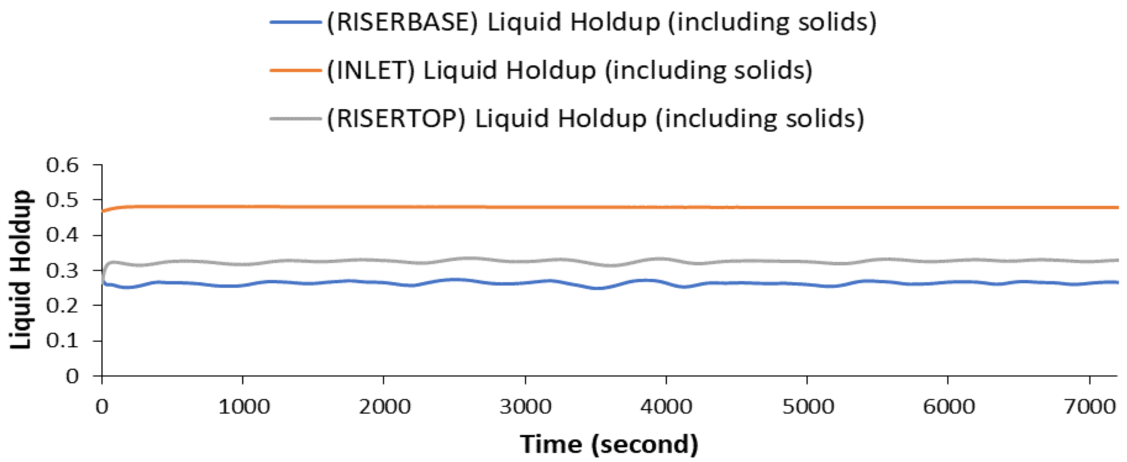


**Figure 14. A plot of Liquid Holdup against time at a mass flow rate of 30kg/s.**

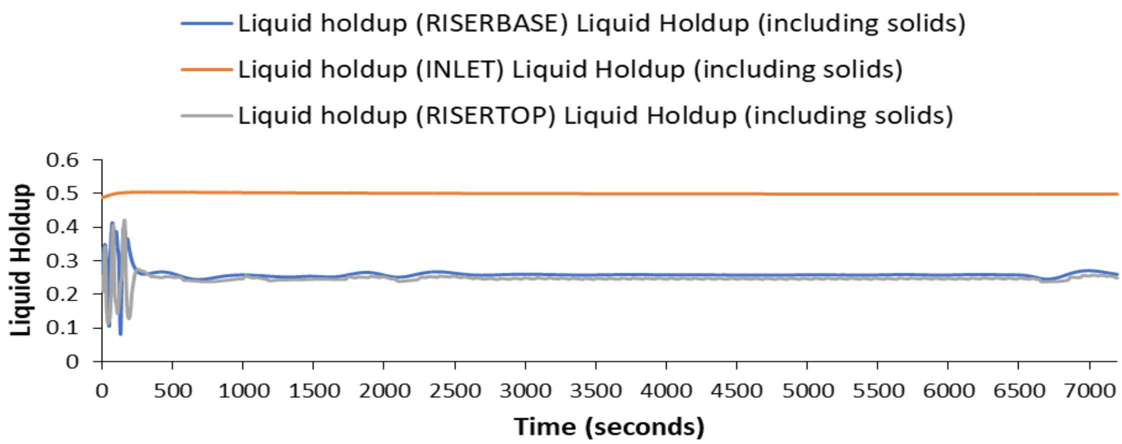


**Figure 15. A plot of Liquid Holdup against time at a mass flow rate of 36.4kg/s.**

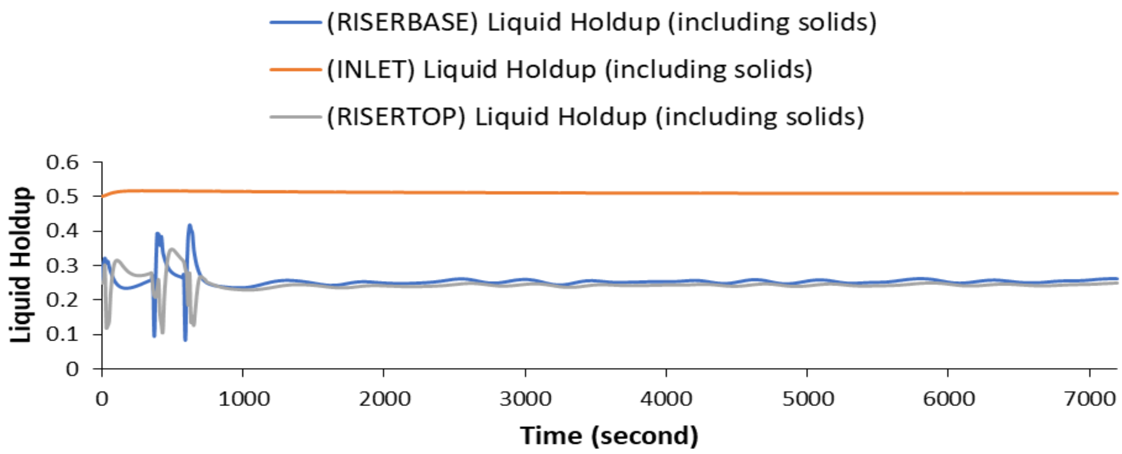


**Figure 16. A plot of Liquid Holdup against time at a mass flow rate of 40kg/s.**

### 3.1.6 Sensitivity analysis on the effect of constraining the length.

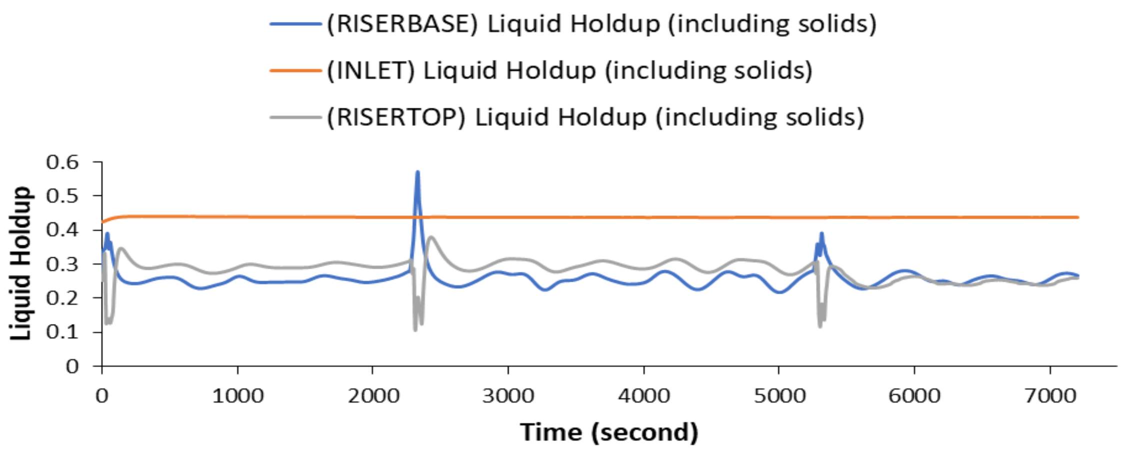


**Figure 17. A plot of liquid holdup against time (for sectional diameter with a length of 100m).**

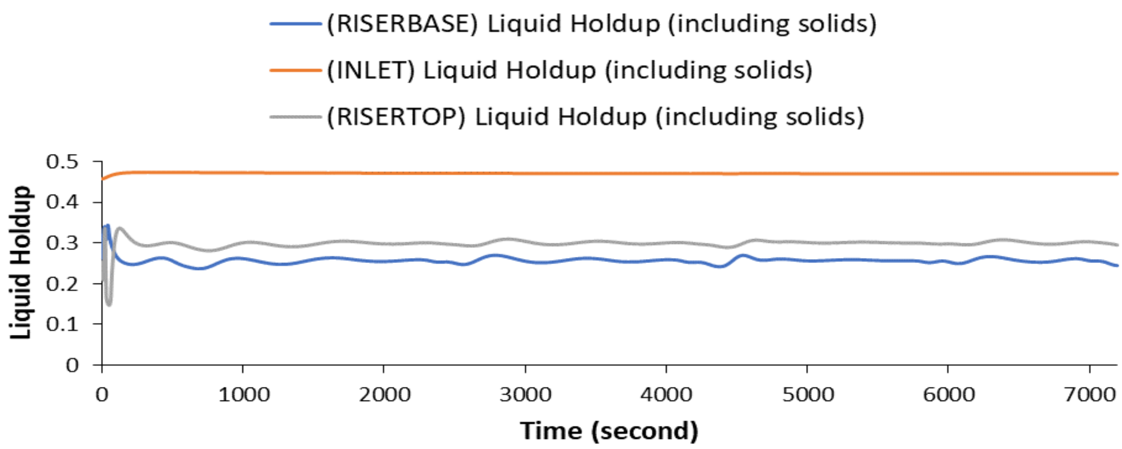


**Figure 18. A plot of liquid holdup against time (for sectional diameter with a length of 200m).**

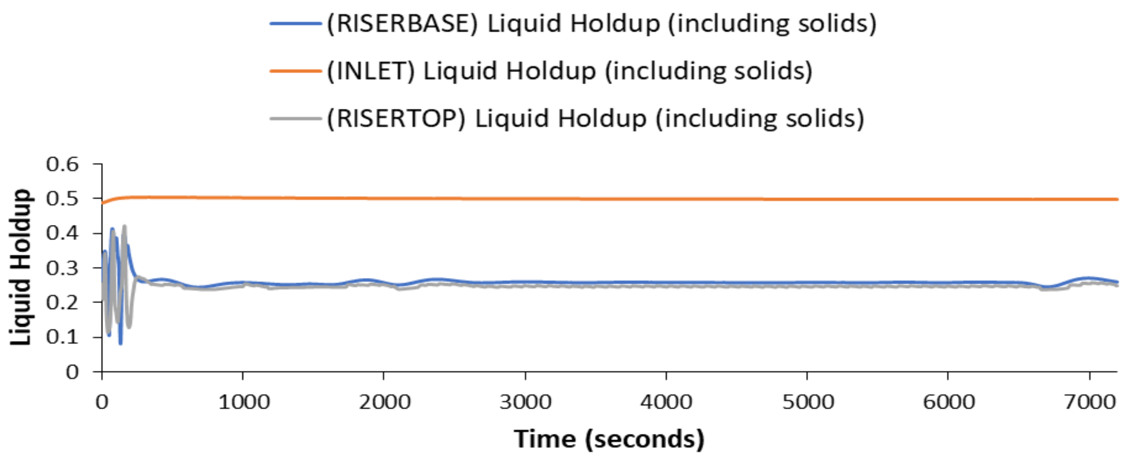


**Figure 19. A plot of liquid holdup against time (for sectional diameter with a length of 300m).**

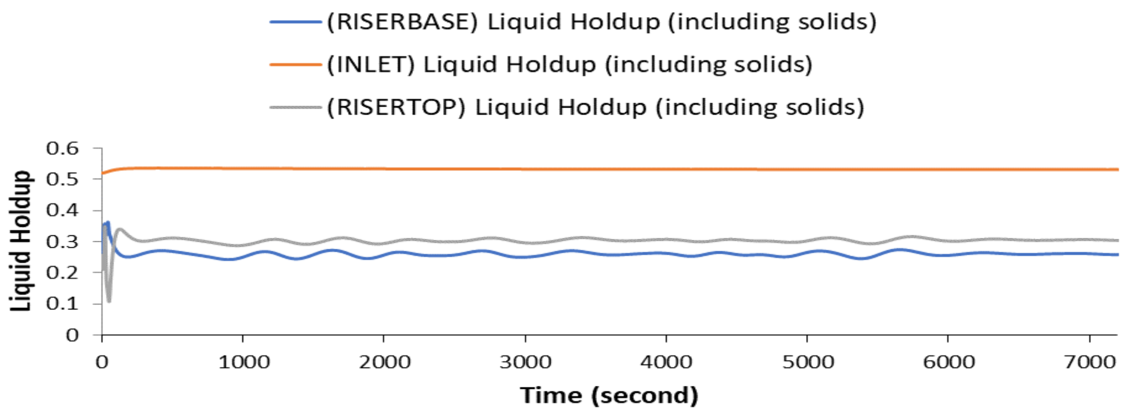


**Figure 20. A plot of liquid holdup against time (for sectional diameter with a length of 400m).**

## 3.2 DISCUSSION

### 3.2.1 Liquid holdup

Figure 4 depicts the liquid holdup with a time plot of the existing field configuration. At the initiation, the liquid holdup has a reasonably constant value of 0.36. At the riser-base, the liquid holds up builds up for approximately 200 seconds after which the velocity of the gas builds for approximately 400 seconds before it was sufficient to push the liquid slug out the riser. Such high spikes cause serious problems; the separator could experience liquid overflow, which would impact negatively on other processing equipment banking on the separator to do a good job. Taking a closer look in Figure 5, there was slug flow after startup for the first 300 seconds (approximate) after which the system stabilised.

### 3.2.2 Pressure

The pressure variation with time plot for the existing field development as depicted in Figure 6 shows the cyclic build-up of pressure at intervals at the riser-base, and the decrease in pressure after the gas has pushed out the liquid slugs out of the riser. This cyclic pattern of pressure shown in Figure 6 poses a severe threat to the integrity of the flow line, for it can lead to fatigue. Figure 7 shows the pressure against time plot for the proposed field configuration. The inlet pressure is consistently declining, but that for riser-base and riser-top is constant.

### 3.2.3 Oil volume fraction

From Figure 8 and 9 above, the oil volume factor plot with variation with simulated time shows that there exists slug in Field A, but with the prototype, the slug was only witnessed in the first 250 seconds before the system stabilised.

### 3.2.4 Water volume fraction

From Figure 10 and 11, the water volume factor plot with variation with simulated time shows that there exists slug in Field A, but with the prototype, the slug was only witnessed in the first 250 seconds before the system stabilised. This also shows that for field A the separator would be experiencing an overflow of produced water, and this has been eradicated using the prototype.

### 3.2.5 Sensitivity analysis

Proper sensitivity analysis was carried out using OLGA parametric case option to check how the prototype would respond to varying mass flow rate and constraint span. Knowing fully well that slug develops more in fewer flow rates, we reduced it and from observation, noticed that 36.4kg/s is the best. The constraint span was run, and 300m came out with a better result for this particular configuration.

## 4. SUMMARY

Slug flow has proven to be a menace in the production of Oil and Gas; from cyclic loading of pipelines, which could cause fatigue, to water overflow in the separator. This work established the presence of slugging in a typical Field A and created a prototype that could mitigate it. In work, the diameter of the existing subsea flowline was varied from 0.3715m to 0.05m and observed using OLGA 2016 software after which the optimal configuration was obtained. The obtained prototype created a constriction towards the riser-base, making the flowline to have a varied internal diameter. Liquid hold up, Pressure, Oil volume factor and Water volume factor were simulated and plotted against time and these plots showed the slug was mitigated with the application of the prototype. Sensitivity analysis was done based on the mass flow rate and pipeline span to observe the effects on slug mitigation.

The knowledge gap was bridged, with the simulated results shown above. This was achieved with the objectives met and the aim fully achieved.

## 5. CONCLUSION

From literature, it is relevant that slug flow is mitigated as it is a nightmare to offshore oil and gas production and processing. From the simulation, the period of slug occurrence was determined from the liquid holdup against time plot. The pressure plot with time also showed areas of interest being affected by slug. This slug if not contained, could propagate cyclic loading, which could cause fatigue or thermal stress-corrosion on the flowline and riser. The variation of water volume factor plot with simulated time shows potential for water overflow in the separator. The oil volume fraction plot with simulated time showed that oil occupies a small percentage of the fluid entering the separator. This unsteady liquid production is a problem for the pump unless a buffer is introduced.

This work has successfully shown that flowline sizing is a means for mitigating slug flow, with the constriction adequately placed and sized. After simulation of the prototype, a plot of the variation of liquid holdup against simulated time, variation of pressure with time, Variation of Water volume factor with time and oil volume factor with time were developed, and all showed elimination of slugging from the system. This conclusion is based on a limited simulation time of 2 hours due to the absence of a work station. Further work should be done on this with an elongated time of 20 years to see how this prototype would behave towards the end life of the field. The study established through simulation that positioning a constriction close to the riser base can mitigate slug flow by the phases mixing, thereby changing its regime from slug flow to dispersed bubble flow.

**REFERENCES**


1. Adedigba, A. (2007). *Two-Phase flow of gas-liquid mixtures in horizontal helical pipes.* UK: Cranfield University.
2. Almeida, A. R., & Gonçalves, M. A. (1999). Venturi for severe slugging. *9th International Conference Multiphase Production* (pp. 149 - 158). Cannes, France: BHRG.
3. Bratland, O. (2010). *Pipe flow 2 Multiphase flow assurance*. Retrieved August 28, 2018, from Flow Assurance Consulting: http://www.drbratland.com
4. Corneliussen, S. C.-P.-E. (2005). *Handbook of multiphase flow metering.* Norway, Norway: Norwegian Society for Oil and GasMeasurement (NFOGM).
5. Drengstig, T., & Magndal, S. (2001). *Slug control of production pipeline.* Ullandhaug, Norway.: School of Science and Technology, Stavanger University College.
6. Guo, B., Song, S., Ghalambor, A., & Chacko, J. (2005). *Offshore Pipelines* (1st Edition ed.). Houston, Texas: Gulf Professional Publishing .
7. Havre, K., & Dalsmo, M. (2002). Active feedback control as a solution to severe slugging. *SPE Production and Facilities*, pp. 138 - 148.
8. Jansen, F., Shoham, O., & Taitel, Y. (1996). The elimination of severe slugging-experiments and modeling. *International journal of multiphase flow*, 1055-1072.
9. Johal, K., Teh, C. E., & Cousins, A. R. (1997). An alternative economic method to riser-base gas lift for deep water subsea field development. *Offshore Europe*, 6.
10. Makogan, T. Y., & Brook, G. J. (2007). *Patent No. WIPO: WO2007/034142.* United States of America.
11. Makogan, T., Estanga, D., & Sarica, C. (2011). A new passive technique for severe slugging attenuation. *International Conference on Multiphase Production Technology*, (pp. 385 - 396). Cannes, France.
12. Malekzadeh, R. (2012). *Severe slugging in gas-liquid two-phase pipe flow.* Delft: Delft University of Technology.
13. Ogazi, A. (2011). *Multiphase Severe Slug Flow Control.* Cranfield University, UK.

14. Pots, B. F., Bromilow, I. G., & Konijn, M. J. (1987). Severe slug flow in offshore flowline/riser systems. *SPE Production Engineering*, pp. 319-324.
15. Sarica, C., Tengesdal, & J.O. (2000). A new technique to eliminate severe slugging in pipeline/riser systems. *SPE Annual Technical Conference and Exhibition, Dallas, Texas*, 9.
16. Schmidt, Z., Brill, J. P., & Beggs, H. D. (1979). Choking can eliminate severe pipeline slugging. *Oil and Gas Journal*, 230 - 238.
17. Skofteland, G., Godhavn, J., & Kulset, T. (2007). *Implementation of a slug control system for subsea wells in sn integrated operation envirnment.* Norweigan University of Science and Technology.
18. Storkaas, E. (2005). *Anti-slug control in pipeline riser systems.* Norway: Norwegian University of Science and Technology.
19. Storkaas, E., & Skogestad, S. (2004). *Cascade control of unstable systems with application to stabilization of slug flow.* Norway: Norwegian University of Science and Technology,.
20. Taitel, Y. (1986). stability of severe slugging. *International journal of multiphase flow*, 203-217.
21. Taitel, Y., & Dukler, A. (1976). Model for predicting flow regime transitions in horizontal and near horizontal gas-liquid low. *AIChE Journal, 22:* 47 - 55.
22. Wallis, G. (1969). *One dimensional two phase flow.* Pennsylvennia: McGraw Hill Book Company.
23. Xing, L. (2011). *Passive Slug Mitigation by Applying Wavy Pipes.* UK: Department of Offshore, Process and Energy Engineering, School of Engineering, Cranfield University.
24. Yocum, B. (1973). Offshore riser slug flow avoidance, mathematical model for design and optimization. *SPE European Meeting* (pp. SPE-4312-MS). London: Society of Petroleum Engineers.

## Appendix

**Table 1. System Layout – Flowline Configuration.**

| Pipe no. | Roughness | Label | Length | Elevation | Section | Diameter |
|---|---|---|---|---|---|---|
| 1-1 | 3.00E-05 | PIPE_1 | 151 | 0 | 2 | 0.3714 |
| 1-2 | 3.00E-05 | PIPE_2 | 355.217 | -0.001 | 3 | 0.3714 |
| 1-3 | 3.00E-05 | PIPE_3 | 514.012 | 3.507 | 3 | 0.3714 |
| 1-4 | 3.00E-05 | PIPE_4 | 514.012 | 3.508 | 3 | 0.3714 |
| 1-5 | 3.00E-05 | PIPE_5 | 521.536 | 6.165 | 3 | 0.3714 |
| 1-6 | 3.00E-05 | PIPE_6 | 506.22 | 0 | 3 | 0.3714 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1-7 | 3.00E-05 | PIPE_7 | 481.443 | 1.626 | 3 | 0.3714 |
| 1-8 | 3.00E-05 | PIPE_8 | 481.453 | 1.625 | 3 | 0.3714 |
| 1-9 | 3.00E-05 | PIPE_9 | 486.504 | -1.932 | 3 | 0.3714 |
| 1-10 | 3.00E-05 | PIPE_10 | 408.1 | 0.473 | 3 | 0.3714 |
| 1-11 | 3.00E-05 | PIPE_11 | 230.301 | 0.658 | 3 | 0.3714 |
| 1-12 | 3.00E-05 | PIPE_12 | 207.402 | -0.903 | 3 | 0.3714 |
| 1-13 | 3.00E-05 | PIPE_13 | 207.402 | -0.903 | 3 | 0.3714 |
| 1-14 | 3.00E-05 | PIPE_14 | 174.513 | 2.14 | 3 | 0.3714 |
| 1-15 | 3.00E-05 | PIPE_15 | 207.302 | -0.902 | 3 | 0.3714 |
| 1-16 | 3.00E-05 | PIPE_16 | 207.302 | -0.902 | 3 | 0.3714 |
| 1-17 | 3.00E-05 | PIPE_17 | 207.402 | -0.902 | 3 | 0.3714 |
| 1-18 | 3.00E-05 | PIPE_18 | 95.0334 | 2.518 | 2 | 0.3714 |
| 1-19 | 3.00E-05 | PIPE_19 | 231.006 | 1.67 | 3 | 0.3714 |
| 1-20 | 3.00E-05 | PIPE_20 | 231.006 | 1.67 | 3 | 0.3714 |
| 1-21 | 3.00E-05 | PIPE_21 | 174.513 | 2.14 | 3 | 0.3714 |
| 1-22 | 3.00E-05 | PIPE_22 | 209.014 | -2.4 | 3 | 0.3714 |
| 1-23 | 3.00E-05 | PIPE_23 | 244 | -3 | 4 | 0.3714 |
| 1-24 | 3.00E-05 | PIPE-24A | 300 | -5 | 5 | 0.075 |
| 1-25 | 3.00E-05 | PIPE_24B | 0 | -5 | 5 | 0.3714 |
| 1-26 | 3.00E-05 | PIPE_25 | 82.8 | -5 | 2 | 0.362 |
| 1-27 | 3.00E-05 | RISER | 200 | 200 | 4 | 0.362 |
| 1-28 | 3.00E-05 | TO-SEP | 70 | 0 | 2 | 0.362 |
| 1-29 | 3.00E-05 | PIPE_1 | 151 | 0 | 2 | 0.3714 |