



Operation Modification of X Gathering Station by Utilizing Existing Production Facilities for Pressure Maintenance Activities and Improving Trunkline Investment Cost Efficiency

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Abstract. X Structure is operated by PT. PERTAMINA EP and located in north Kalimantan. In 2008, the peak production was around 190 BOPD. Currently, X Structure produce 60 BOPD from 8 wells. The oil is transferred using a reciprocating pump with a capacity of 120 m³/hour. The total production from X gathering station and Y gathering station is transferred to MGS along 11.78 Km. Somehow there are leaks on X trunkline to the MGS which caused production loss and environmental pollution. In 2017 AFE-19-22A-736 was made to accommodate the improvement of the trunkline which requires a budget of more than one million USD. The authors see the potential cost reduction from AFE by utilizing existing facilities and adding other benefits such as pressure maintenance for X structure and reduce water level in Y water injection plant. Based on the calculation, the maximum oil thickness in wash tank is 1.6 meters, with a tank height of 6 meters, diameter of 8 meters, and retention time for 63 minutes. X gathering station has a water cut of 95% in wash tank, separation process analysis in actual condition in tank can be set as high as 5.7 meters for the water and 0.3 meters for the oil. The oil stored in the storage tank will be sent by vacuum truck to the storage tank at the MGS.

Based on sonolog data, current X structure pressure is 600 Psi, so it requires pressure maintenance. Modification in operating patterns to carry out pressure maintenance is possible. Previously, this could not be done since there is no WIP in the X structure. Separated water in the wash tank will be injected into the well with a reciprocating pump, along 1 km between the well and the pump, to reduce the water by 2000 BWPD using a pump with capacity of 120 m³ / hour. There will be installed gate valve for circulation into the well and wash tank. it is expected that water will be injected at 70 bbl / hour which can support Pressure Maintenance activities in X structure. Based on the economics calculation, it could save investment about one million USD.

Keyword: X structure; Pressure maintenance; Separation process



1 Introduction

Production Excellence is the most challenging task in this volatile era for producing crude oil from mature field. Beside good performance in operations, Production Excellence can also be defined by having effective control of cost production and continuous identification of opportunities to increase the value of our asset (SPE 131465). Declined well pressure and corrosion in production facilities are problems that we see often in a day to day operation. Therefore, continuous monitoring of well pressure and identification of opportunities in oil gathering system development, oil transport system and pressure maintenance are beneficial to help produce maturing oil field economically.

X Structure has been operated by PT Pertamina EP Asset 5 Tarakan Field since 2008 which produced 2500 BFPD with net oil of 190 BOPD. The Reservoir Pressure continues to decline throughout years and now it reaches 600 Psi with average production of 1227 BFPD and 60 BOPD. Crude oil from X Structure production well is processed at X Gathering Station before being shipped to MGS/Main Gathering Station. Aside of processing X Structure Crude Oil, X Gathering Station also being used as a temporary storage for gross production of Y Mini Gathering Station.

X Gathering Station is one of Gathering Station in Tarakan Oil Field to gather, separate and transfer gross production. Gross production that being processed on X Gathering Station is transferred through 11.78 KM trunkline to MGS/Main Gathering Station using a reciprocating pump with a capacity of 120m³/hour. Aging critical equipment like trunkline is also a major problem in Tarakan Oil Field. Evidently, through 2016 – 2019 there were 13 cases reported of leak trunkline and it caused production loss and environmental pollution. Therefore in 2017, a capital investment to replace 11.78 KM trunkline created under AFE No. AFE-19-22A-736 which required USD 1.134.820.

Upon conditions stated above, the idea of optimizing the existing production facilities is determined. According to the research idea, to postpone declining rate it is necessary to undertake pressure maintenance at X Structure. To solve aging trunkline issue, it is necessary to evaluate transportation system at X Gathering Station. Hence, operation modification of X Gathering Station could deliver production process that is more efficient and effective.

2 Methodology

2.1 Field Optimization Studies (FOS) (OTC 15079)

FOS methodology is used to determine problem solving in Tarakan Oil Field. FOS is a comprehensive systemic investigation of production process. The objective of the study is not to merely identify and select random improvement opportunities but rather to seek the root causes effecting economic performance and strategically redesign the operation for long term improvement. Steps to conduct FOS are as follow: Define the Scope, Gather Initial Data, Form Study Team, Prepare for the Field Visit, Conduct the Field Visit, Evaluate Opportunities, Conclusion.



2.2 X Structure Production Performance Analysis

Complex technical and operational problems are inevitable from producing a mature field. One of potential problem is declined well pressure. Production data of X Structure, and sonolog test are used to evaluate the production performance. Whereat, the evaluation result is being used to ensure pressure maintenance through water injection can be done.

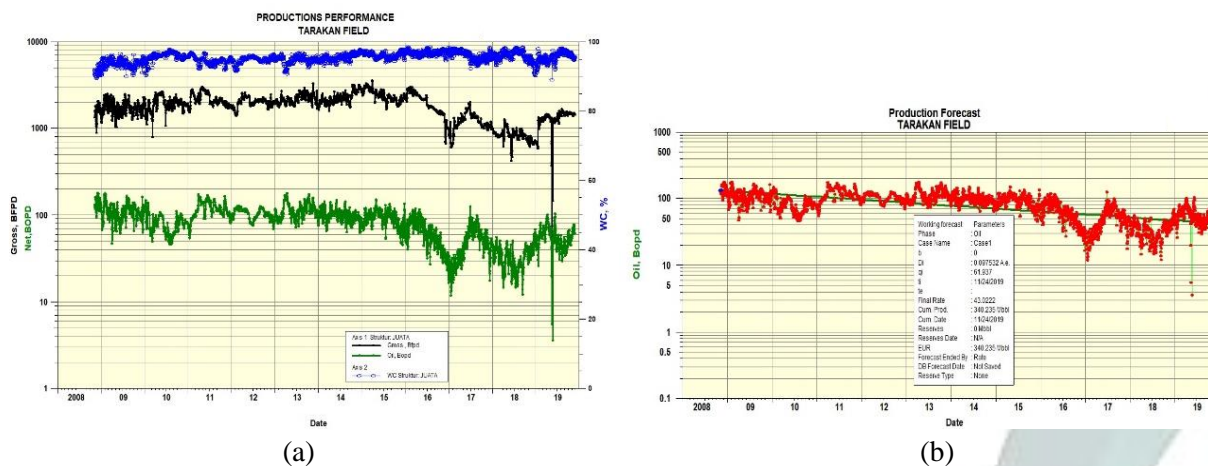


Figure 1. (a) Production Performance of X Structure; (b) Decline Rate of X Structure.

2.3 The Gathering System Analysis at X Gathering Station

Current operational condition of X Gathering Station is as shown at Figure 2. Production from X Structure is gathered in Header Manifold, undergo separation process in Wash Tank then being stored in Storage Tank before shipped to Main Gathering Station. X Gathering Station has also been treating production from Y Mini Gathering Station by injecting chemical before transported to Main Gathering Station. Gross production from X Gathering Station flows through 11.78 KM aging trunkline that was reported to have leaked more than 10 times from 2016 – 2019.

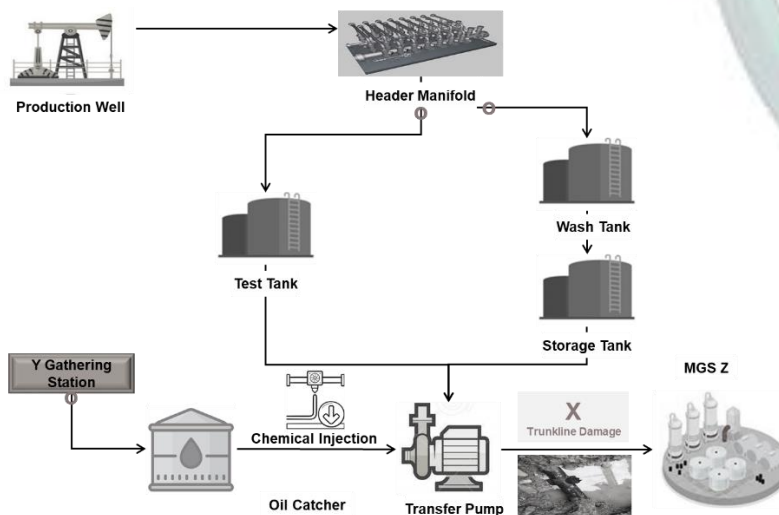


Figure 2. Current Operational Condition of X Gathering Station.



Replacement of 11.78 KM trunkline will cost USD 1.134.820 while not changing it will cause potential losses of 2067 BFPD and environmental pollution. High investment cost and potential production losses of X Gathering Station have lead a research to operation modification of X Gathering Station from sending gross production through trunkline to sending net production using vacuum trucks and utilize produced water for pressure maintenance in X Structure.

Separation Process Analysis is done to calculate the maximum oil level ($H_{o_{max}}$) in Wash Tank. The maximum oil level is used to ensure the current condition of X Gathering Station Production Facilities meet the To-Be operational condition. The calculation steps are as follow:

2.3.1 Settling Equation

$$d = 81,8 \left[\frac{F \cdot Q \cdot \mu_o}{(\Delta SG) \cdot d_m^2} \right] \quad (1)$$

2.3.2 Liquid Capacity Constraint, Retention Time (t_r)

$$d^2 h = \left[\frac{F \cdot t_r \cdot Q}{0,12} \right] \quad (2)$$

2.3.3 Maximum Oil Thickness ($H_{o_{max}}$)

for $d_m = 500$ micron

$$H_{o_{max}} = 320 \frac{(tr)_o \cdot (\Delta SG)}{\mu} \quad (3)$$

2.4 The Transportation System Analysis

To-be condition after operational modification at X Gathering Station is shown in Figure 3. Economical evaluation between trunkline replacement and operation modification is done to get the most profitable transportation system of X Gathering Station.

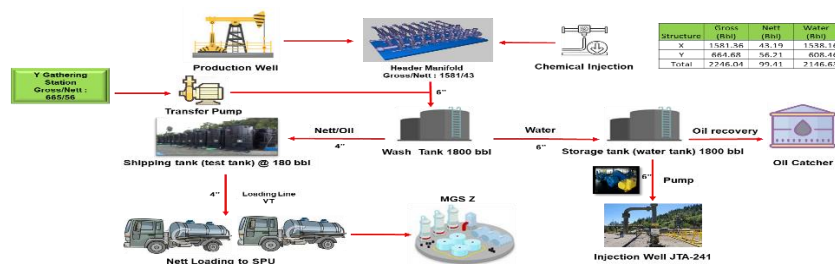


Figure 3. To-Be Operational Condition of X Gathering Station.



3 Result and Discussion

Operation modification of X Gathering Station is calculated conscientiously, starts from defining the parameter, evaluating the production performance, analyzing opportunity of production facilities optimization, until economic evaluation of transportation system. Operational data like well pressure, production rate and water cut are monitored daily. Based on production performance and production forecast in Figure 1, X Structure has 9,7% decline rate with current average well pressure is 600 Psi. Right now, there is no pressure maintenance activities in X Structure because X Gathering Station shipped gross production to the Main Gathering Station. Modification of gathering system at X Gathering Station would allow pressure maintenance activities as shown in Figure 3.

Changing operational patterns of Wash Tank, Storage Tank and Water Tanks of X Gathering Station were analyzed by using Separation Process Analysis by Arnold K. Figure 4 shows the parameter being used to do the separation process analysis as mentioned earlier in 2.3.1 – 2.3.3. The result shows that maximum oil thickness ($H_{o_{max}}$) in X Gathering Station Wash Tank is 1,6 Meters with retention time of 63 Minutes. Separation Process Analysis of X Gathering Station also shown that it has average production water cut of 95%. Therefore, with 6 Meter of tank height, water level in X Gathering Station Wash Tank can be set up to 5,7 Meters with oil level 0,3 Meters as shown in figure 5. The overflow line is located 0,3 Meters from top of Wash Tank. Hence, the current condition can meet the requirement of new gathering system parameter.

Parameter		Units	Number
Temperature	T	F	80.00
Kinematic Viscosity	μ_o	cp	40.00
Diameter water droplets	dm		500.00
Specific gravity oil	SG oil		0.91
specific gravity water	SG water		1.04
	ΔSG		0.13
Flow	Q	BPD	2246.00

Figure 4. Parameter of X Gathering Station for Separation Process Analysis.

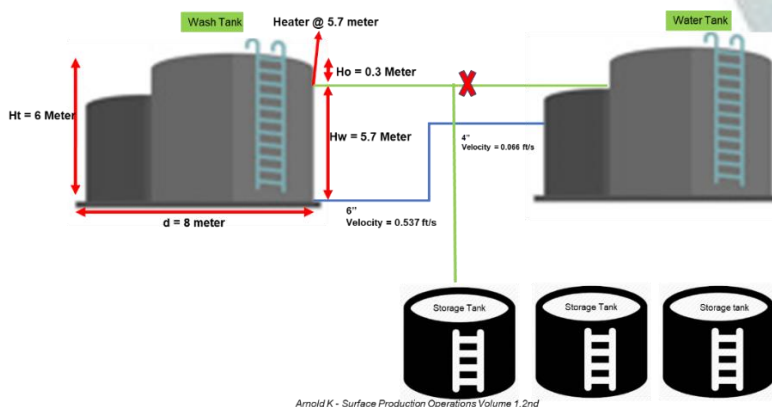


Figure 5. New Gathering System of X Gathering Station.



New Gathering System of X Gathering Station will only ship the net oil production to Main Gathering Station using Vacuum Truck. The produced water of X Gathering Station will be injected to X Structure through X-241 injection well. Around 2000 BWPD of produced water will be injected using pump with 120 M³/Hr of capacity to support pressure maintenance activities. Several modifications of pipeline are needed to maintain the water injection system and operational changes. Change in operational patterns of X Gathering Station will require a total cost of USD 34.062. Therefore, a total cost of USD 1 Million can be saved from capital investment.

4 Conclusion

- Pressure maintenance at X structure can maintain pressure decline and reduce production water at Z Water Injection Plant.
- Net oil will be delivered from X gathering station to Z main gathering station using vacuum truck.
- Modification of X gathering station can be done by designing changes in operating patterns on wash tanks, storage tanks, water tanks and pumps. Based on separation analysis in the wash tank, the thickness of the oil will be designed with a thickness of 0.3 meters and water with 5.7 meters, which is expected to be able to maintain the water level that will be injected into X-241 Well's.
- Modification of X gathering station needs USD 34.062 for additional materials. The operation pattern using Vacuum truck is more profitable compared to X gathering station to MGS trunkline investment requires a budget of USD 1,134,820

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