Using PipelineStudio®
to Simulate Pigging Operations
on an Indonesian Pipeline

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Abstract

PT Perusahaan Gas Negara (Persero), Tbk (PGN) is the Indonesia state-owned company in gas transportation and distribution. SBU Transmisi Sumatera Java is Gas Transportation Business Unit that operates and maintains the transmission pipeline in delivering Natural Gas from gas field in Sumatera Island to the Industrial Customers in Java Island. This paper addresses the experiences of comparing between actual and simulation prognosis for pigging that shall be close each other to ensure the pig shall be arrived pursuant to ETA using TG-Net.

About PGN

PGN started life in 1859 as a privately owned Dutch company called Firma L.I. Enthoven, later coming under Government control and eventually emerging as a state company, named Perusahaan Negara Gas, in 1965. Further transformation saw its status change to a limited liability company owned by the state, and then to a public company with its shares listed on the Indonesia Stock Exchanges.

Today PGN is part state-owned, financially strong and professionally managed, with good corporate governance. Focusing on transportation and distribution of natural gas, PGN connects Indonesia's natural gas sources with users, bringing previously underutilized energy to major markets, as well as having the expertise, the ability and the motivation to look beyond transportation and distribution to integrate up or down the supply chain, securing new sources of energy to meet customers' long-term needs.

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Introduction

South Sumatera – West Java Gas Transmission Pipeline System ("SSWJ") is an open access pipeline that ruled by Access Arrangement (AA) to ensure that SSWJ is operated in a manner which is fair, proper and transparent. Thus, it is needed a tool to get the several useful information in operating or maintaining the gas flow through the pipe. PipelineStudio (TG-Net) is one of the tools that used in PGN as the stand-alone software, and user can perform an offline simulation using various scenarios, such as calculating the ETA for pigging, analyzing the optional equipment for maximum delivery the gas, calculating linepack in the pipeline, calculating the maximum capacity, calculating the nomination, predicting the survival time on emergency case, etc. This paper will focus the subject on the ETA for pigging and analyses the optional equipment on the pipeline for maximum gas flow on the delivery, and the rest have been presented at the 2011 APAC User Group Meeting in Singapore.

SSWJ

Before we go further talking about the advantages of using of TG-Net, it would be helpful to review SSWJ pipeline system first.

Figure 1. is SSWJ which has three supply points and three demand points. All gas from supply 1, 2, and 3 are mixed and will be separated to the parallel pipeline along Palembang to Lampung and again be mixed in the Lampung. From Lampung the pipeline is separated into two pipelines through the offshore until reach each delivery point.

Figure 1. SSWJ Pipeline System

Design of the Network Using Tg-Net

Having reviewed the SSWJ network, it is needed to design the network using Tg-Net, and insert the required parameters of pipeline in the simulation. Below is the design that was created by Tg-net represent the real networking.
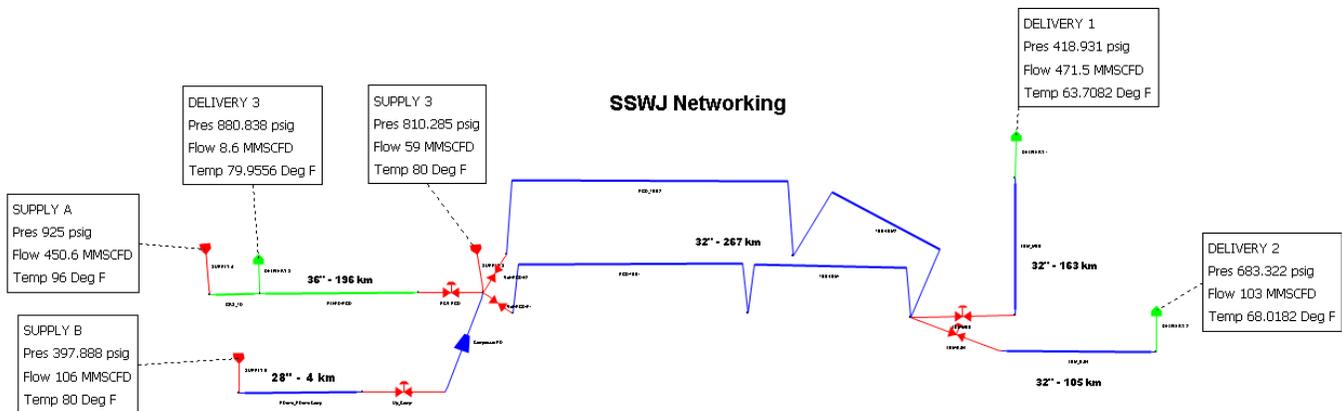

Figure 2. SSWJ Networking

Estimated Time Arrivals (ETA) for Pigging

As a prudent operator and to maintain the pipeline performance, pigging needs to be conducted to clean and inspect the inside of the pipeline.

As a feature in the Tg-net by running the steady state and transient simulation we can calculate the Estimated Time Arrival (ETA) of pig when we perform pigging by using velocity of gas.

What we need to do to get the value of the ETA? First, we need to define the supply, demand and pipe to run the simulation, and then create the scenario using scenario editor. Just click transient simulation and we shall obtain the velocity of gas from starting time until the end of scenario by opening the trend plot feature.

Pigging Section 1

Below are the network and the result obtained using the Tg-net to calculate the ETA for CDG (Corrosion Detection Gyro) pig Section 1 of the network. CDG pig was launched on 20 October 2012 14:52 PM; the result velocity on section 1 is around 2.3 m/s, Pipe Length 193,500 meters, and total Supply/Delivery shall be 486 MMscfd. It means for next day the nomination at the delivery total shall be around 486 MMscfd. By running the transient simulation, the result for Time Travel about 23.14 hours, ETA CDG to be arrived at Point B of Section 1 is on 23 October 2012 14:06 PM.
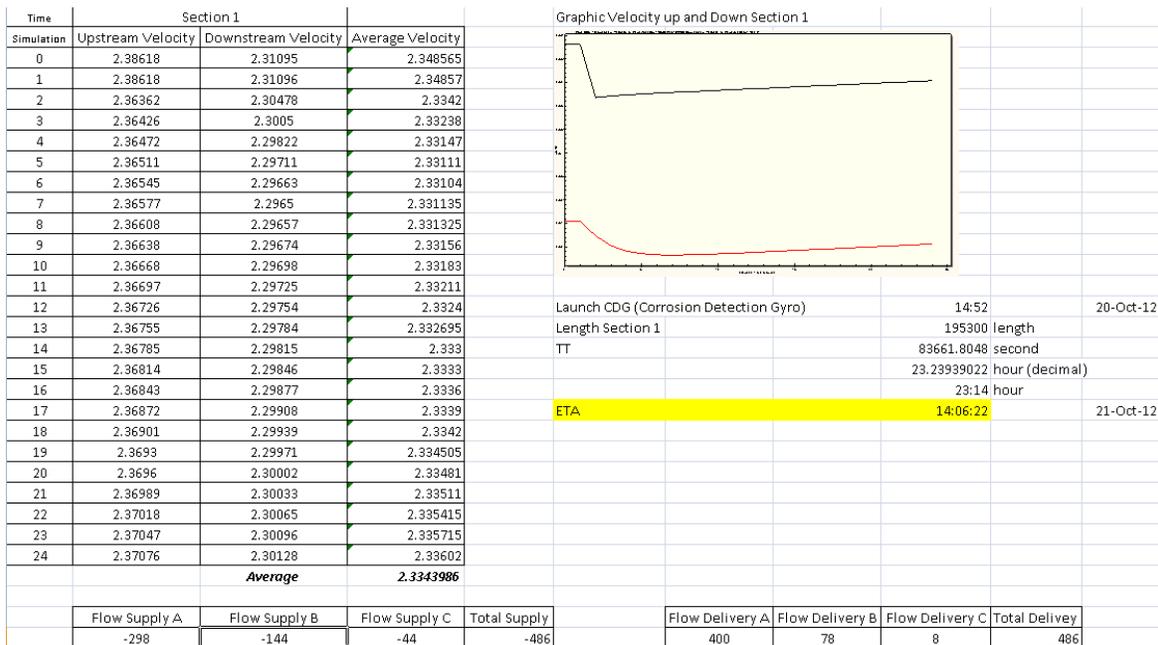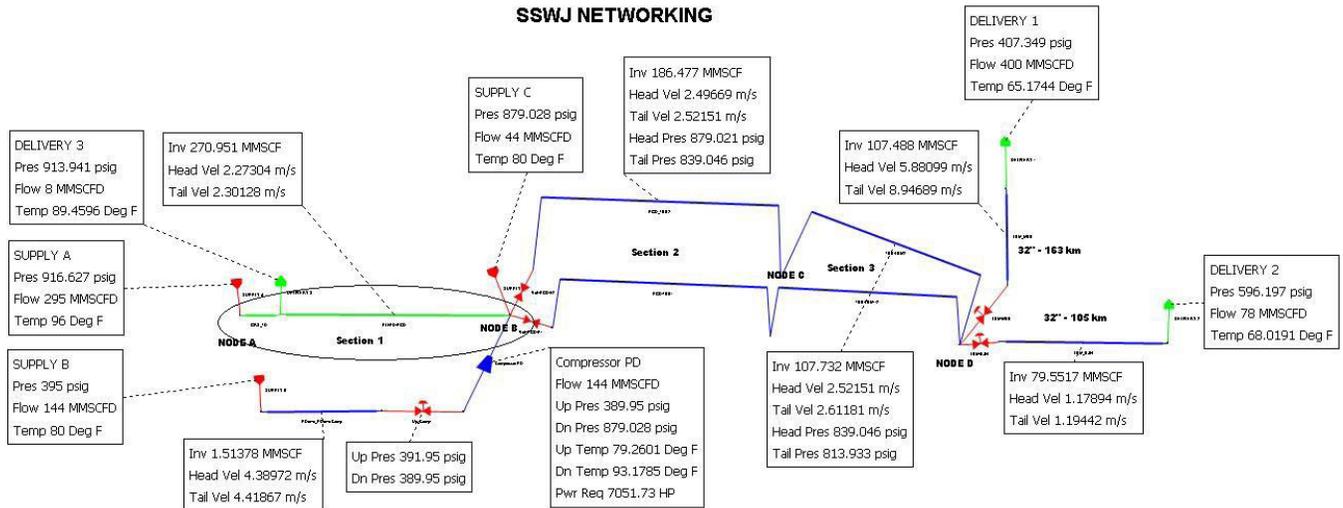

SSWJ NETWORKING

Time	Section 1				Graphic Velocity up and Down Section 1			
Simulation	Upstream Velocity	Downstream Velocity	Average Velocity					
0	2.38618	2.31095	2.348565					
1	2.38618	2.31096	2.34857					
2	2.36362	2.30478	2.3342					
3	2.36426	2.3005	2.33238					
4	2.36472	2.29822	2.33147					
5	2.36511	2.29711	2.33111					
6	2.36545	2.29663	2.33104					
7	2.36577	2.2965	2.331135					
8	2.36608	2.29657	2.331325					
9	2.36638	2.29674	2.33156					
10	2.36668	2.29698	2.33183					
11	2.36697	2.29725	2.33211					
12	2.36726	2.29754	2.3324	Launch CDG (Corrosion Detection Gyro)		14:52	20-Oct-12	
13	2.36755	2.29784	2.332695	Length Section 1		195300	length	
14	2.36785	2.29815	2.333	TT		83661.8048	second	
15	2.36814	2.29846	2.3333			23.23939022	hour (decimal)	
16	2.36843	2.29877	2.3336			23:14	hour	
17	2.36872	2.29908	2.3339	ETA		14:06:22	21-Oct-12	
18	2.36901	2.29939	2.3342					
19	2.3693	2.29971	2.334505					
20	2.3696	2.30002	2.33481					
21	2.36989	2.30033	2.33511					
22	2.37018	2.30065	2.335415					
23	2.37047	2.30096	2.335715					
24	2.37076	2.30128	2.33602					
		Average	2.3343986					

Flow Supply A	Flow Supply B	Flow Supply C	Total Supply		Flow Delivery A	Flow Delivery B	Flow Delivery C	Total Delivey
-298	-144	-44	-486		400	78	8	486

Figure 3. Pigging Section 1

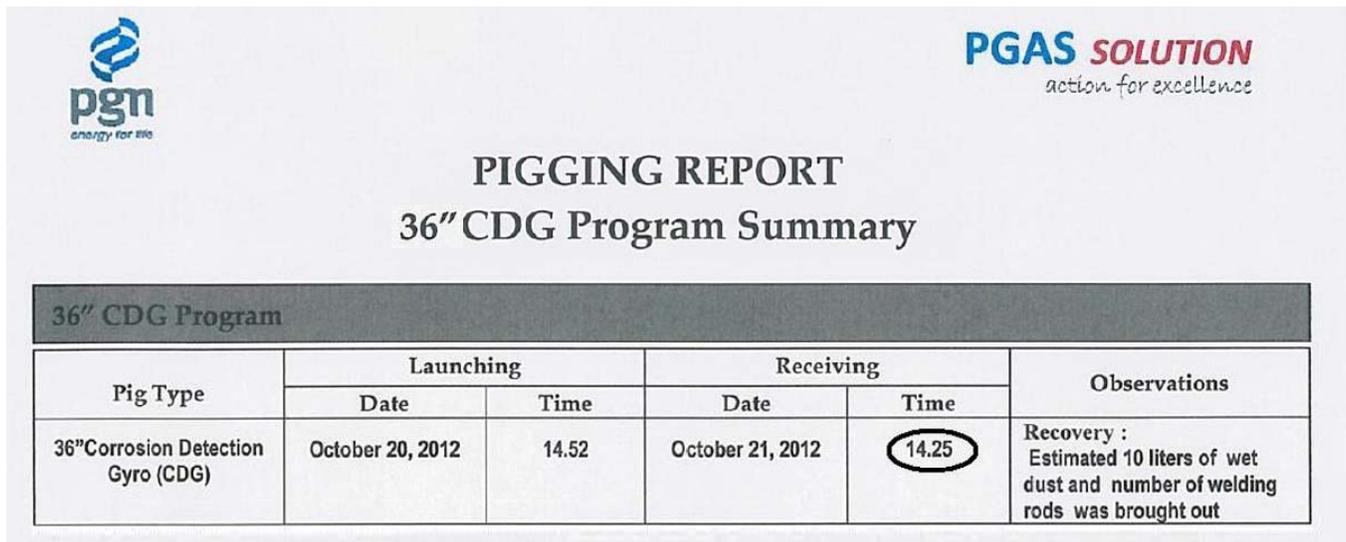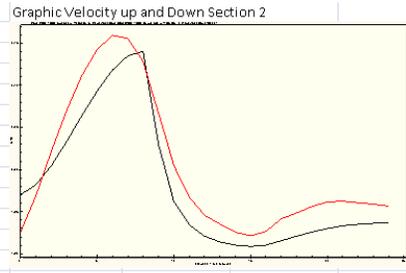Comparing the result from Tg-net with actual ETA, giving the 19 minutes in difference.

Figure 4. Pigging Report Section 1

Pigging Section 2

Below are the network and the result obtained using the Tg-net to calculate the ETA for CDG (Corrosion Detection Gyro) pig Section 2 of the network. CDG pig was launched on 2 November 2012 09:25 AM; the result velocity on section 2 is around 1.9 m/s, Pipe Length 171,000 meters, and total Supply/Delivery shall be 396 MMscfd. It means for next day the nomination at the delivery total shall be around 396 MMscfd. By running the transient simulation, the result for Time Travel about 23.30 hours, ETA CDG to be arrived at Point C of Section 2 is on 3 November 2012 08:55 AM.

SSWJ NETWORKING
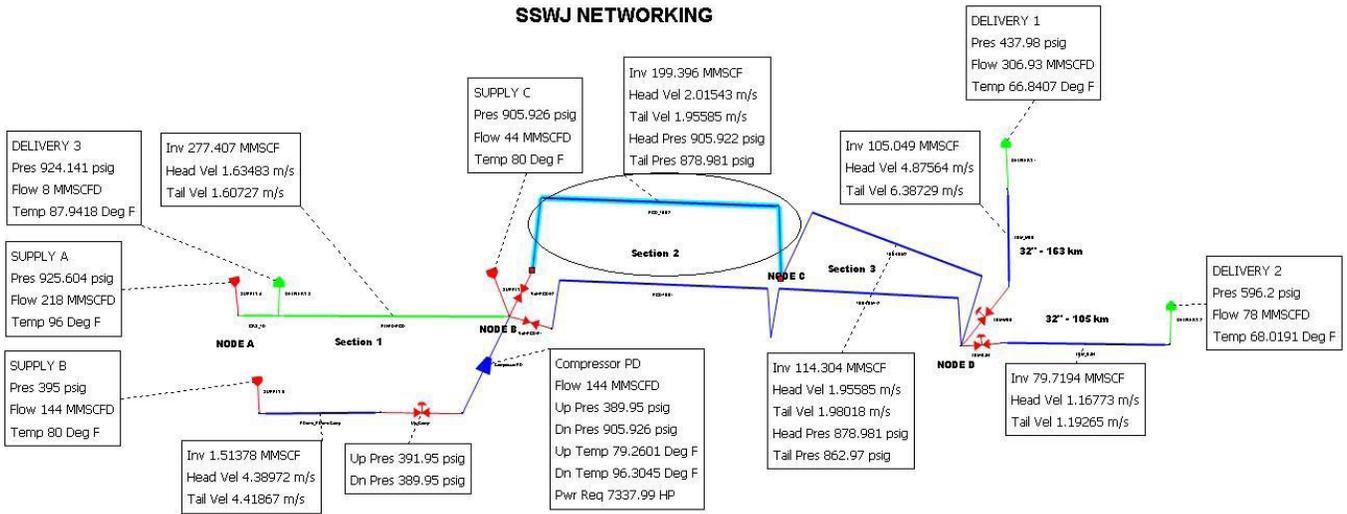
Time	Section 2			Graphic Velocity up and Down Section 2			
Simulation	Upstream Velocity	Downstream Velocity	Average Velocity				
0	1.96285	1.91954	1.941195				
1	1.97366	1.96181	1.967735				
2	1.99578	2.01507	2.005425				
3	2.02412	2.06402	2.04407				
4	2.05445	2.10523	2.07984				
5	2.08362	2.13634	2.10998				
6	2.1085	2.15287	2.130685				
7	2.12549	2.14903	2.13726				
8	2.13125	2.12167	2.12646				
9	2.02079	2.06099	2.04089				
10	2.0156	2.01192	2.01376				
11	2.02555	1.98782	2.006685				
12	2.02551	1.97464	2.000075	Launch CDG (Corrosion Detection Gyro)		9:25	2-Nov-12
13	2.02317	1.96729	1.99523	Length Section 1		171000 length	
14	2.01984	1.95761	1.988725	TT		84643.05676 second	
15	2.01674	1.95184	1.98429			23.51196021 hour (decimal)	
16	2.01559	1.9543	1.984945			23:30 hour	
17	2.01754	1.96597	1.991755	ETA		8:55:43	3-Nov-12
18	2.01943	1.96972	1.994575				
19	2.021	1.97383	1.997415				
20	2.02197	1.97546	1.998715				
21	2.02169	1.97275	1.99722				
22	2.02014	1.96724	1.99369				
23	2.01798	1.96192	1.98995				
24	2.01543	1.95585	1.98564				
		Average	2.0202484				

Flow Supply A	Flow Supply B	Flow Supply C	Total Supply		Flow Delivery A	Flow Delivery B	Flow Delivery C	Total Delivey
-208	-144	-44	-396		310	78	8	396

Figure 5. Pigging Section 2

Comparing the result from Tg-net with actual ETA, giving the 12 minutes in difference.
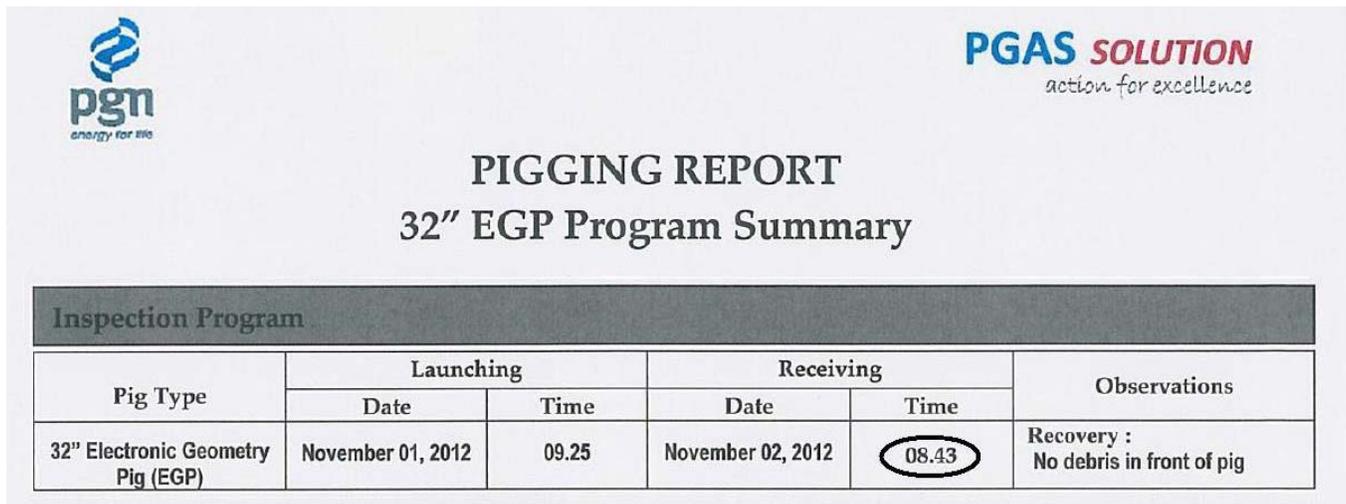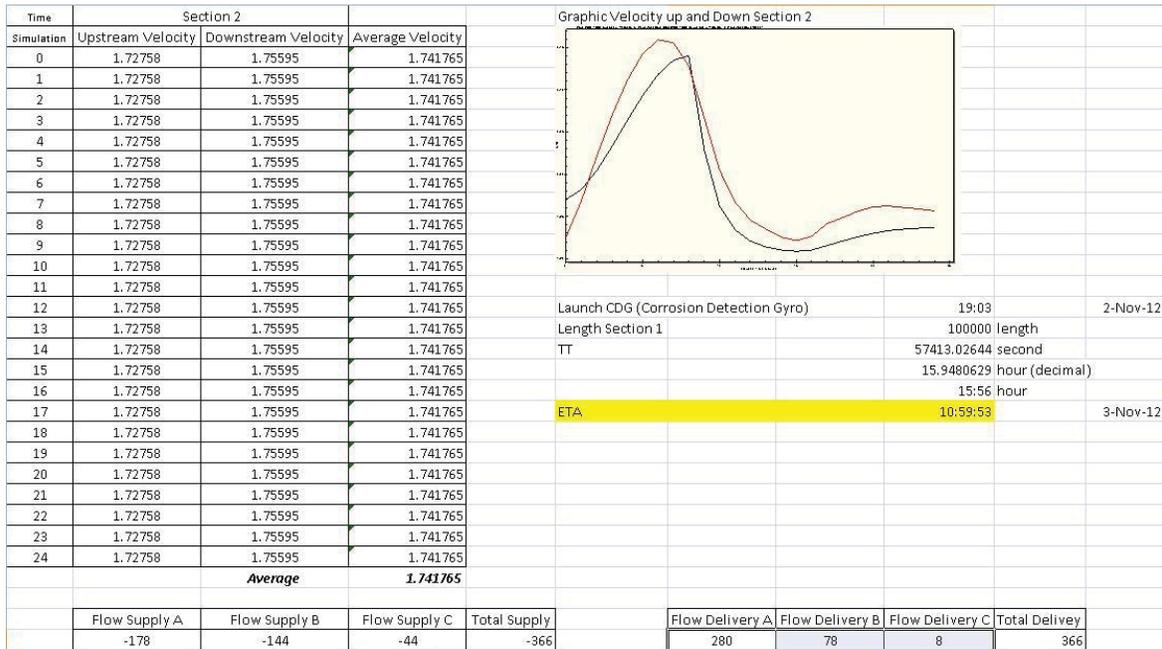

Figure 6. Pigging Report Section 2

Pigging Section 3

Below are the network and the result obtained using the Tg-net to calculate the ETA for CDG (Corrosion Detection Gyro) pig Section 3 of the network. CDG pig was launched on 9 November 2012 19:03 PM; the result velocity on section 3 is around 1.7 – 1.8 m/s, Pipe Length 100,000 meters, and total Supply/Delivery shall be 366 MMscfd. It means for next day the nomination at the delivery total shall be around 366 MMscfd. By running the transient simulation, the result for Time Travel about 15.56 hours, ETA CDG to be arrived at Point D of Section 3 is on 9 November 2012 10:59 AM.

Time	Section 2				Graphic Velocity up and Down Section 2			
Simulation	Upstream Velocity	Downstream Velocity	Average Velocity					
0	1.72758	1.75595	1.741765					
1	1.72758	1.75595	1.741765					
2	1.72758	1.75595	1.741765					
3	1.72758	1.75595	1.741765					
4	1.72758	1.75595	1.741765					
5	1.72758	1.75595	1.741765					
6	1.72758	1.75595	1.741765					
7	1.72758	1.75595	1.741765					
8	1.72758	1.75595	1.741765					
9	1.72758	1.75595	1.741765					
10	1.72758	1.75595	1.741765					
11	1.72758	1.75595	1.741765					
12	1.72758	1.75595	1.741765		Launch CDG (Corrosion Detection Gyro)		19:03	2-Nov-12
13	1.72758	1.75595	1.741765		Length Section 1		100000	length
14	1.72758	1.75595	1.741765		TT		57413.02644	second
15	1.72758	1.75595	1.741765				15.9480629	hour (decimal)
16	1.72758	1.75595	1.741765				15:56	hour
17	1.72758	1.75595	1.741765		ETA		10:59:53	3-Nov-12
18	1.72758	1.75595	1.741765					
19	1.72758	1.75595	1.741765					
20	1.72758	1.75595	1.741765					
21	1.72758	1.75595	1.741765					
22	1.72758	1.75595	1.741765					
23	1.72758	1.75595	1.741765					
24	1.72758	1.75595	1.741765					
		Average	1.741765					

	Flow Supply A	Flow Supply B	Flow Supply C	Total Supply		Flow Delivery A	Flow Delivery B	Flow Delivery C	Total Delivey
	-178	-144	-44	-366		280	78	8	366

Figure 7. Pigging Section 3

Comparing the result from Tg-net with actual ETA, giving the 2 minutes in difference.

Figure 8. Pigging Report Section 3

Conclusions

PipelineStudio – (TG-Net) really useful and helpful to handle any case that needs calculating during the operation of the transmission pipeline. The result from the TG-Net is accurate to the real operation condition, and helps the management to make some planning or decision.

About the Authors

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Herlenika currently works as Gas Planning Engineer for PT. Perusahaan Gas Negara (Persero) Tbk. She has six years' experience in the gas industry, especially in gas planning and pipeline hydraulics.

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