APPENDIX A

The following is the complete test data from different flow meters trialled sequentially in time. In most cases only the diaphragm and PD meters were trialled. The turbine meter was out of range for the vent flowrates of all tests except tank tests 5 and 17. The standard deviation was calculated for the PD and turbine meter flowrate measurements. Generally, standard deviation of the flowrate could not be calculated for the diaphragm meter because flowrates were low and there were too few data points of volume). The diaphragm meter only logged volume when the volume changed by 1 cubic foot.

Table 17 —Test Data of Total Tank Vent Gas with Flow Meters

		Diaphragm Meter						*Positive Displacement Meter*						*Turbine Meter*					
Site trip	Tank test	Actual flow (m^3/d)	Actual temp. (°C)	Actual pressure (kPa_a)	Duration of test (min)	Standard flow (S m^3/d)	Flow Std Dev (Sm^3/d)	Actual flow (m^3/d)	Actual temp. (°C)	Actual pressure (kPa_a)	Duration of test (min)	Standard flow (S m^3/d)	Flow Std Dev (S m^3/d)	Actual flow (m^3/d)	Actual temp. (°C)	Actual pressure (kPa_a)	Duration of test (min)	Standard flow (S m^3/d)	Flow Std Dev (Sm^3/d)
1	1	18.5	25.4	92.9	77	16.4	N/A	19.7	27.2	92.6	45	17.3	10						
2	2	5.5	20.3	91.6	59	4.9	N/A	11.6	19.0	91.4	62	10.3	9						
3	3	64.6	10.5	92.9	73	60.1	N/A	73.1	14.2	92.7	48	67.0	78						
3	4	0.0	4.0	93.6	120	0.0	N/A	0.0	5.8	93.4	38	0.0	0						
3	5	6.2	11.6	93.3	132	5.8	N/A	0.0	8.2	93.5	40	0.0	0	680.4	17.1	93.0	41	619.1	129.5
4	6	11.6	15.5	93.5	49	10.7	N/A	31.1	18.0	94.9	40	28.8	3						
4	7	0.0	14.0	95.2	120	0.0	N/A	0.0	21.7	94.8	46	0.0	0						
5	8	12.6	18.9	94.2	45	11.5	N/A	29.2	18.6	94.0	40	26.7	8						
6	9	40.8	34.0	93.9	50	35.5	N/A	47.0	32.8	93.7	48	40.9	9						
7	10	0.0	26.0	91.4	150	0.0	N/A	9.1	28.7	93.3	44	8.0	8						
7	11	9.7	21.0	92.8	59	8.7	N/A	30.3	25.0	94.2	44	27.2	5						
8	12	52.5	25.0	94.9	59	47.5	N/A	68.1	26.2	94.2	60	61.0	17						
8	13	28.6	24.9	93.7	50	25.6	N/A	30.3	25.0	94.2	44	27.2	5						
9	14	11.4	20.8	92.1	50	10.2	N/A	21.3	17.7	93.1	48	19.4	13						
10	15	2.0	13.8	95.6	41	1.9	N/A	0.0	16.9	94.0	0	0.0	0						
11[12]	16																		
12	17	0.0	22.1	92	110	0	N/A	710.1	22.2	95	48	646	6	554.1	23.7	93	41	491.3	6.0
13	18	5.4	22.5	92.4	23	4.8	N/A	0.0	18.2	94.5	48	0.0	0						
13	19	7.1	26.8	91.6	64	6.1	N/A	0.0	27.0	94.3	50	0.0	0						
14	20	28.7	31.5	94.9	45	25.5	N/A	42.4	31.7	94.6	48	37.4	6						
15	21	0.0	44.7	95.4	>45	0.0	N/A	17.9	25.4	95.1	54	16.2	8						
16	22	3.0	23.6	94.7	14	2.7	N/A	11.7	23.6	95.0	50	10.6	18						
17	23	0.0	28.2	94.7	>45	0.0	N/A	19.3	21.5	94.5	60	17.6	6						
18[13]	24	0.0	16.5	94.1	>45	0.0	N/A	0.0	17.0	93.8	50	0.0	4						
19	25	16.2	15.9	94.0	45	14.9	N/A	45.4	15.5	93.7	54	45.6	15						
20	26	0.0	24.6	0.0	>45	0.0	N/A	15.8	18.4	94.0	54	14.5	7						
21	27	0.0	29.4	94.8	>45	0.0	N/A	4.5	27.1	94.6	46	4.0	4						
22	28	0.0	29.5	94.5	>45	0.0	N/A	0.0	31.0	94.4	48	0.0	0						
23	29	0.0	29.5	94.2	>45	0.0	N/A	0.0	31.8	94.1	48	0.0	0						

[12] Testing halted due to poor weather conditions.
[13] Wind blew off hose during testing.

APPENDIX B

Table 18 — Complete Gas in Solution Data

			Sample 1						Sample 2						Sample 3							
Site trip	Tank test	Aver. BS&W (%)	Sample weight (g)	Liquid Volume (mL)	Density (g/mL)	Test Gas Vol. (mL)	Std. Gas Vol. (mL)	GIS (S m^3/m^3)	Sample weight (g)	Liquid Volume (mL)	Density (g/mL)	Test Gas Vol. (mL)	Std. Gas Vol. (mL)	GIS (S m^3/m^3)	Sample weight (g)	Liquid Volume (mL)	Density (g/mL)	Test Gas Vol.(mL)	Std. Gas Vol. (mL)	GIS (S m^3/m^3)	Average GIS (S m^3/m^3)	STD DEV GIS (S m^3/m^3)
1	1	36%	52.77	55.68	0.948	60	55	0.98	33.24	33.59	0.99	70	64	1.89	54.4	55.87	0.97	105	95	0.91	1.26	0.550
2	2	21%	65.32	64.82	1.008	90	82	1.26	48.58	49.39	0.984	110	100	2.02	66.29	65.18	1.02	115	105	0.91	1.40	0.570
3	3	91%	80.34	78.82	1.02	85	77	0.98	76.48	70.81	1.03	80	73	1.03	83.57	81.19	1.03	100	91	0.91	0.97	0.059
3	4	91%	70.3	69.41	1.013	70	64	0.92	77.66	77.73	0.999	90	82	1.05	-	-	-	-	-	-	0.98	0.096
3	5	31%	83.86	83.62	1.002	90	82	0.98	74.1	73.79	1.004	90	82	1.11	80.7	81.53	0.989	85	77	0.91	1.00	0.101
4	6	8%	59.8	60.2	0.993	100	91	1.51	44.15	46.83	0.943	95	86	1.84	60.24	61.04	0.986	130	118	0.91	1.42	0.474
4	7	8%	58.77	63.59	0.924	110	100	1.57	64.33	64.49	0.9975	125	114	1.76	53.53	54.27	0.985	120	109	0.91	1.41	0.448
5	8	96%	45.41	46.65	0.973	75	68	1.46	17.92	15.14	1.18	35	32	2.10	14.86	14.11	1.053	35	32	0.91	1.49	0.597
6	9	21%	63.31	63.96	0.99	110	100	1.56	67.38	66.72	1.01	100	91	1.36	71.78	72.74	0.987	100	91	0.91	1.28	0.335
7	10	46%	43.4	43.4	1	60	55	1.26	62.96	63.18	0.997	80	73	1.15	75.88	77.32	0.981	95	86	0.91	1.11	0.178
7	11	63%	62.75	64.1	0.98	110	100	1.56	75.06	77.42	0.97	120	109	1.41	22.58	22.53	1.002	40	36	0.91	1.29	0.341
8	12	89%	57.59	58.19	0.99	125	114	1.95	67.69	69.37	0.976	160	145	2.10	57.63	58.84	0.98	125	114	0.91	1.65	0.648
8	13	5%	81.42	83.76	0.972	170	155	1.84	65.89	68.28	0.965	125	114	1.66	60.56	62.8	0.964	110	100	0.91	1.47	0.496
9	14	86%	61.98	62.13	0.997	90	82	1.32	18.84	17.7	1.06	20	18	1.03	26.94	27.63	0.975	60	55	0.91	1.08	0.210
10	15	85%	13.74	13.24	1.038	30	27	2.06	15.79	14.87	1.062	30	27	1.83	20.01	19.51	1.026	50	45	0.91	1.60	0.610
11[14]	16																					
12	17	31%	83.86	83.63	1.003	90	82	0.98	74.1	73.79	1.004	90	82	1.11	80.7	81.53	0.99	85	77	0.91	1.00	0.101
13	18	98%	75.1	73.81	1.017	85	77	1.05	72.47	74.09	0.978	80	73	0.98	73.82	71.82	1.03	85	77	0.91	0.98	0.069
13	19	98%	86.36	81.86	1.055	90	82	1.00	74.78	73.08	1.023	85	77	1.06	76.2	72.7	1.05	85	77	0.91	0.99	0.075
14	20	23%	67.05	70.08	0.957	120	109	1.56	80.46	81.65	0.99	145	132	1.61	67.4	70.1	0.961	125	114	0.91	1.36	0.392
15	21	75%	72.76	77.13	0.942	120	109	1.41	75.56	75.68	0.998	90	82	1.08	73.73	77.96	0.946	115	105	0.91	1.13	0.257
16	22	87%	68.27	69.8	0.978	180	164	2.34	72.29	74.25	0.974	155	141	1.90	72.13	74.45	0.969	145	132	0.91	1.72	0.734
17	23	96%	39.72	39.6	1.003	80	73	1.84	60.53	60.15	1.006	95	86	1.44	64.67	65.68	0.985	110	100	0.91	1.39	0.465
18[15]	24	73%																				
19	25	71%	68.35	73.11	0.935	125	114	1.55	57.53	61.16	0.941	155	141	2.30	51.17	53.81	0.951	140	127	0.91	1.59	0.698
20	26	19%	78.78	81.11	0.971	135	123	1.51	72.37	75.81	0.954	135	123	1.62	68.23	70.68	0.965	135	123	0.91	1.35	0.383
21	27	93%	52.77	51.15	1.032	110	100	1.95	68.6	66.95	1.025	150	136	2.04	78.04	79.95	0.976	150	136	0.91	1.63	0.629
22	28	58%	75.06	77.88	0.964	135	123	1.58	77.55	80.32	0.966	130	118	1.47	71.19	74.02	0.962	110	100	0.91	1.32	0.359
23	29	40%	92.05	88.38	1.04	100	91	1.03	69.91	72.79	0.9605	140	127	1.75	80.27	84.73	0.947	145	132	0.91	1.23	0.454

[14] Testing halted due to weather an no GIS samples were taken.
[15] GIS samples contained only water and no gas nor oil.

The following is the procedure for GIS analysis of multiple samples from each site of the production liquid:

GIS Analysis Procedure

1) Using the syringe pump, set the pressure to 200 PSI and pressurize the sample cylinder with distilled water. Record the volume and the beginning and end of this step and note how much sample is in the cylinder
   (Sample container-(start volume-end volume) = Sample volume
2) Store in the oven at 50^{o}C (give the cylinder at least 4 hours to reach temperature)
3) Remove sample cannister from oven and wrap with silicone heater (heater should be set to approx. 70^{o}C), then attach the syringe pump injection line to the bottom port of the sample cannister and ensure pressure is still at 200 PSI (turn on the syringe pump and open the bottom valve of the sample cannister). Attach the sample outlet line to the top port of the sample cylinder (this will connect to our collection flask)
4) Allow the sample cannister to sit for at least 15 minutes with the heater on to help the oil and water separate so the oil is at the top to provide the sample.
5) Weigh out the collection flask. Take the collection flask and rubber stopper and connect to the gas meter, using Argon purge the flask and gas-meter (300 ml 3 times) to ensure as little air as possible is in the flask and gasmeter.
6) Before connecting the collection flask to the sample cannister purge the sample outlet line from the sample container to purge any gas or fluid (might hear a pop due to the gas cap inside the sample cannister) purge and let the sample flow for 3-5 seconds with constant sample coming out. Attach the collection flask now to the sample outlet line. Ensure the gasmeter has been fully vented and is reading zero.
7) Record the syringe pumps volume (initial volume) and the gasmeters volume (should be 0) and place the gasmeter valving into the sample collecting position
8) Ensure the collection flask is immersed in a hot water bath at around 85C to help the gas flash from the oil.
9) Open the top valve on the sample cannister to let the sample start flowing into the collection flask. Fill the flask to about 75 ml or with as much sample as possible depending on how much sample there was determined to be in step 1.
10) Allow the sample to sit in the flask for 15-45 min (or until bubbles stop forming) to ensure that all the gas in solution has been removed.
11) Record the final volume of the syringe pump, the final volume on the gas meter
12) Turn the gasmeter to the closed position and disconnect the gas meter from the flask and quickly cover the end of the tubing to prevent any air escaping or entering the tube. Hook that ends to the Micro GC and analyze the gas (switch the gas meter to sampling position when doing analysis)
13) Disconnect the collection flask from all the tubing and weigh the flask with the oil in it (be careful as it will be hot)

Fig. 22 — Total set up for GIS samples.
On the left is the syringe pump, middle is the heated bath and sample container, and gas meter on the right

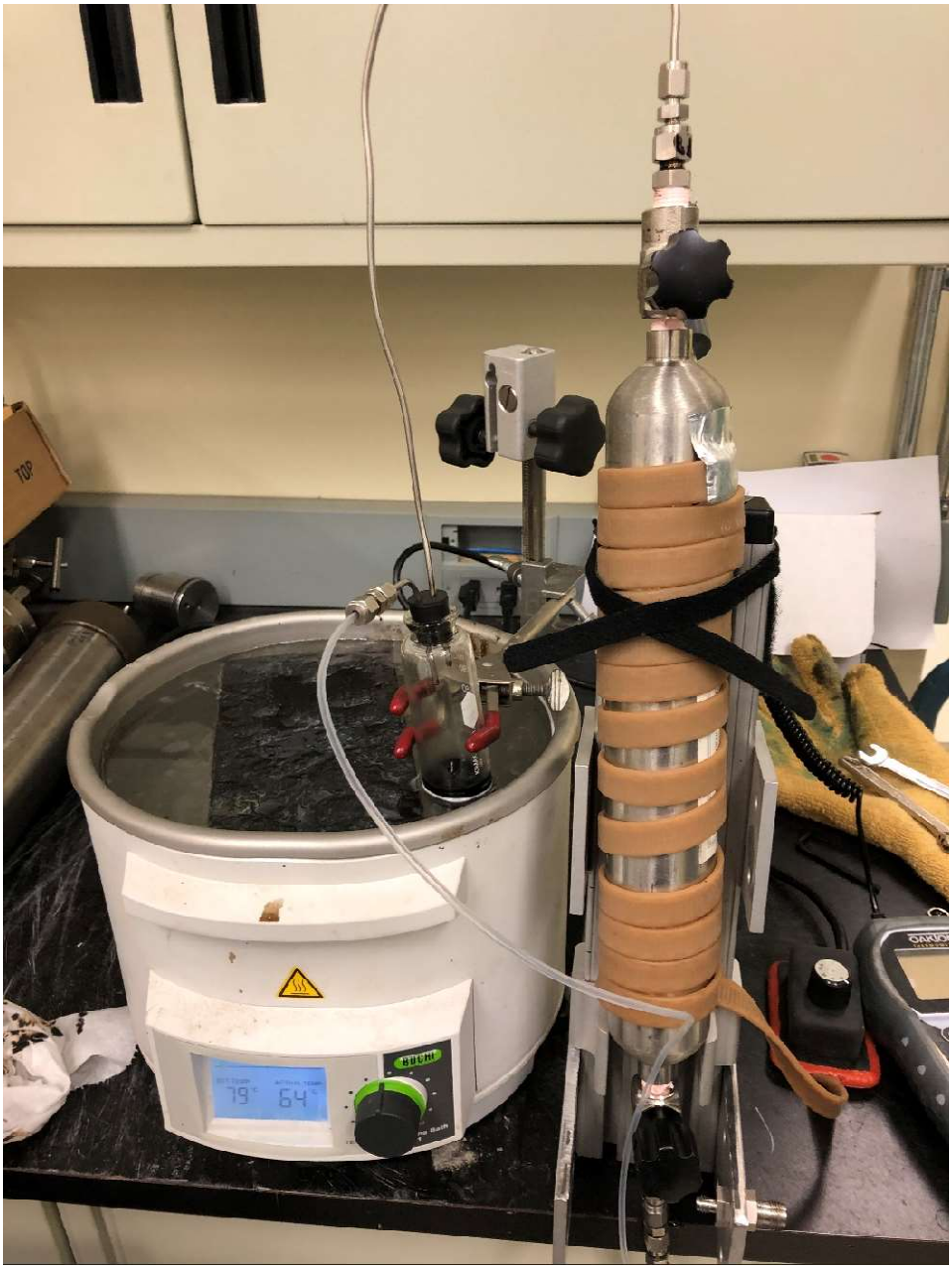

Fig. 23 — Sample cannister and heated bath

Fig. 24 — Gasometer