

# XYZ COMPANY LTD.

Prepared For:  
JOHN DOE

XYZ et al Knopcik  
100/01-02-003-04-W5/06

## **PRESSURE TRANSIENT ANALYSIS**

PAS-TRG

Dinosaur Park Formation

673.00 – 676.00 mKB

Test Date: October 2 – 8, 2004

Release Date: May 5, 2008

Job No.: 08.001

Prepared by:





# ANALYSIS SUMMARY

Company:	XYZ Company Ltd.	Test Date:	<b>October 2 – 8, 2007</b>
Contact:	John Doe	Report Date:	May 5, 2008
Well Name:	XYZ et al Knopck	Job Number:	08.001
Location:	100/01-02-003-04-W5/06	Formation:	Dinosaur Park (673.00 – 676.00 mKB)

Objective:	The test was conducted to determine the reservoir/fracture parameters and flow characteristics from the buildup then predict the well deliverability from the test results. The test was to fulfill the well's deliverability and reservoir pressure requirements for EUB file submission.
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Data Preparation:	<ul style="list-style-type: none"> <li>The reservoir pressure was obtained from the post frac surface flow &amp; buildup test data conducted from October 2 – 8, 2004. The welltest data was recorded at surfacing using an electronic data acquisition system. The surface casing (quiet side) pressures were extrapolated to the gas-water interface depth (LLD = 585.6 m) using Cullinder and Smith correlation and further to the mid point of the perforated interval (MPP = 674.50 mKB) using an assumed water gradient of 9.796 kPa/m.</li> <li>The rate data used in the interpretation was from the testers "Fieldnotes".</li> <li>A conventional Log-Log diagnostic plot was constructed to identify the flow regimes during the pressure buildup response. The pressure transient response was indicative of a fractured reservoir, as bilinear and linear (fracture) flow regimes were identified and eventually radial flow conditions developed during the late-time buildup.</li> <li>The test was analyzed and model matched to a Finite Conductivity Fracture model using a ½ section drainage area. The model results were used to indicate a stabilized rate after 3 months of production, AOF and perform a deliverability forecast.</li> <li>All pressures are absolute assuming 93 kPa.</li> </ul>
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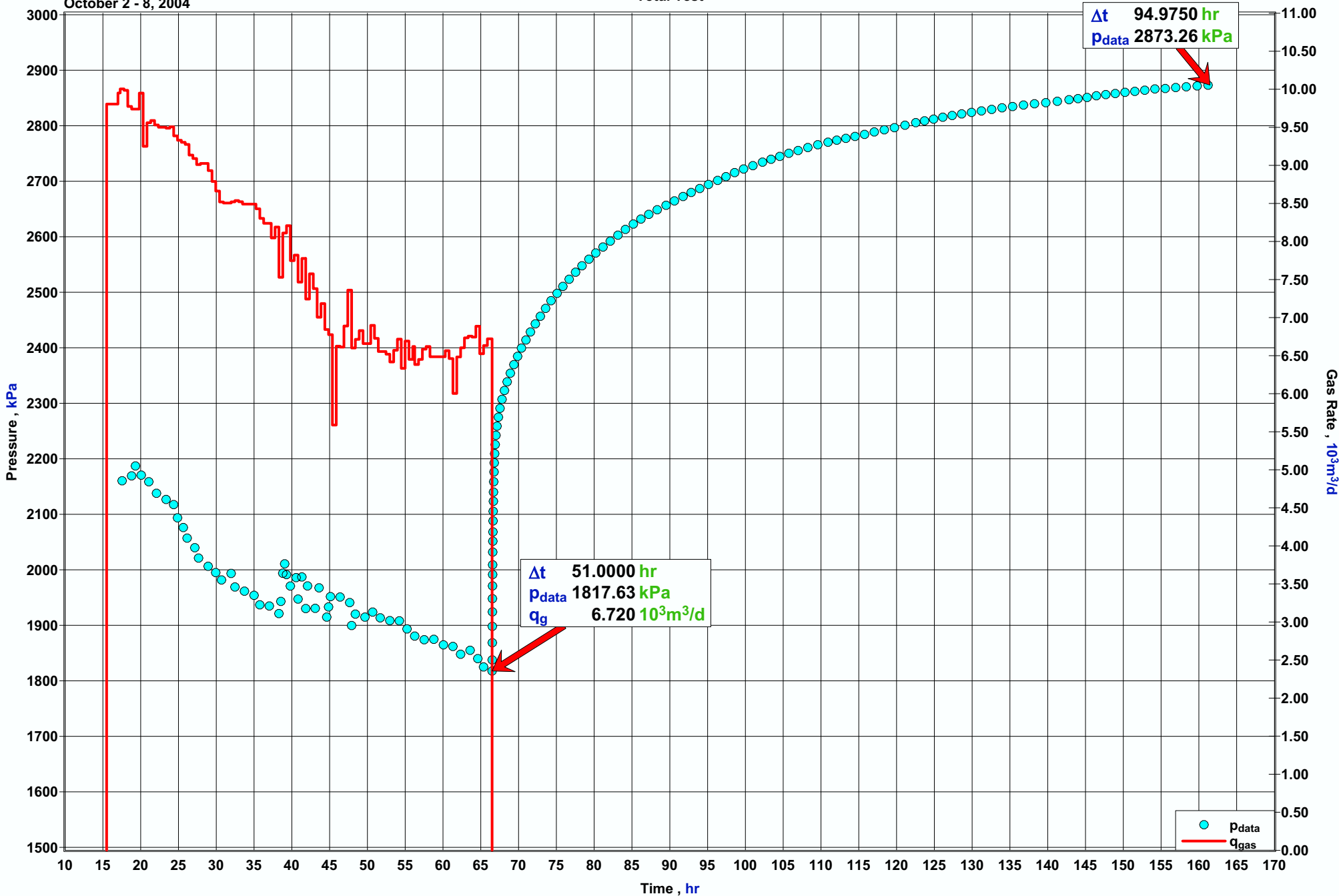
Results:	Reservoir Pressure ( $P_{i(syn)}$ )	3014	kPaa	
	Final Casing Shut In Pressure ( $P_{sic}$ )	1944	kPaa	
	Final Sandface Shut In Pressure ( $P_{si}$ )	2873	kPaa	
	Flow Duration	51	Hr	
	Final Surface Tubing Pressure ( $P_{wft}$ )	698	kPaa	
	Final Sandface Flowing Pressure ( $P_{fws}$ )	1818	kPaa	
	Reservoir Flow Capacity (kh)	7.6	mDm	
	Reservoir Permeability (k)	2.5	mD	
	Fracture Half Length (Xf)	33	M	
	Apparent Skin Factor ( $s'$ )	-4.4		
	Final Gas Rate ( $q_g$ )	6.72	$10^3 m^3/d$	
	Test Sandface AOF <sub>st</sub>	10.5	$10^3 m^3/d$	n = 1
	Stabilized Sandface AOF <sub>st</sub>	5.0	$10^3 m^3/d$	n = 1 (3 months)
	Test Wellhead WAOF <sub>f</sub>	7.1	$10^3 m^3/d$	n = 1
	Stabilized Wellhead WAOF <sub>st</sub>	3.4	$10^3 m^3/d$	n = 1 (3 months)

Redress:	Should you have any questions or concerns, please email <a href="mailto:slavin-away@lonewolfssolutions.ca">slavin-away@lonewolfssolutions.ca</a>
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XYZ Company Ltd.  
100/01-02-003-04w5/06  
Dinosaur Park (673 - 676 mKB)  
October 2 - 8, 2004

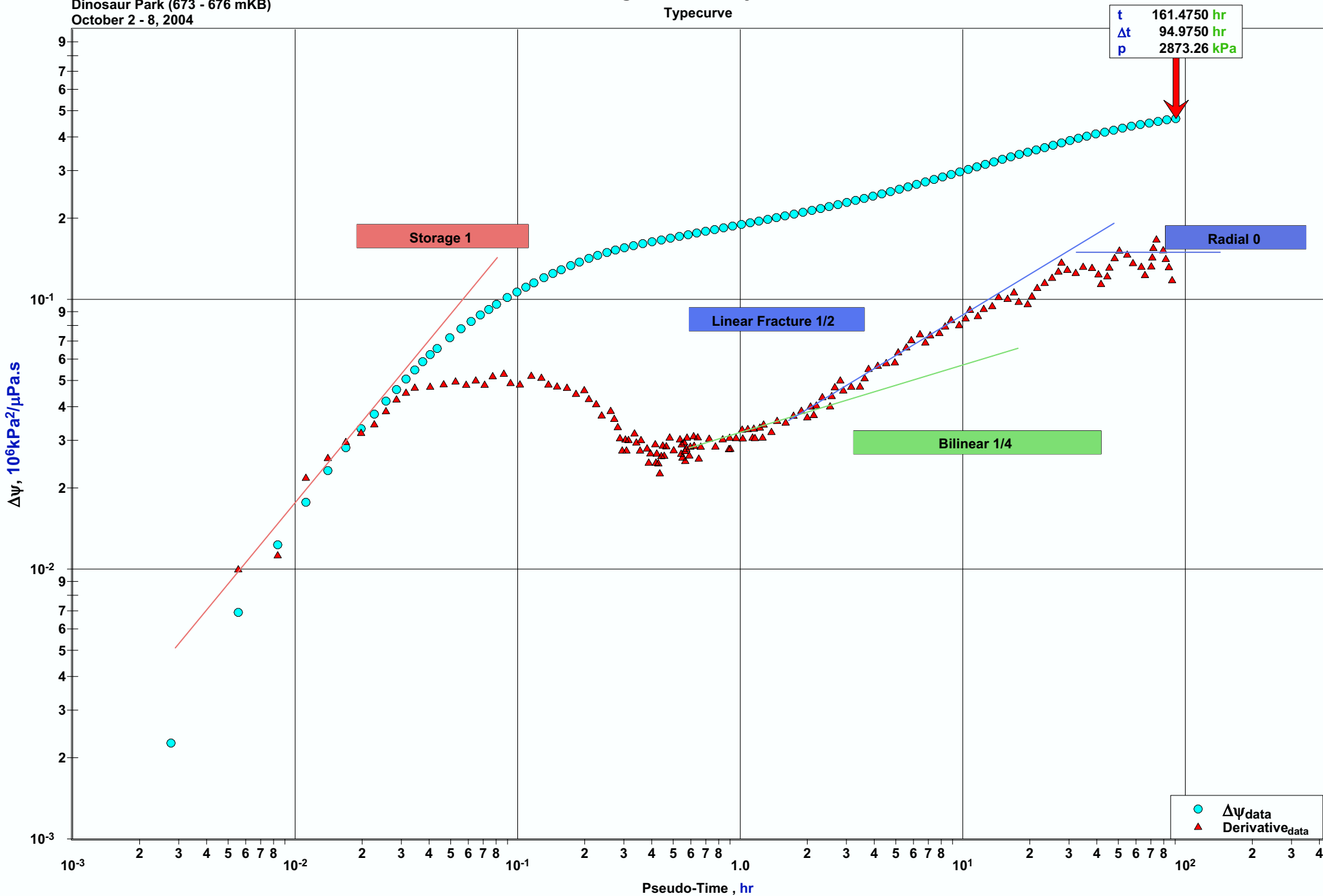
### Calculated Pressure @ MPP=674.5 mKB

Total Test



# Diagnostic Analysis 1

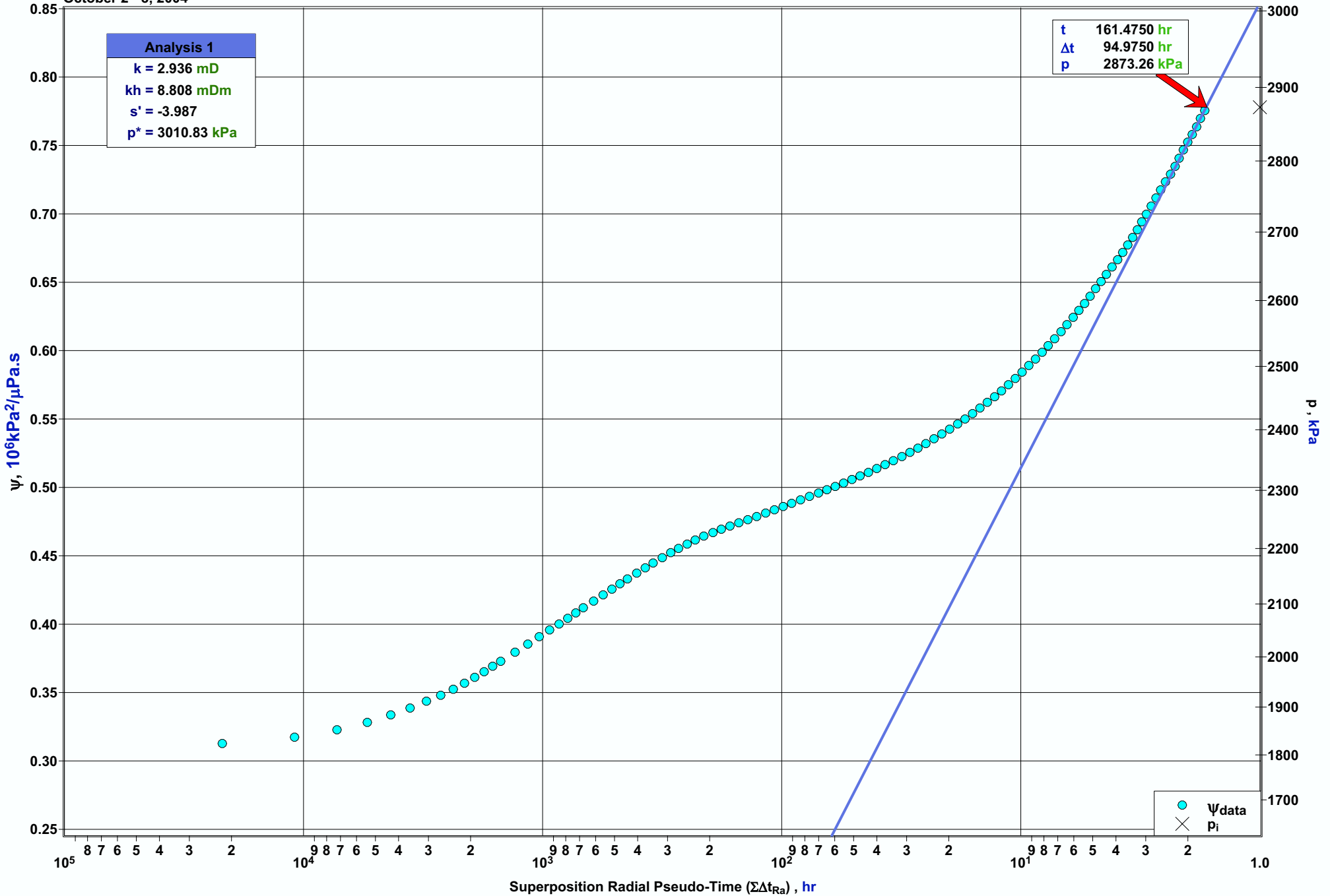
Typecurve



XYZ Company Ltd.  
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# Diagnostic Analysis 1

Radial



# Gas Well Test - Buildup

## Radial Flow Analysis

XYZ Company Ltd.  
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### Analysis Results

Total Sandface Rate ( $q_t B_t$ )	229.889 m <sup>3</sup> /d	Apparent Skin (s')	-3.987
Semilog Slope (m)	9.13	Skin - Damage	-3.987
Gas Permeability ( $k_g$ )	2.936 mD	Skin - Inclination	
Oil Permeability ( $k_o$ )	mD	Skin - Partial Penetration	
Water Permeability ( $k_w$ )	mD	Pressure Drop Due to Skin ( $\Delta p_s$ )	-226586.71 kPa
Flow Capacity (kh)	8.808 mD.m	Damage Ratio (DR)	0.284
Total Mobility ( $k/\mu_t$ )	259.48 mD/mPa.s	Flow Efficiency (FE)	3.522
Total Transmissivity ( $kh/\mu_t$ )	778.43 mDm/mPa.s		

### Reservoir Parameters

Net Pay (h)	3.00 m
Total Porosity ( $\phi_t$ )	20.00 %
Water Saturation ( $S_w$ )	35.00 %
Oil Saturation ( $S_o$ )	0.00 %
Gas Saturation ( $S_g$ )	65.00 %
Wellbore Radius ( $r_w$ )	0.150 m
Formation Temperature (T)	25.8 °C
Formation Compressibility ( $c_f$ )	5.289e-7 kPa <sup>-1</sup>
Total Compressibility ( $c_t$ )	2.425e-4 kPa <sup>-1</sup>

### Pressures

Initial Pressure ( $p_i$ )	2873.26 kPa
Extrapolated Pressure ( $p^*$ )	3010.83 kPa
Final Flowing Pressure ( $p_{wfo}$ )	1817.63 kPa

### Production and Times

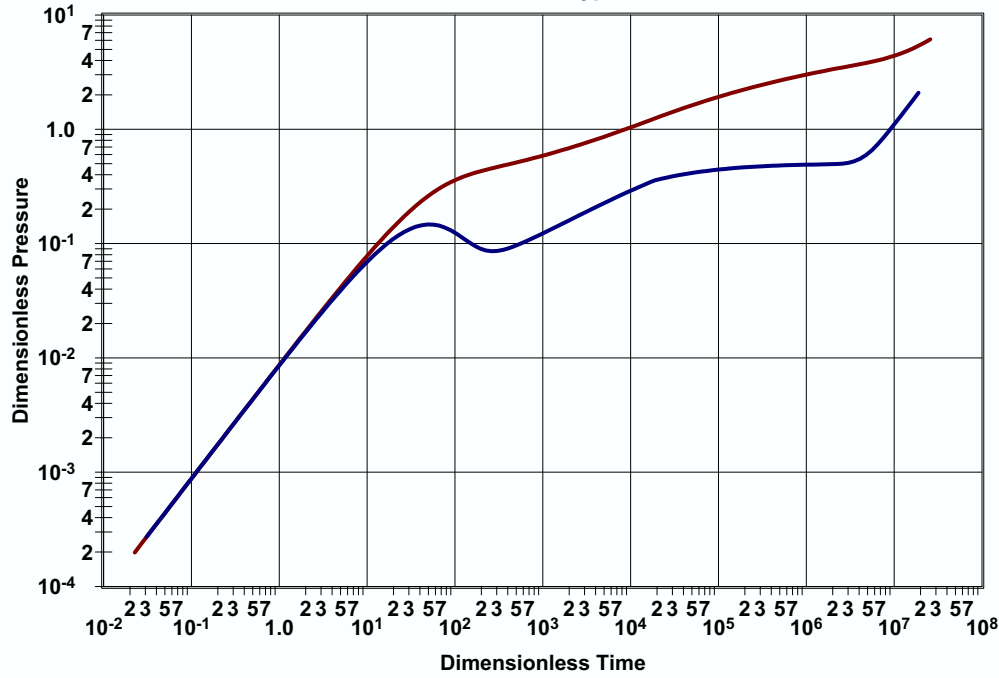
Corrected Flow Time ( $t_c$ )	59.3978 hr
Cumulative Gas Production	16.632 10 <sup>3</sup> m <sup>3</sup>
Final Gas Rate	6.720 10 <sup>3</sup> m <sup>3</sup> /d

### Fluid Properties

Gas Gravity (G)	0.656
N <sub>2</sub>	1.72 %
CO <sub>2</sub>	2.60 %
H <sub>2</sub> S	0.00 %
Critical Pressure ( $P_c$ )	4681.36 kPa
Critical Temperature ( $T_c$ )	205.08 K
PVT Reference Pressure ( $p_{pVT}$ )	2873.26 kPa
Gas Compressibility ( $c_g$ )	3.71972e-4 kPa <sup>-1</sup>
Gas Compressibility Factor (z)	0.935
Gas Viscosity ( $\mu_g$ )	11.316 $\mu$ Pa.s
Gas Formation Volume Factor ( $B_g$ )	0.034208 m <sup>3</sup> /m <sup>3</sup>

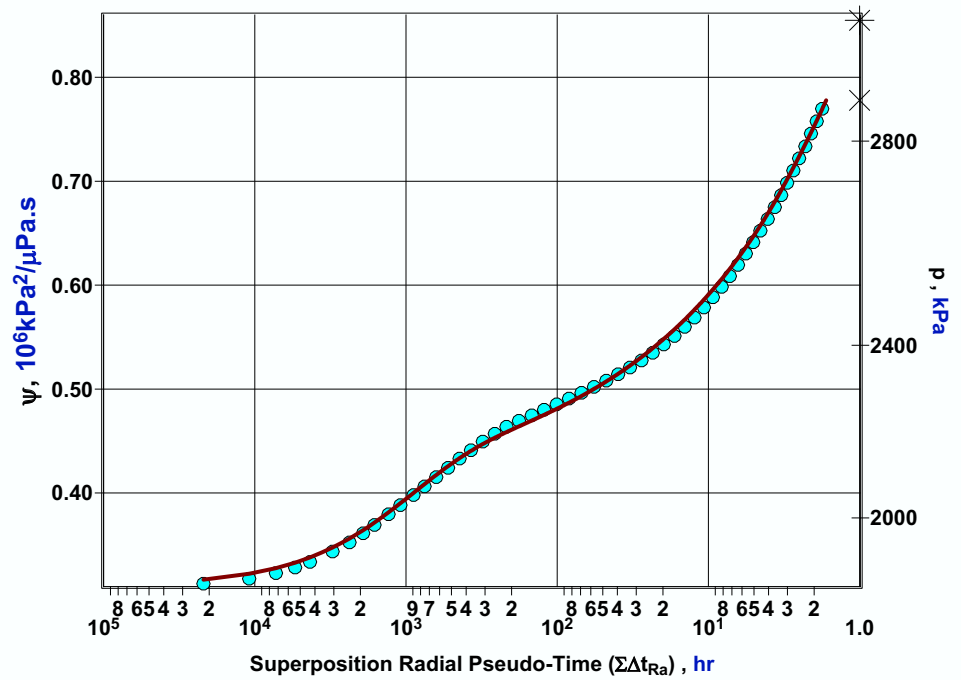
### Fin. Cond. Frac. 2

Dimensionless Typecurve



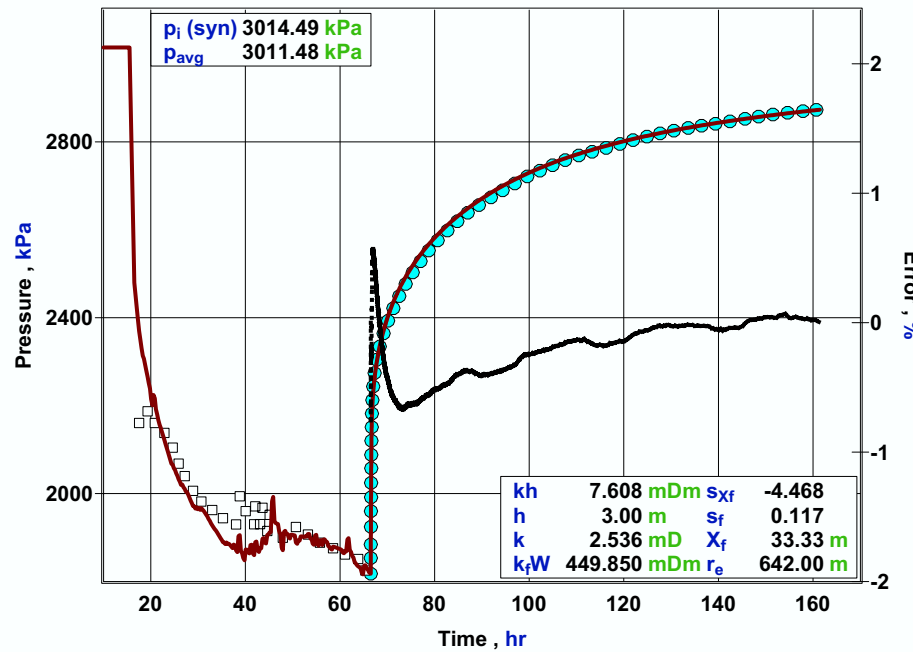
### Fin. Cond. Frac. 2

Radial



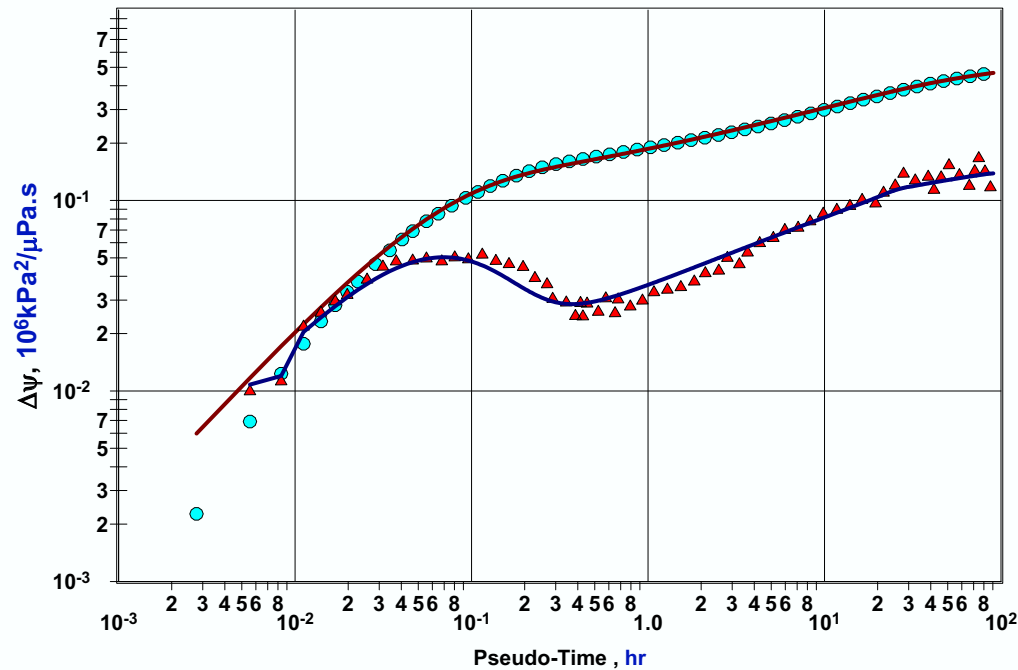
### Fin. Cond. Frac. 2

Total Test



### Fin. Cond. Frac. 2

Typecurve



# Finite Conductivity Fracture Gas Well Model

Case Name : Fin. Cond. Frac. 2

XYZ Company Ltd.

Dinosaur Park (673 - 676 mKB)

100/01-02-003-04w5/06

October 2 - 8, 2004

## Model Parameters

Permeability (k)	2.536mD	Fracture Flow Capacity ( $k_{fw}$ )	449.850mD.m
Wellbore Storage Constant Dim. ( $C_D$ )	114.09	Fracture Face Skin (sf)	0.117
Turbulence Factor (D)	0.00( $10^3 \text{ m}^3/\text{d}$ ) <sup>-1</sup>	Fracture Half Length ( $x_f$ )	33.33m
		Exterior Radius ( $r_e$ )	642.00m
		Skin Equivalent to $X_f$	-4.468

## Formation Parameters

Net Pay (h)	3.00m
Total Porosity ( $\phi_t$ )	20.00%
Gas Saturation ( $S_g$ )	65.00%
Water Saturation ( $S_w$ )	35.00%
Oil Saturation ( $S_o$ )	0.00%
Wellbore Radius ( $r_w$ )	0.150m
Formation Temperature (T)	25.8°C
Formation Compressibility ( $c_f$ )	5.289e-7kPa <sup>-1</sup>
Total Compressibility ( $c_t$ )	2.425e-4kPa <sup>-1</sup>

## Fluid Properties

Gas Gravity (G)	0.656
N <sub>2</sub>	1.72%
H <sub>2</sub> S	0.00%
CO <sub>2</sub>	2.60%
Critical Pressure ( $P_c$ )	4681.36kPa
Critical Temperature ( $T_c$ )	205.08K
PVT Reference Pressure ( $p_{pVT}$ )	2873.26kPa
Gas Compressibility ( $c_g$ )	3.71972e-4kPa <sup>-1</sup>
Gas Compressibility Factor (z)	0.935
Gas Viscosity ( $\mu_g$ )	11.316 $\mu\text{Pa}\cdot\text{s}$
Gas Formation Volume Factor ( $B_g$ )	0.034208m <sup>3</sup> /m <sup>3</sup>

## Production and Pressure

Final Gas Rate	6.72010 <sup>3</sup> m <sup>3</sup> /d
Cumulative Gas Production	16.63210 <sup>3</sup> m <sup>3</sup>
Final Measured Pressure	2873.26kPa

## Synthesis Results

Average Error	-0.17%
Synthetic Initial Pressure ( $p_i$ )	3014.49kPa
Average Reservoir Pressure	3011.48kPa
Pressure Drop Due To Fracture Face Skin ( $\Delta p_{sf}$ )	174.55kPa
Flow Efficiency (FE)	0.854
Damage Ratio (DR)	1.171

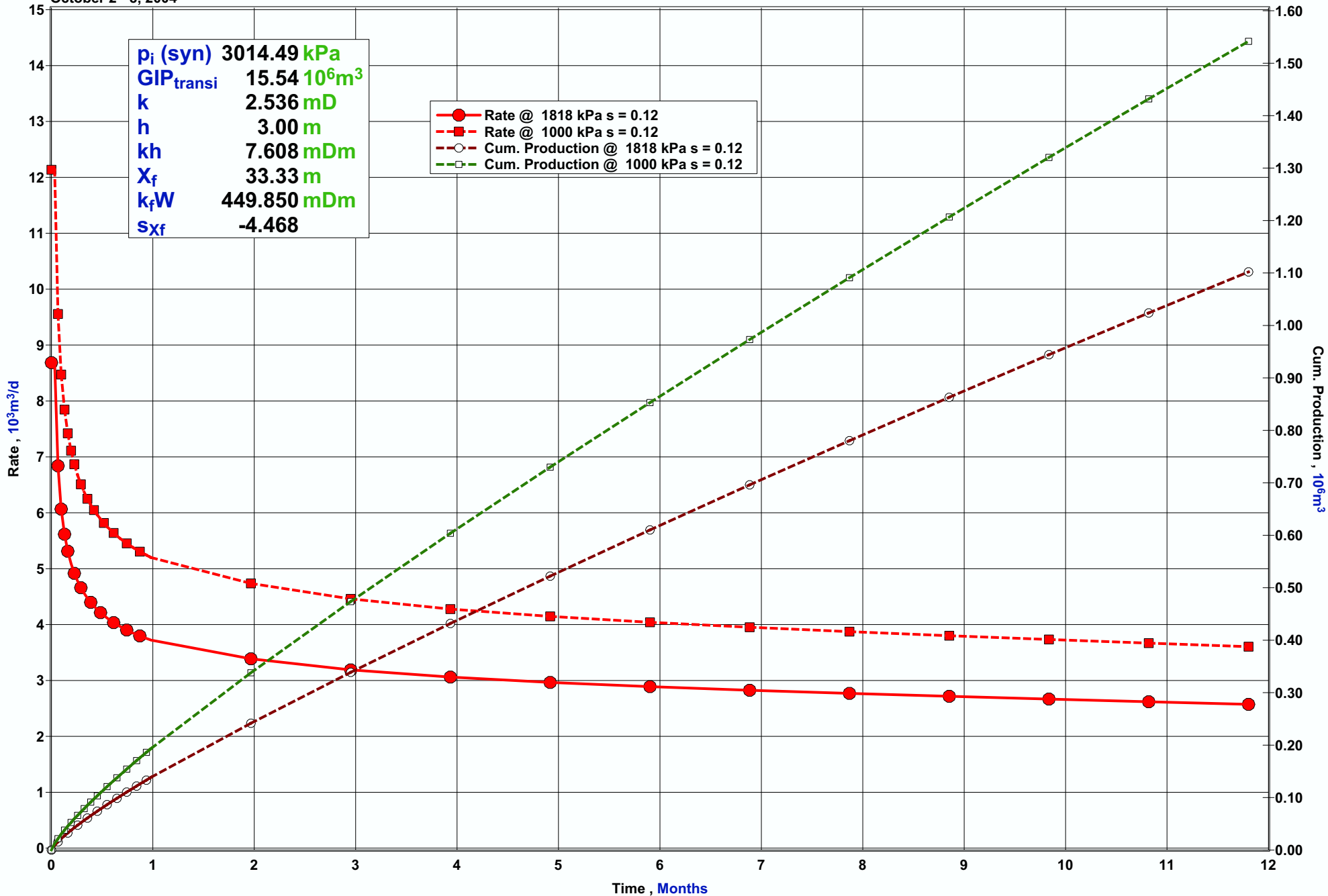
## Forecasts

Forecast Flowing Pressure ( $P_{flow}$ )	1817.63kPa
3 - Month Constant Rate Forecast @ Curr. Skin	3.29610 <sup>3</sup> m <sup>3</sup> /d
6 - Month Constant Rate Forecast @ Curr. Skin	2.97910 <sup>3</sup> m <sup>3</sup> /d
Forecast Flow Duration ( $t_{flow}$ )	12.00month
Constant Rate Forecast @ Curr. Frac. Face Skin	2.67410 <sup>3</sup> m <sup>3</sup> /d
Constant Rate Forecast @ Frac. Face Skin=0	2.80210 <sup>3</sup> m <sup>3</sup> /d



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Transient Forecast



$p_i$  (syn) 3014.49 kPa  
 $GIP_{transi}$  15.54 10<sup>6</sup>m<sup>3</sup>  
 $k$  2.536 mD  
 $h$  3.00 m  
 $kh$  7.608 mDm  
 $X_f$  33.33 m  
 $k_f W$  449.850 mDm  
 $S_{Xf}$  -4.468

● Rate @ 1818 kPa s = 0.12  
 ■ Rate @ 1000 kPa s = 0.12  
 ○ Cum. Production @ 1818 kPa s = 0.12  
 □ Cum. Production @ 1000 kPa s = 0.12

## Fin. Cond. Frac. 2

Item	Time Months	Rate @ 1818 kPa s = 0.12	Cum. Prod. @ 1818 kPa s = 0.12	P <sub>R</sub> @ 1818 kPa s = 0.12	P <sub>wf</sub> @ 1818 kPa s = 0.12	Rate @ 1000 kPa s = 0.12	Cum. Prod. @ 1000 kPa s = 0.12	P <sub>R</sub> @ 1000 kPa s = 0.12	P <sub>wf</sub> @ 1000 kPa s = 0.12
		10 <sup>3</sup> m <sup>3</sup> /d	10 <sup>6</sup> m <sup>3</sup>	kPa	kPa	10 <sup>3</sup> m <sup>3</sup> /d	10 <sup>6</sup> m <sup>3</sup>	kPa	kPa
1	0.00	8.686	0.000	3014.00	3014.00	12.136	0.000	3014.00	3014.00
2	0.03	8.686	0.009	3012.43	1818.00	12.136	0.012	3011.81	1000.00
3	0.07	6.840	0.016	3011.20	1818.00	9.557	0.022	3010.09	1000.00
4	0.10	6.065	0.022	3010.10	1818.00	8.473	0.030	3008.56	1000.00
5	0.13	5.615	0.027	3009.09	1818.00	7.845	0.038	3007.14	1000.00
6	0.16	5.313	0.033	3008.13	1818.00	7.422	0.045	3005.80	1000.00
7	0.20	5.090	0.038	3007.21	1818.00	7.111	0.053	3004.52	1000.00
8	0.23	4.917	0.043	3006.33	1818.00	6.869	0.059	3003.28	1000.00
9	0.26	4.776	0.047	3005.46	1818.00	6.673	0.066	3002.07	1000.00
10	0.30	4.659	0.052	3004.62	1817.40	6.509	0.073	3000.90	1000.00
11	0.33	4.559	0.057	3003.80	1818.00	6.370	0.079	2999.75	1000.00
12	0.36	4.473	0.061	3002.99	1818.00	6.249	0.085	2998.62	1000.00
13	0.39	4.397	0.065	3002.20	1818.00	6.143	0.091	2997.51	1000.00
14	0.43	4.329	0.070	3001.42	1818.00	6.049	0.097	2996.42	1000.00
15	0.46	4.269	0.074	3000.65	1818.00	5.964	0.103	2995.34	1000.00
16	0.49	4.214	0.078	2999.89	1818.00	5.887	0.109	2994.28	1000.00
17	0.53	4.164	0.082	2999.13	1817.73	5.817	0.115	2993.23	1000.00
18	0.56	4.118	0.086	2998.39	1818.00	5.753	0.121	2992.19	1000.00
19	0.59	4.075	0.091	2997.65	1818.00	5.693	0.127	2991.16	999.40
20	0.62	4.036	0.095	2996.93	1818.00	5.638	0.132	2990.14	1000.00
21	0.66	3.999	0.099	2996.20	1818.00	5.587	0.138	2989.13	1000.00
22	0.69	3.965	0.103	2995.49	1818.00	5.539	0.143	2988.13	1000.00
23	0.72	3.933	0.106	2994.78	1818.00	5.494	0.149	2987.14	1000.00
24	0.76	3.903	0.110	2994.07	1818.00	5.452	0.154	2986.15	1000.00
25	0.79	3.874	0.114	2993.37	1818.00	5.412	0.160	2985.18	1000.00
26	0.82	3.847	0.118	2992.68	1818.00	5.375	0.165	2984.20	1000.00
27	0.85	3.822	0.122	2991.99	1818.00	5.339	0.170	2983.24	1000.00
28	0.89	3.797	0.126	2991.30	1818.00	5.305	0.176	2982.28	1000.00
29	0.92	3.774	0.130	2990.62	1818.00	5.273	0.181	2981.33	1000.00
30	0.95	3.752	0.133	2989.94	1818.00	5.242	0.186	2980.38	1000.00
31	0.99	3.731	0.137	2989.27	1818.00	5.213	0.191	2979.44	1000.00
32	1.00	3.721	0.139	2988.97	1818.00	5.199	0.194	2979.03	1000.00
33	2.00	3.388	0.242	2970.34	1818.00	4.736	0.338	2952.95	1000.00
34	3.00	3.189	0.339	2952.78	1818.00	4.459	0.474	2928.38	1000.00
35	4.00	3.060	0.432	2935.91	1818.00	4.277	0.604	2904.77	1000.00
36	5.00	2.965	0.522	2919.56	1818.00	4.145	0.730	2881.87	1000.00
37	6.00	2.889	0.610	2903.61	1818.00	4.041	0.853	2859.52	1000.00
38	7.00	2.825	0.696	2888.01	1818.00	3.952	0.973	2837.64	1000.00
39	8.00	2.768	0.780	2872.70	1818.00	3.873	1.091	2816.17	1000.00
40	9.00	2.716	0.863	2857.68	1818.00	3.801	1.207	2795.08	1000.00
41	10.00	2.666	0.944	2842.92	1818.00	3.732	1.320	2774.35	1000.00
42	11.00	2.618	1.024	2828.41	1818.00	3.667	1.432	2753.98	1000.00
43	12.00	2.573	1.102	2814.14	1818.00	3.605	1.542	2733.93	1000.00

# Sandface Deliverability

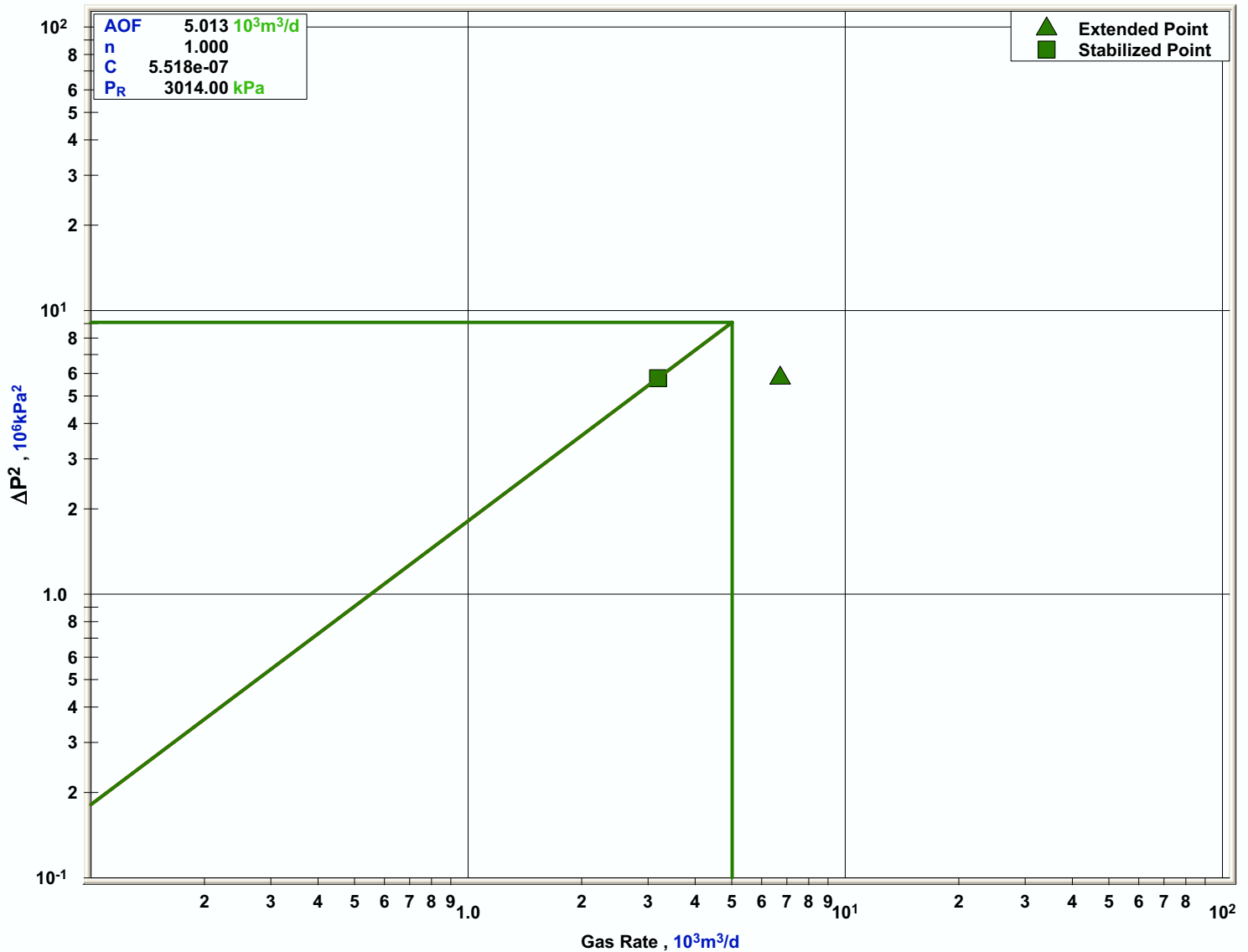
## Simplified Analysis

(Pressure Squared)

XYZ Company Ltd.  
 100/01-02-003-04w5/06  
 Dinosaur Park (673 - 676 mKB)  
 October 2 - 8, 2004

	Time	Sandface Pressure	P <sup>2</sup>	ΔP <sup>2</sup>	Gas Rate
	hr	kPa	10 <sup>6</sup> kPa <sup>2</sup>	10 <sup>6</sup> kPa <sup>2</sup>	10 <sup>3</sup> m <sup>3</sup> /d
Extended Flow	51.0000	1818.00	3.31	5.78	6.720
Stab. Shut-in		3014.00	9.08		
Stab. Flow		1818.00	3.31	5.78	3.189

	<u>Stabilized</u>	<u>Extended</u>	<u>Transient</u>
AOF	5.013	10.563	10 <sup>3</sup> m <sup>3</sup> /d
n	1.000	1.000	1.000
C	5.5182e-07	1.1628e-06	10 <sup>3</sup> m <sup>3</sup> /d/(kPa <sup>2</sup> ) <sup>n</sup>



# Sandface Deliverability Curve

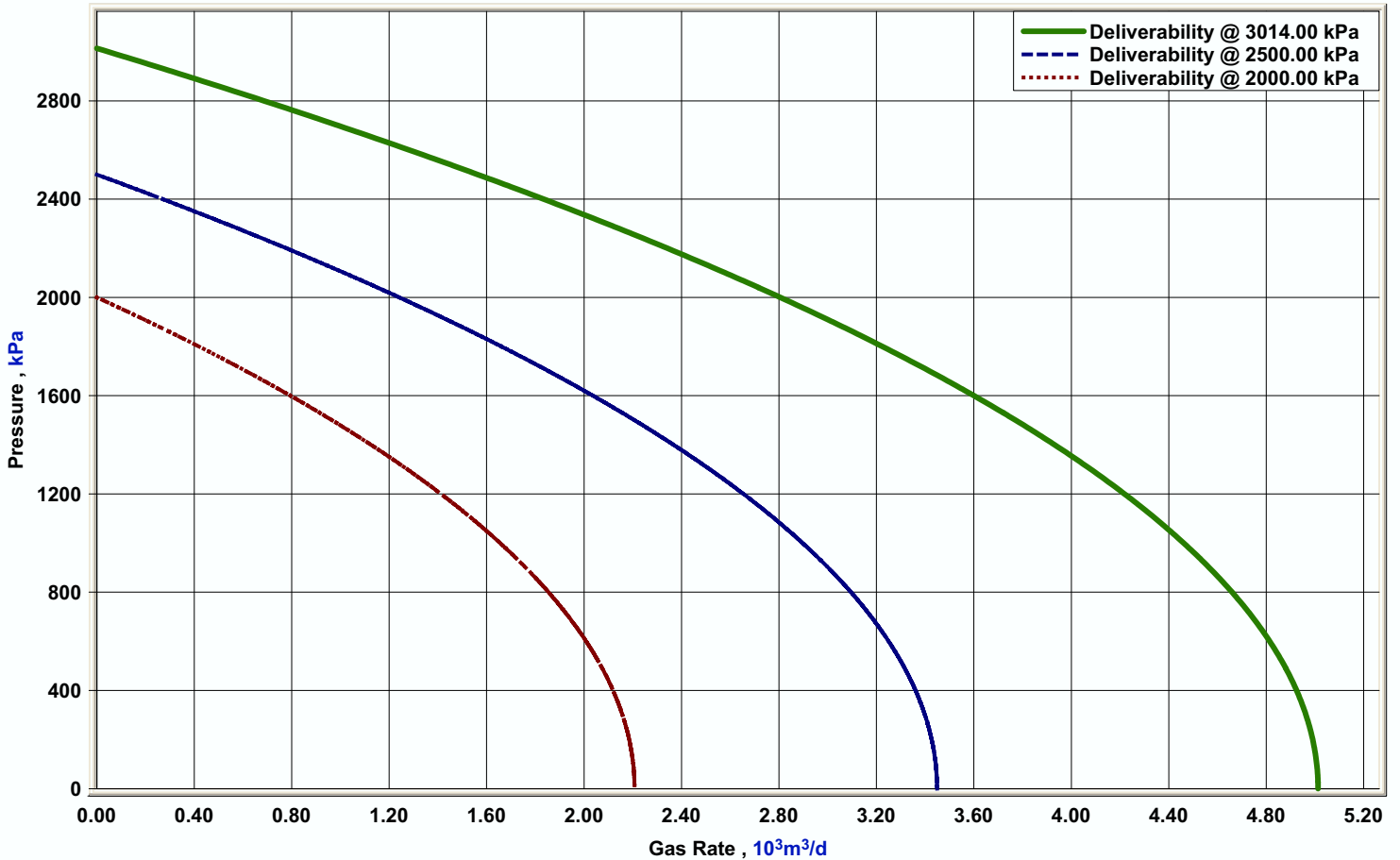
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(Pressure Squared)

XYZ Company Ltd.  
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Stabilized Shut In Pressure = 3014.00 kPa  
Alternate Shut In Pressure 1 = 2500.00 kPa  
Alternate Shut In Pressure 2 = 2000.00 kPa

Flowing Pressure kPa	Gas Rate @ 3014.00 kPa 10 <sup>3</sup> m <sup>3</sup> /d	Gas Rate @ 2500.00 kPa 10 <sup>3</sup> m <sup>3</sup> /d	Gas Rate @ 2000.00 kPa 10 <sup>3</sup> m <sup>3</sup> /d
0.00	5.013	3.449	2.207
400.00	4.925	3.361	2.119
800.00	4.660	3.096	1.854
1200.00	4.218	2.654	1.413
1600.00	3.600	2.036	0.795
2000.00	2.806	1.242	0.000
2400.00	1.834	0.270	
2500.00	1.564	0.000	
2800.00	0.687		
3014.00	0.000		



# Wellhead Deliverability

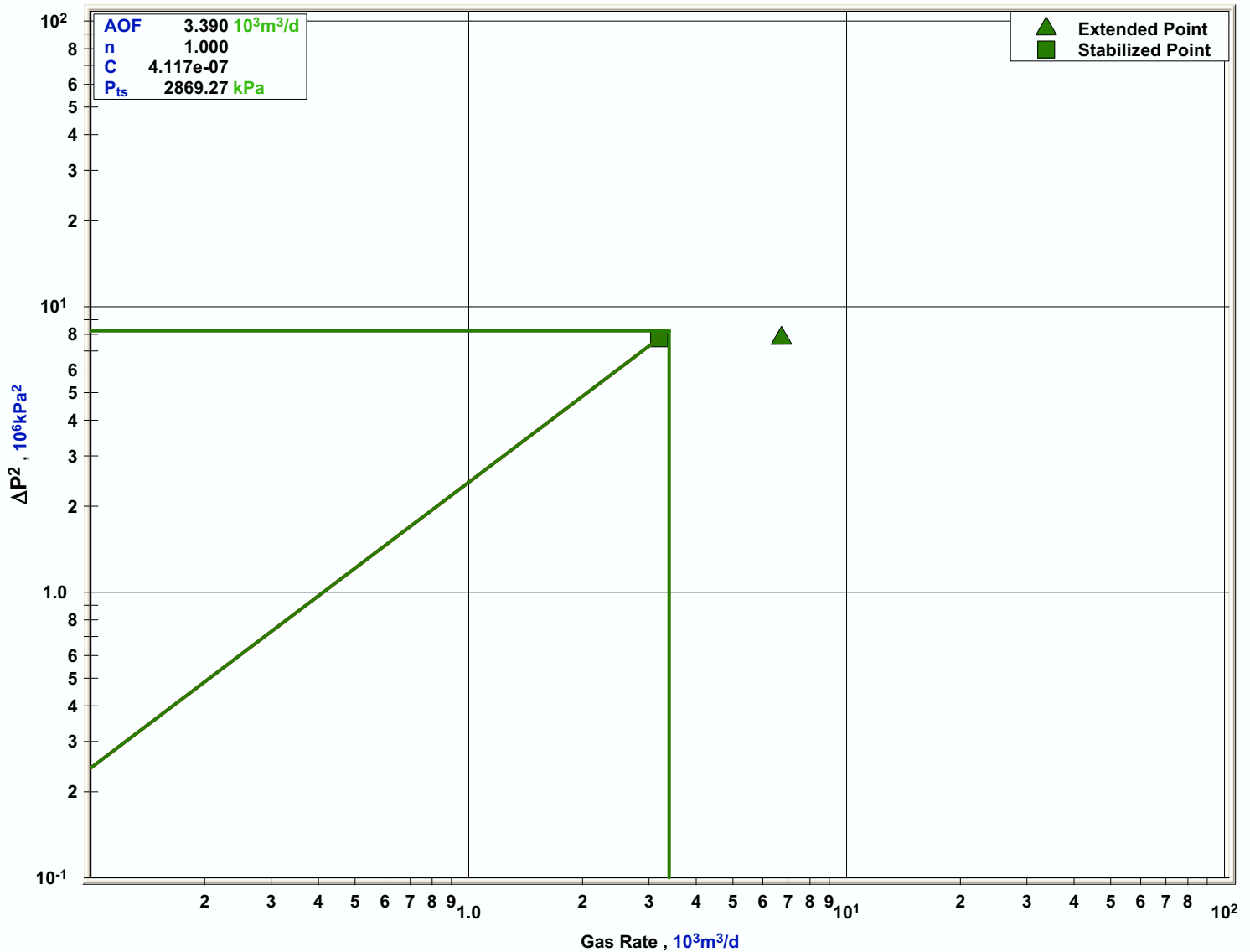
## Simplified Analysis

(Pressure Squared)

XYZ Company Ltd.  
 100/01-02-003-04w5/06  
 Dinosaur Park (673 - 676 mKB)  
 October 2 - 8, 2004

	Time	Wellhead Pressure	P <sup>2</sup>	ΔP <sup>2</sup>	Gas Rate
	hr	kPa	10 <sup>6</sup> kPa <sup>2</sup>	10 <sup>6</sup> kPa <sup>2</sup>	10 <sup>3</sup> m <sup>3</sup> /d
Extended Flow	51.0000	698.00	0.49	7.75	6.720
Stab. Shut-in		2869.27	8.23		
Stab. Flow		698.00	0.49	7.75	3.189

	Stabilized	Extended	Transient
AOF	3.390	7.143	10 <sup>3</sup> m <sup>3</sup> /d
n	1.000	1.000	1.000
C	4.1172e-07	8.6760e-07	10 <sup>3</sup> m <sup>3</sup> /d/(kPa <sup>2</sup> ) <sup>n</sup>



# Wellhead Deliverability Curve

## Simplified Analysis

(Pressure Squared)

XYZ Company Ltd.  
100/01-02-003-04w5/06  
Dinosaur Park (673 - 676 mKB)  
October 2 - 8, 2004

Stabilized Shut In Pressure = 2869.27 kPa  
Alternate Shut In Pressure 1 = 2381.61 kPa  
Alternate Shut In Pressure 2 = 1906.50 kPa

Flowing Pressure kPa	Gas Rate @ 2869.27 kPa 10 <sup>3</sup> m <sup>3</sup> /d	Gas Rate @ 2381.61 kPa 10 <sup>3</sup> m <sup>3</sup> /d	Gas Rate @ 1906.50 kPa 10 <sup>3</sup> m <sup>3</sup> /d
0.00	3.390	2.335	1.497
300.00	3.353	2.298	1.459
600.00	3.241	2.187	1.348
900.00	3.056	2.002	1.163
1200.00	2.797	1.742	0.904
1500.00	2.463	1.409	0.570
1800.00	2.056	1.001	0.163
1906.50	1.893	0.839	0.000
2100.00	1.574	0.520	
2381.61	1.054	0.000	
2400.00	1.018		
2700.00	0.388		
2869.27	0.000		

