Bakersfield (661-746-0511)
Calgary (403-234-7692)
Houston – Headquarters
(281-495-1100)

LUFKIN AUTOMATION

Midland (432-697-2228)
Oklahoma (405-677-0567)
Lufkin Automation Website
http://www.lufkinautomation.com

SROD v6.8.6 - PREDICTION OF ROD PUMPING SYSTEM PERFORMANCE

WELL NAME : Well 4
ANALYST : Scott Malone
DATA FILE : Sandia Data Well 4.inp6e (BASE CASE)
COMMENTS : Test Number: 04. Test Date Mar.1996

DATE/TIME : 9/10/2014 7:34:02 PM
COMPANY : Sandia Data
WELL TYPE : Deviated

** PRIME MOVER **

Mfgr and Type : ROBBINS & MYERS 40 HP (FRAME 404U) (OLD TYPE)

Max Speed (rpm)	: 1209	Speed Variation (%)	: 3.3
Min Speed (rpm)	: 1169	Cyclic Load Factor	: 1.488
Power Required (hp)	: 12.47	Peak Regenerative Power (hp)	: -6.18
Motor Load (% of Rating)	: 31.2	Prime Mover Output (hp)	: 7.13
Sheave Ratio (Unit/ Prime Mover)	: 9.076		

** PUMPING UNIT **

Mfgr and Type : LUFKIN C640-305-168 WITH 94110B CRANKS (4 pins) (CC'WISE)

Actual Max Load (lbs)	: 8946	Actual Min Load (lbs)	: 3673
Average Pumping Speed (spm)	: 4.58	Max Load (% of Rating)	: 29.3
Polished Rod Power (hp)	: 6.42	Unit and Drive Train Loss (hp)	: 0.71
Computed Surface Stroke (in)	: 169.8		

** SUMMARY OF REDUCER LOADING **

	IN BALANCE
Max Torque (m in-lbs)	242.8
Min Torque (m in-lbs)	-79.1
Counterbalance Moment (m in-lbs)	642.7
Counterbalance Effect (X100 lbs)	65.04
Percent of Reducer Rating	37.9

** ROD LOADING **

	Diameter (in)	Length (ft)	Modulus (MM psi)	Fr Coeff	Guides	Loading
1)	0.875	1006	30.5	0.2	N (0)	32
2)	0.75	2030	30.5	0.2	N (0)	35
3)	1.5	25	30.5	0.2	N (0)	6

Norris PPS-Standard guide weights has been considered

Max Stress (surf.) (psi) : 14712
Min Stress (surf.) (psi) : 6275

ROD LOADING AT SURFACE AS % OF RATING

Service Factor	Class C,K	Class D	API D
1	43	32	32
0.9	49	37	37
0.8	58	43	43
0.7	71	52	52

** DOWNHOLE PERFORMANCE **

	Stroke (in)	BPD at 100% eff.	BPD at 85% eff.
Gross:	164.6	198 (24h/d)	168 (24h/d)
Net:	164.5	198 (24h/d)	168 (24h/d)

Tubing Stretch (in)	: 0.1	Lost Displacement (bpd)	: 0
Loss Along Rod String (hp)	: 1.7	Pump Power (hp)	: 4.72
Tubing Size (in)	: 2.875	Tubing Anchor Location (ft)	: 3058
Pump Spacing Guide (in)	: N/A	Pump Fillage (%)	: 100

** Non-Dimensional Variables **

Fo/S/Kr : 0.03
N/No' : 0.05

** OTHER BASIC DATA **

Reducer Rating (in-lbs)	: 640	Crank Rotation	: (CC'WISE) - Well to right
Overall Speed Ratio	: 259.6	Rod Damping Factors (up/down)	: 0.05 / 0.15
Min/Max Tubing Head Press. (psi)	: N/A	Buoyant Rod Weight (lbs)	: 5011
Total Load on Pump (lbs)	: 2236	Pump Bore Size (in)	: 1.5
Pump Load Adjustment (lbs)	: 0	Tubing Gradient (psi/ft)	: 0.433
Pump Depth (ft)	: 3061	Pump Intake Pressure (psi)	: 100

Pump Friction (lbs)	: 200	SV Load (lbs)	: 4711
TV Load (lbs)	: 7547		

** ROD LOADING AT SPECIAL DEPTHS (Top of Lower Interval) **

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COMPANY : Sandia Data
WELL TYPE : Deviated

Interval : 1

Depth (ft)	: 0	Rod Diameter (in)	: 0.875
Max Stress (psi)	: 14712	Min Stress (psi)	: 6275
Min Stress at Bottom (psi)	: 3171	Rod Weight (lbs/ft)	: 2.224

ROD LOADING AS % OF RATING

Service Factor	Class C,K	Class D	API D
1	43	32	32
0.9	49	37	37
0.8	58	43	43
0.7	71	52	52

Interval : 2

Depth (ft)	: 1006	Rod Diameter (in)	: 0.75
Max Stress (psi)	: 13994	Min Stress (psi)	: 4488
Min Stress at Bottom (psi)	: -1507	Rod Weight (lbs/ft)	: 1.634

ROD LOADING AS % OF RATING

Service Factor	Class C,K	Class D	API D
1	46	35	35
0.9	53	40	40
0.8	61	46	46
0.7	73	55	55

Interval : 3

Depth (ft)	: 3036	Rod Diameter (in)	: 1.5
Max Stress (psi)	: 45	Min Stress (psi)	: -1393
Min Stress at Bottom (psi)	: -1479	Rod Weight (lbs/ft)	: 6

ROD LOADING AS % OF RATING

Service Factor	Class C,K	Class D	User Defined API C
1	6	5	6
0.9	7	5	7
0.8	8	6	8
0.7	9	7	9

Note: if this section is a sinker bar, the rod loading at elevator neck 1" at 1 sevice factor will be 14%

**** SUGGESTED ROD GUIDES ****

WELL NAME : Well 4 DATE/TIME : 9/10/2014 7:34:02 PM
ANALYST : Scott Malone COMPANY : Sandia Data
DATA FILE : Sandia Data Well 4.inp6e (BASE CASE) WELL TYPE : Deviated
COMMENTS : Test Number: 04. Test Date Mar.1996

Rod Number From Surface	Interval From (ft) - To (ft)	Max Side Load in Interval (lbs/rod)	Molded Guides (number/rod)	Wheeled Guides (number/rod)	Rod Taper Index

**** ROD GUIDE DESIGN ****

WELL NAME : Well 4
ANALYST : Scott Malone
DATA FILE : Sandia Data Well 4.inp6e (BASE CASE)
COMMENTS : Test Number: 04. Test Date Mar.1996

DATE/TIME : 9/10/2014 7:34:02 PM
COMPANY : Sandia Data
WELL TYPE : Deviated

Rod Number From Surface	Interval From (ft)	To (ft)	Max Side Load in Interval (lbs/rod)	Molded Guides (number/rod)	Wheeled Guides (number/rod)	Rod Taper Index
1	0	11	0	0	0	1
2	11	36	0	0	0	1
3	36	61	0	0	0	1
4	61	86	0	0	0	1
5	86	111	0	0	0	1
6	111	136	0	0	0	1
7	136	161	0	0	0	1
8	161	186	0	0	0	1
9	186	211	0	0	0	1
10	211	236	0	0	0	1
11	236	261	0	0	0	1
12	261	286	0	0	0	1
13	286	311	0	0	0	1
14	311	336	0	0	0	1
15	336	361	0	0	0	1
16	361	386	0	0	0	1
17	386	411	0	0	0	1
18	411	436	0	0	0	1
19	436	461	0	0	0	1
20	461	486	0	0	0	1
21	486	511	0	0	0	1
22	511	536	0	0	0	1
23	536	561	0	0	0	1
24	561	586	0	0	0	1
25	586	611	0	0	0	1
26	611	636	0	0	0	1
27	636	661	0	0	0	1
28	661	686	0	0	0	1
29	686	711	0	0	0	1
30	711	736	0	0	0	1
31	736	761	0	0	0	1
32	761	786	0	0	0	1
33	786	811	0	0	0	1
34	811	836	0	0	0	1
35	836	861	0	0	0	1
36	861	886	0	0	0	1
37	886	911	0	0	0	1
38	911	936	0	0	0	1
39	936	961	0	0	0	1
40	961	986	0	0	0	1
41	986	1011	0	0	0	2
42	1011	1036	0	0	0	2
43	1036	1061	0	0	0	2
44	1061	1086	0	0	0	2
45	1086	1111	0	0	0	2
46	1111	1136	0	0	0	2
47	1136	1161	0	0	0	2
48	1161	1186	0	0	0	2
49	1186	1211	0	0	0	2
50	1211	1236	0	0	0	2
51	1236	1261	0	0	0	2
52	1261	1286	0	0	0	2
53	1286	1311	0	0	0	2
54	1311	1336	0	0	0	2
55	1336	1361	0	0	0	2
56	1361	1386	0	0	0	2
57	1386	1411	0	0	0	2
58	1411	1436	0	0	0	2
59	1436	1461	0	0	0	2
60	1461	1486	0	0	0	2
61	1486	1511	0	0	0	2

62	1511	1536	0	0	0	2
63	1536	1561	0	0	0	2
64	1561	1586	0	0	0	2
65	1586	1611	0	0	0	2
66	1611	1636	0	0	0	2
67	1636	1661	0	0	0	2
68	1661	1686	0	0	0	2
69	1686	1711	0	0	0	2
70	1711	1736	0	0	0	2
71	1736	1761	0	0	0	2
72	1761	1786	0	0	0	2
73	1786	1811	0	0	0	2
74	1811	1836	0	0	0	2
75	1836	1861	0	0	0	2
76	1861	1886	0	0	0	2
77	1886	1911	0	0	0	2
78	1911	1936	0	0	0	2
79	1936	1961	0	0	0	2
80	1961	1986	0	0	0	2
81	1986	2011	0	0	0	2
82	2011	2036	0	0	0	2
83	2036	2061	0	0	0	2
84	2061	2086	0	0	0	2
85	2086	2111	0	0	0	2
86	2111	2136	0	0	0	2
87	2136	2161	0	0	0	2
88	2161	2186	0	0	0	2
89	2186	2211	0	0	0	2
90	2211	2236	0	0	0	2
91	2236	2261	0	0	0	2
92	2261	2286	0	0	0	2
93	2286	2311	0	0	0	2
94	2311	2336	0	0	0	2
95	2336	2361	0	0	0	2
96	2361	2386	0	0	0	2
97	2386	2411	0	0	0	2
98	2411	2436	0	0	0	2
99	2436	2461	0	0	0	2
100	2461	2486	0	0	0	2
101	2486	2511	0	0	0	2
102	2511	2536	0	0	0	2
103	2536	2561	0	0	0	2
104	2561	2586	0	0	0	2
105	2586	2611	0	0	0	2
106	2611	2636	0	0	0	2
107	2636	2661	0	0	0	2
108	2661	2686	0	0	0	2
109	2686	2711	0	0	0	2
110	2711	2736	0	0	0	2
111	2736	2761	0	0	0	2
112	2761	2786	0	0	0	2
113	2786	2811	0	0	0	2
114	2811	2836	0	0	0	2
115	2836	2861	0	0	0	2
116	2861	2886	0	0	0	2
117	2886	2911	0	0	0	2
118	2911	2936	0	0	0	2
119	2936	2961	0	0	0	2
120	2961	2986	0	0	0	2
121	2986	3011	0	0	0	2
122	3011	3036	0	0	0	2
123	3036	3061	0	0	0	3

**** INPUT DATA SUMMARY ****

WELL NAME : Well 4
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COMMENTS : Test Number: 04. Test Date Mar.1996

DATE/TIME : 9/10/2014 7:34:02 PM
COMPANY : Sandia Data
WELL TYPE : Deviated

WELL NAME	: Well 4
ANALYST	: Scott Malone
COMPANY	: Sandia Data
PUMPING UNIT ID	: LC640-305-168
(Description)	(LUFKIN C640-305-168 WITH 94110B CRANKS (4 pins))
MOTOR ID	: RM40HP
(Description)	(ROBBINS & MYERS 40 HP (FRAME 404U) (OLD TYPE))
C'BAL OPTION	: SROD Defined
COUNTERBALANCE MOMENT (in-lbs)	: 0
CRANK HOLE	: 1 - 169.8 (in)
ROTATION OF UNIT	: CC'WISE
SPEED VARIATION	: VARIED
PUMP DEPTH (ft)	: 3061
PUMP DIAMETER (in)	: 1.5
PUMP INTAKE PRESSURE (psi)	: 100
PERCENT COMPLETE PUMP FILLAGE	: 100
PUMPING SPEED (SPM)	: 4.58
TUBINGHEAD PRESSURE (psi)	: 40
TUBING ANCHOR DEPTH (ft)	: 3058
TUBING GRADIENT (psi/ft)	: 0.433
TUBING SIZE	: 3 - 2 7/8 in.

Rod/Taper Information:

ROD STRING DESIGN OPTION : SPECIFY ROD DESIGN

	Diameter (in)	Length (ft)	Tensile (psi)	Modulus (MM psi)	Weight (lbs/ft)	Guide Type
1)	API D					
	0.875	1006	115000	30.5	2.224	N
2)	API D					
	0.75	2030	115000	30.5	1.634	N
3)	API C					
	1.5	25	90000	30.5	6	N

SERVICE FACTOR	: 1.
ELECTRIC COST (cents/kwh)	: 10
UPSTROKE DAMPING FACTOR	: 0.05
DOWNSTROKE DAMPING FACTOR	: 0.15
PUMP FRICTION (lbs)	: 200
STUFFING BOX FRICTION (lbs)	: 100
PUMP LOAD ADJUSTMENT (lbs)	: 0
BUOYANT WEIGHT ADJUSTMENT (lbs)	: 0
PUMP LOAD COEFFICIENT (lbs/ft/sec)	: 5
Run Time (h/d)	: 24
MAX SIDE LOAD FOR BASE ROD (lbs/rod)	: 50
MAX SIDE LOAD FOR MOLDED GUIDE (lbs/rod)	: 40
MAX SIDE LOAD FOR WHEELED GUIDE (lbs/rod)	: 200
ROD FRICTION COEFFICIENT	: 0.2
MOLDED GUIDE FRICTION RATIO	: 1.5
WHEELED GUIDE FRICTION RATIO	: 0.1
OTHER GUIDE FRICTION RATIO	: 2
WELL DEVIATION SURVEY	: See Well Deviation Report

Auto Add Rod Guide Weights

**** DYNO GRAPH ****

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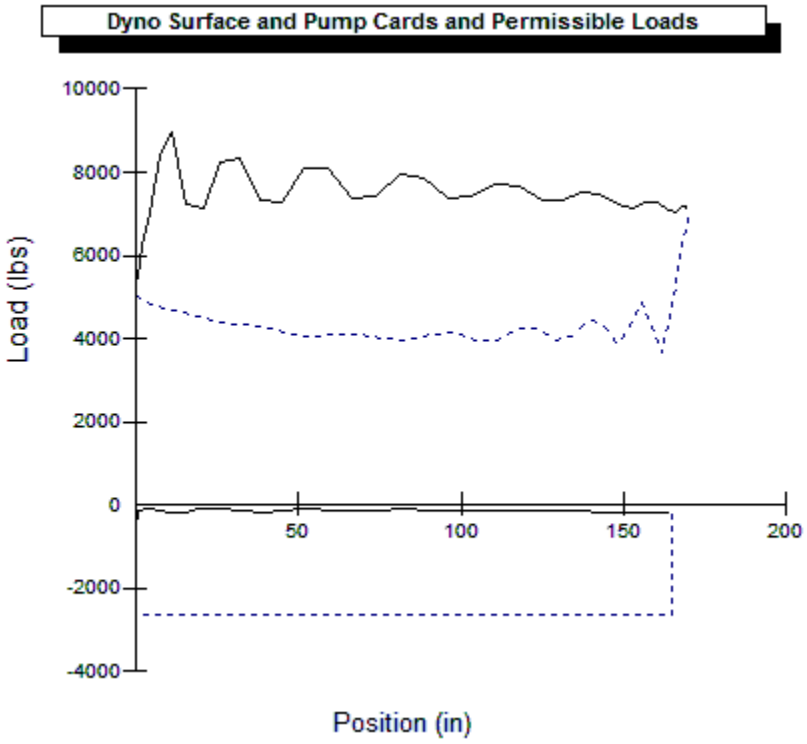
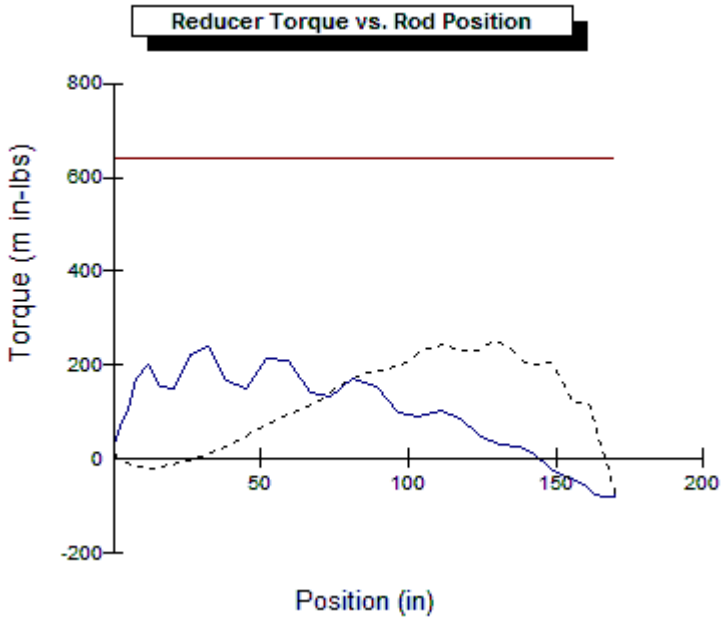
COMPANY : Sandia Data
WELL TYPE : Deviated



**** REDUCER TORQUE ****

WELL NAME : Well 4
ANALYST : Scott Malone
DATA FILE : Sandia Data Well 4.inp6e (BASE CASE)
COMMENTS : Test Number: 04. Test Date Mar.1996

DATE/TIME : 9/10/2014 7:34:02 PM
COMPANY : Sandia Data
WELL TYPE : Deviated



**** AXIAL LOAD ~ BUCKLING TENDENCY ****

WELL NAME : Well 4
ANALYST : Scott Malone
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DATE/TIME : 9/10/2014 7:34:02 PM
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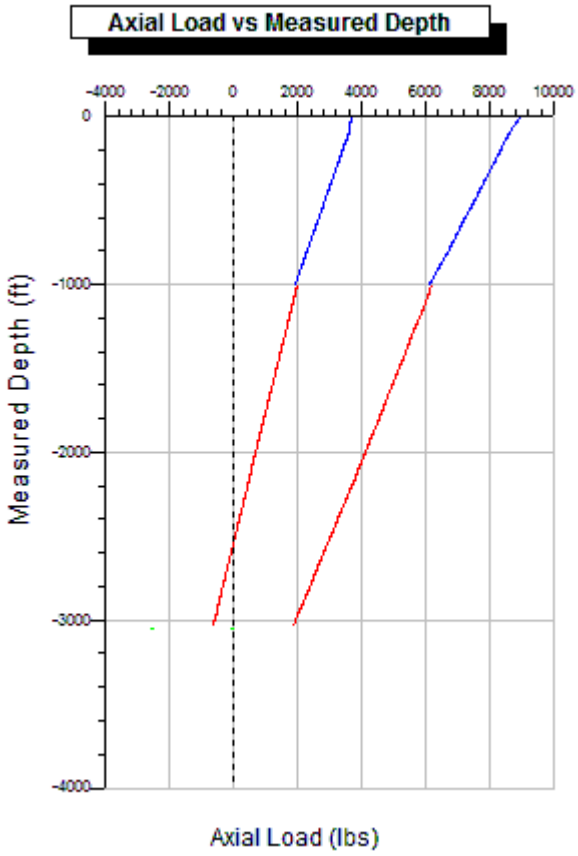
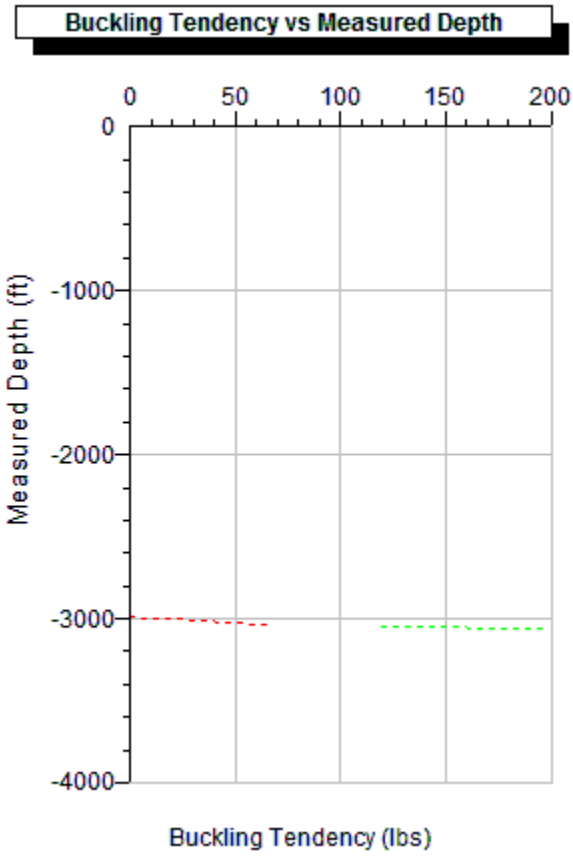
WELL TYPE : Deviated





	Rod Type	Rod Diam in (in)	Max Load (lbs)	Min Load (lbs)	Max Stress (psi)	Min Stress (psi)	Rod Load @ 1 %
1.	API D	0.875	8846	3773	14712	6275	32
2.	API D	0.75	6182	1983	13994	4488	35
3.	API C	1.5	79	-2462	45	-1393	6

Max Buckling (lbs) : 199
Location of Max Buckling (ft) : 3061
Buckling Starts at (ft) : 2995
Buckling tendency does not include buoyancy forces because buoyancy forces do not cause buckling.

*** Neutral Point in Rod String (Buoyancy Considered) ***
Measured Depth (ft) : 2536
Rod Diameter (in) : 0.75
Max/Min Load (lbs) : 2955/-3
Buckling Tendency (lbs) : 0

**** SIDE/DRAG LOAD ****

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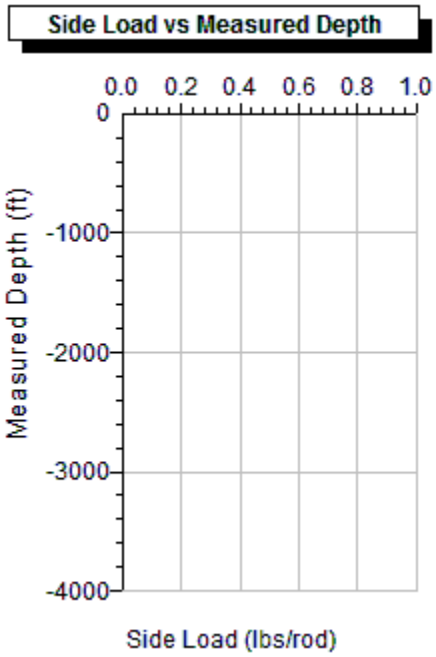
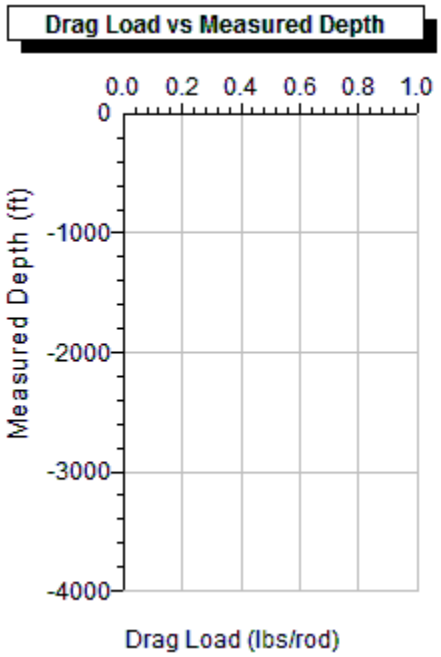
COMMENTS : Test Number: 04. Test Date Mar.1996

DATE/TIME : 9/10/2014 7:34:03 PM
COMPANY : Sandia Data
WELL TYPE : Deviated





Max Side Load (lbs/rod) : 0
Max Drag Load (lbs/rod) : 0
Rod Length for Steel/Fiberglass (ft/ft) : 25/37.5

**** WELL DEVIATION ****

WELL NAME : Well 4
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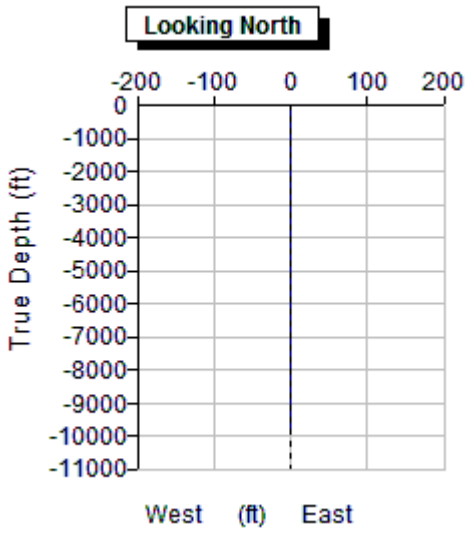
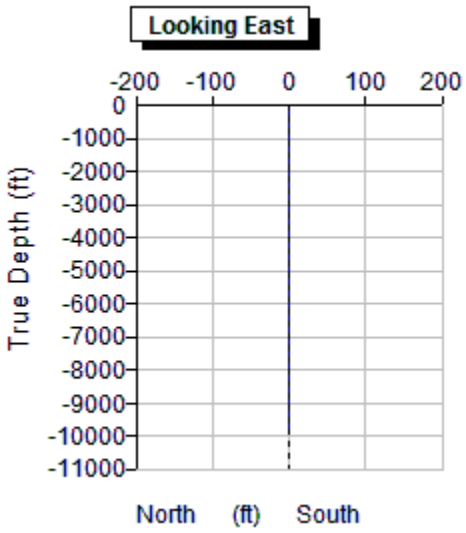
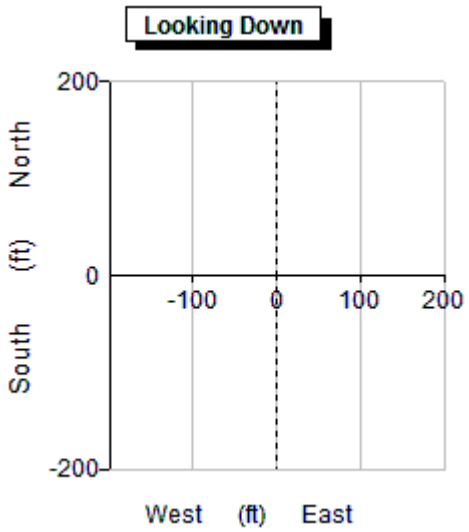
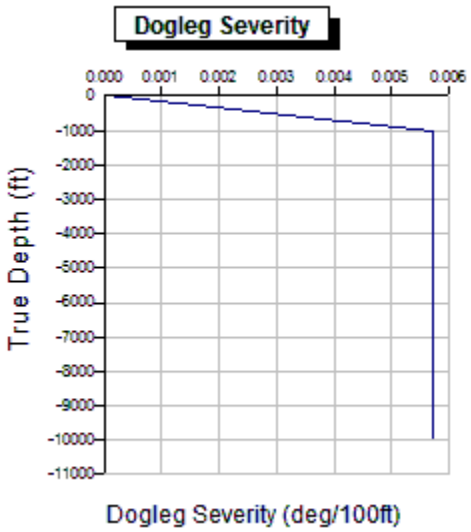
COMMENTS : Test Number: 04. Test Date Mar.1996

DATE/TIME : 9/10/2014 7:34:03 PM
COMPANY : Sandia Data
WELL TYPE : Deviated









MD (ft)	INC (deg)	Azimuth (deg)	TVD (ft)	N-S (ft)	E-W (ft)	Dogleg Severity (deg/100ft)
0.00	0.00	0.00	0.00	0.00N	0.00E	0.00
1000.00	0.00	0.00	1000.00	0.00N	0.00E	0.01
3000.00	0.00	0.00	3000.00	0.00N	0.00E	0.01
8000.00	0.00	0.00	8000.01	0.00N	0.00E	0.01
10000.00	0.00	0.00	10000.01	0.00N	0.00E	0.01