

Bakersfield (661-746-0511)
Calgary (403-234-7692)
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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 2
ANALYST : Scott Malone
DATA FILE : Sandia Data Well 2(FG).inp6e (BASE CASE)
COMMENTS : Test Number: 02. Test Date Oct, 1995

DATE/TIME : 9/10/2014 5:35:49 PM
COMPANY : Sandia Data
WELL TYPE : Deviated

WARNINGS/NOTIFICATIONS (Please see Input Data Summary Report)

**** PRIME MOVER ****

Mfgr and Type : ROBBINS & MYERS 75 HP (FRAME 445U) (OLD TYPE)

Max Speed (rpm)	: 1211	Speed Variation (%)	: 5.3
Min Speed (rpm)	: 1147	Cyclic Load Factor	: 1.236
Power Required (hp)	: 37.34	Peak Regenerative Power (hp)	: -13.77
Motor Load (% of Rating)	: 49.8	Prime Mover Output (hp)	: 28.7
Sheave Ratio (Unit/ Prime Mover)	: 4.935		

**** PUMPING UNIT ****

Mfgr and Type : LUFKIN M640-305-144 WITH MRO CRANKS (CC'WISE)

Actual Max Load (lbs)	: 21221	Actual Min Load (lbs)	: 6074
Average Pumping Speed (spm)	: 8.32	Max Load (% of Rating)	: 69.6
Polished Rod Power (hp)	: 25.83	Unit and Drive Train Loss (hp)	: 2.87
Computed Surface Stroke (in)	: 144.1		

**** SUMMARY OF REDUCER LOADING ****

	<u>IN BALANCE</u>
Max Torque (m in-lbs)	405.5
Min Torque (m in-lbs)	-88.8
Counterbalance Moment (m in-lbs)	1286.2
Counterbalance Effect (X100 lbs)	161.09
Percent of Reducer Rating	63.4

**** ROD LOADING ****

	<u>Diameter (in)</u>	<u>Length (ft)</u>	<u>Modulus (MM psi)</u>	<u>Fr Coeff</u>	<u>Guides</u>	<u>Loading</u>
1)	1.24 *	4362	7.2	0.2	N (0)	62
2)	1 *	3293	30.5	0.2	N (0)	78

* Requires slimhole couplings

Max Stress (surf.) (psi) : 17490
Min Stress (surf.) (psi) : 5112

Rod Load as % of Fiberflex Guideline: 62

**** DOWNHOLE PERFORMANCE ****

	<u>Stroke (in)</u>	<u>BPD at 100% eff.</u>	<u>BPD at 85% eff.</u>	
Gross:	156.9	342 (24h/d)	291 (24h/d)	
Net:	155.1	339 (24h/d)	288 (24h/d)	

Tubing Stretch (in)	: 1.9	Lost Displacement (bpd)	: 4
Loss Along Rod String (hp)	: 5.86	Pump Power (hp)	: 19.98
Tubing Size (in)	: 2.875	Tubing Anchor Location (ft)	: 6168
Pump Spacing Guide (in)	: N/A	Pump Fillage (%)	: 100

**** Non-Dimensional Variables ****

Fo/S/Kr	: 0.3	N/No'	: 0.36
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**** OTHER BASIC DATA ****

Reducer Rating (in-lbs)	: 640	Crank Rotation	: (CC'WISE) - Well to right
Overall Speed Ratio	: 141.1	Rod Damping Factors (up/down)	: 0.05 / 0.15
Min/Max Tubing Head Press. (psi)	: N/A	Buoyant Rod Weight (lbs)	: 11726
Total Load on Pump (lbs)	: 5760	Pump Bore Size (in)	: 1.5
Pump Load Adjustment (lbs)	: 0	Tubing Gradient (psi/ft)	: 0.433
Pump Depth (ft)	: 7655	Pump Intake Pressure (psi)	: 100
Pump Friction (lbs)	: 200	SV Load (lbs)	: 11426
TV Load (lbs)	: 17786		

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ANALYST   : Scott Malone                          COMPANY   : Sandia Data
DATA FILE : Sandia Data Well 2(FG).inp6e (BASE CASE) WELL TYPE : Deviated
COMMENTS  : Test Number: 02. Test Date Oct, 1995

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Depth (ft)	: 0	Rod Diameter (in)	: 1.24 *
Max Stress (psi)	: 17490	Min Stress (psi)	: 5112
Min Stress at Bottom (psi)	: 1495	Rod Weight (lbs/ft)	: 1.288
Rod Load as % of Fiberflex Guideline: 62			

Depth (ft)	: 4362	Rod Diameter (in)	: 1 *
Max Stress (psi)	: 19770	Min Stress (psi)	: 3338
Min Stress at Bottom (psi)	: -3614	Rod Weight (lbs/ft)	: 2.904

<u>Service Factor</u>	<u>Class C,K</u>	<u>Class D</u>	<u>User Defined API C</u>
1	78	60	78
0.9	88	68	88
0.8	102	78	102
0.7	120	91	120

* Slimhole couplings are required for this rod section.

**** SUGGESTED ROD GUIDES ****

WELL NAME : Well 2
ANALYST : Scott Malone
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COMMENTS : Test Number: 02. Test Date Oct, 1995

DATE/TIME : 9/10/2014 5:35:49 PM
COMPANY : Sandia Data
WELL TYPE : Deviated

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

**** ROD GUIDE DESIGN ****

WELL NAME : Well 2
 ANALYST : Scott Malone
 DATA FILE : Sandia Data Well 2(FG).inp6e (BASE CASE)
 COMMENTS : Test Number: 02. Test Date Oct, 1995

DATE/TIME : 9/10/2014 5:35:49 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	5	0	0	0	1
2	5	30	0	0	0	1
3	30	55	0	0	0	1
4	55	80	0	0	0	1
5	80	105	0	0	0	1
6	105	130	0	0	0	1
7	130	155	0	0	0	1
8	155	180	0	0	0	1
9	180	205	0	0	0	1
10	205	230	0	0	0	1
11	230	255	0	0	0	1
12	255	280	0	0	0	1
13	280	305	0	0	0	1
14	305	330	0	0	0	1
15	330	355	0	0	0	1
16	355	380	0	0	0	1
17	380	405	0	0	0	1
18	405	430	0	0	0	1
19	430	455	0	0	0	1
20	455	480	0	0	0	1
21	480	505	0	0	0	1
22	505	530	0	0	0	1
23	530	555	0	0	0	1
24	555	580	0	0	0	1
25	580	605	0	0	0	1
26	605	630	0	0	0	1
27	630	655	0	0	0	1
28	655	680	0	0	0	1
29	680	705	0	0	0	1
30	705	730	0	0	0	1
31	730	755	0	0	0	1
32	755	780	0	0	0	1
33	780	805	0	0	0	1
34	805	830	0	0	0	1
35	830	855	0	0	0	1
36	855	880	0	0	0	1
37	880	905	0	0	0	1
38	905	930	0	0	0	1
39	930	955	0	0	0	1
40	955	980	0	0	0	1
41	980	1005	0	0	0	1
42	1005	1030	0	0	0	1
43	1030	1055	0	0	0	1
44	1055	1080	0	0	0	1
45	1080	1105	0	0	0	1
46	1105	1130	0	0	0	1
47	1130	1155	0	0	0	1
48	1155	1180	0	0	0	1
49	1180	1205	0	0	0	1
50	1205	1230	0	0	0	1
51	1230	1255	0	0	0	1
52	1255	1280	0	0	0	1
53	1280	1305	0	0	0	1
54	1305	1330	0	0	0	1
55	1330	1355	0	0	0	1
56	1355	1380	0	0	0	1
57	1380	1405	0	0	0	1
58	1405	1430	0	0	0	1
59	1430	1455	0	0	0	1
60	1455	1480	0	0	0	1
61	1480	1505	0	0	0	1
62	1505	1530	0	0	0	1
63	1530	1555	0	0	0	1

64	1555	1580	0	0	0	1
65	1580	1605	0	0	0	1
66	1605	1630	0	0	0	1
67	1630	1655	0	0	0	1
68	1655	1680	0	0	0	1
69	1680	1705	0	0	0	1
70	1705	1730	0	0	0	1
71	1730	1755	0	0	0	1
72	1755	1780	0	0	0	1
73	1780	1805	0	0	0	1
74	1805	1830	0	0	0	1
75	1830	1855	0	0	0	1
76	1855	1880	0	0	0	1
77	1880	1905	0	0	0	1
78	1905	1930	0	0	0	1
79	1930	1955	0	0	0	1
80	1955	1980	0	0	0	1
81	1980	2005	0	0	0	1
82	2005	2030	0	0	0	1
83	2030	2055	0	0	0	1
84	2055	2080	0	0	0	1
85	2080	2105	0	0	0	1
86	2105	2130	0	0	0	1
87	2130	2155	0	0	0	1
88	2155	2180	0	0	0	1
89	2180	2205	0	0	0	1
90	2205	2230	0	0	0	1
91	2230	2255	0	0	0	1
92	2255	2280	0	0	0	1
93	2280	2305	0	0	0	1
94	2305	2330	0	0	0	1
95	2330	2355	0	0	0	1
96	2355	2380	0	0	0	1
97	2380	2405	0	0	0	1
98	2405	2430	0	0	0	1
99	2430	2455	0	0	0	1
100	2455	2480	0	0	0	1
101	2480	2505	0	0	0	1
102	2505	2530	0	0	0	1
103	2530	2555	0	0	0	1
104	2555	2580	0	0	0	1
105	2580	2605	0	0	0	1
106	2605	2630	0	0	0	1
107	2630	2655	0	0	0	1
108	2655	2680	0	0	0	1
109	2680	2705	0	0	0	1
110	2705	2730	0	0	0	1
111	2730	2755	0	0	0	1
112	2755	2780	0	0	0	1
113	2780	2805	0	0	0	1
114	2805	2830	0	0	0	1
115	2830	2855	0	0	0	1
116	2855	2880	0	0	0	1
117	2880	2905	0	0	0	1
118	2905	2930	0	0	0	1
119	2930	2955	0	0	0	1
120	2955	2980	0	0	0	1
121	2980	3005	0	0	0	1
122	3005	3030	0	0	0	1
123	3030	3055	0	0	0	1
124	3055	3080	0	0	0	1
125	3080	3105	0	0	0	1
126	3105	3130	0	0	0	1
127	3130	3155	0	0	0	1
128	3155	3180	0	0	0	1
129	3180	3205	0	0	0	1
130	3205	3230	0	0	0	1
131	3230	3255	0	0	0	1
132	3255	3280	0	0	0	1
133	3280	3305	0	0	0	1
134	3305	3330	0	0	0	1
135	3330	3355	0	0	0	1
136	3355	3380	0	0	0	1
137	3380	3405	0	0	0	1
138	3405	3430	0	0	0	1
139	3430	3455	0	0	0	1
140	3455	3480	0	0	0	1
141	3480	3505	0	0	0	1
142	3505	3530	0	0	0	1

143	3530	3555	0	0	0	1
144	3555	3580	0	0	0	1
145	3580	3605	0	0	0	1
146	3605	3630	0	0	0	1
147	3630	3655	0	0	0	1
148	3655	3680	0	0	0	1
149	3680	3705	0	0	0	1
150	3705	3730	0	0	0	1
151	3730	3755	0	0	0	1
152	3755	3780	0	0	0	1
153	3780	3805	0	0	0	1
154	3805	3830	0	0	0	1
155	3830	3855	0	0	0	1
156	3855	3880	0	0	0	1
157	3880	3905	0	0	0	1
158	3905	3930	0	0	0	1
159	3930	3955	0	0	0	1
160	3955	3980	0	0	0	1
161	3980	4005	0	0	0	1
162	4005	4030	0	0	0	1
163	4030	4055	0	0	0	1
164	4055	4080	0	0	0	1
165	4080	4105	0	0	0	1
166	4105	4130	0	0	0	1
167	4130	4155	0	0	0	1
168	4155	4180	0	0	0	1
169	4180	4205	0	0	0	1
170	4205	4230	0	0	0	1
171	4230	4255	0	0	0	1
172	4255	4280	0	0	0	1
173	4280	4305	0	0	0	1
174	4305	4330	0	0	0	1
175	4330	4355	0	0	0	1
176	4355	4380	0	0	0	2
177	4380	4405	0	0	0	2
178	4405	4430	0	0	0	2
179	4430	4455	0	0	0	2
180	4455	4480	0	0	0	2
181	4480	4505	0	0	0	2
182	4505	4530	0	0	0	2
183	4530	4555	0	0	0	2
184	4555	4580	0	0	0	2
185	4580	4605	0	0	0	2
186	4605	4630	0	0	0	2
187	4630	4655	0	0	0	2
188	4655	4680	0	0	0	2
189	4680	4705	0	0	0	2
190	4705	4730	0	0	0	2
191	4730	4755	0	0	0	2
192	4755	4780	0	0	0	2
193	4780	4805	0	0	0	2
194	4805	4830	0	0	0	2
195	4830	4855	0	0	0	2
196	4855	4880	0	0	0	2
197	4880	4905	0	0	0	2
198	4905	4930	0	0	0	2
199	4930	4955	0	0	0	2
200	4955	4980	0	0	0	2
201	4980	5005	0	0	0	2
202	5005	5030	0	0	0	2
203	5030	5055	0	0	0	2
204	5055	5080	0	0	0	2
205	5080	5105	0	0	0	2
206	5105	5130	0	0	0	2
207	5130	5155	0	0	0	2
208	5155	5180	0	0	0	2
209	5180	5205	0	0	0	2
210	5205	5230	0	0	0	2
211	5230	5255	0	0	0	2
212	5255	5280	0	0	0	2
213	5280	5305	0	0	0	2
214	5305	5330	0	0	0	2
215	5330	5355	0	0	0	2
216	5355	5380	0	0	0	2
217	5380	5405	0	0	0	2
218	5405	5430	0	0	0	2
219	5430	5455	0	0	0	2
220	5455	5480	0	0	0	2
221	5480	5505	0	0	0	2

222	5505	5530	0	0	0	2
223	5530	5555	0	0	0	2
224	5555	5580	0	0	0	2
225	5580	5605	0	0	0	2
226	5605	5630	0	0	0	2
227	5630	5655	0	0	0	2
228	5655	5680	0	0	0	2
229	5680	5705	0	0	0	2
230	5705	5730	0	0	0	2
231	5730	5755	0	0	0	2
232	5755	5780	0	0	0	2
233	5780	5805	0	0	0	2
234	5805	5830	0	0	0	2
235	5830	5855	0	0	0	2
236	5855	5880	0	0	0	2
237	5880	5905	0	0	0	2
238	5905	5930	0	0	0	2
239	5930	5955	0	0	0	2
240	5955	5980	0	0	0	2
241	5980	6005	0	0	0	2
242	6005	6030	0	0	0	2
243	6030	6055	0	0	0	2
244	6055	6080	0	0	0	2
245	6080	6105	0	0	0	2
246	6105	6130	0	0	0	2
247	6130	6155	0	0	0	2
248	6155	6180	0	0	0	2
249	6180	6205	0	0	0	2
250	6205	6230	0	0	0	2
251	6230	6255	0	0	0	2
252	6255	6280	0	0	0	2
253	6280	6305	0	0	0	2
254	6305	6330	0	0	0	2
255	6330	6355	0	0	0	2
256	6355	6380	0	0	0	2
257	6380	6405	0	0	0	2
258	6405	6430	0	0	0	2
259	6430	6455	0	0	0	2
260	6455	6480	0	0	0	2
261	6480	6505	0	0	0	2
262	6505	6530	0	0	0	2
263	6530	6555	0	0	0	2
264	6555	6580	0	0	0	2
265	6580	6605	0	0	0	2
266	6605	6630	0	0	0	2
267	6630	6655	0	0	0	2
268	6655	6680	0	0	0	2
269	6680	6705	0	0	0	2
270	6705	6730	0	0	0	2
271	6730	6755	0	0	0	2
272	6755	6780	0	0	0	2
273	6780	6805	0	0	0	2
274	6805	6830	0	0	0	2
275	6830	6855	0	0	0	2
276	6855	6880	0	0	0	2
277	6880	6905	0	0	0	2
278	6905	6930	0	0	0	2
279	6930	6955	0	0	0	2
280	6955	6980	0	0	0	2
281	6980	7005	0	0	0	2
282	7005	7030	0	0	0	2
283	7030	7055	0	0	0	2
284	7055	7080	0	0	0	2
285	7080	7105	0	0	0	2
286	7105	7130	0	0	0	2
287	7130	7155	0	0	0	2
288	7155	7180	0	0	0	2
289	7180	7205	0	0	0	2
290	7205	7230	0	0	0	2
291	7230	7255	0	0	0	2
292	7255	7280	0	0	0	2
293	7280	7305	0	0	0	2
294	7305	7330	0	0	0	2
295	7330	7355	0	0	0	2
296	7355	7380	0	0	0	2
297	7380	7405	0	0	0	2
298	7405	7430	0	0	0	2
299	7430	7455	0	0	0	2
300	7455	7480	0	0	0	2

301	7480	7505	0	0	0	2
302	7505	7530	0	0	0	2
303	7530	7555	0	0	0	2
304	7555	7580	0	0	0	2
305	7580	7605	0	0	0	2
306	7605	7630	0	0	0	2
307	7630	7655	0	0	0	2

**** INPUT DATA SUMMARY ****

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 ANALYST : Scott Malone
 COMPANY : Sandia Data

PUMPING UNIT ID : LM640-305-144
 (Description) (LUFKIN M640-305-144 WITH MRO CRANKS)
 MOTOR ID : RM75HP
 (Description) (ROBBINS & MYERS 75 HP (FRAME 445U) (OLD TYPE))
 C'BAL OPTION : SROD Defined
 COUNTERBALANCE MOMENT (in-lbs) : 0
 CRANK HOLE : 1 - 144.1 (in)
 ROTATION OF UNIT : CC'WISE
 SPEED VARIATION : VARIED
 PUMP DEPTH (ft) : 7655
 PUMP DIAMETER (in) : 1.5
 PUMP INTAKE PRESSURE (psi) : 100
 PERCENT COMPLETE PUMP FILLAGE : 100
 PUMPING SPEED (SPM) : 8.28
 TUBINGHEAD PRESSURE (psi) : 45
 TUBING ANCHOR DEPTH (ft) : 6168
 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) FIBERFLEX	1.24	4362	N/A	7.2	1.2879	N
2) API C	1	3293	90000	30.5	2.904	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
 User Input Rod Guide Weights

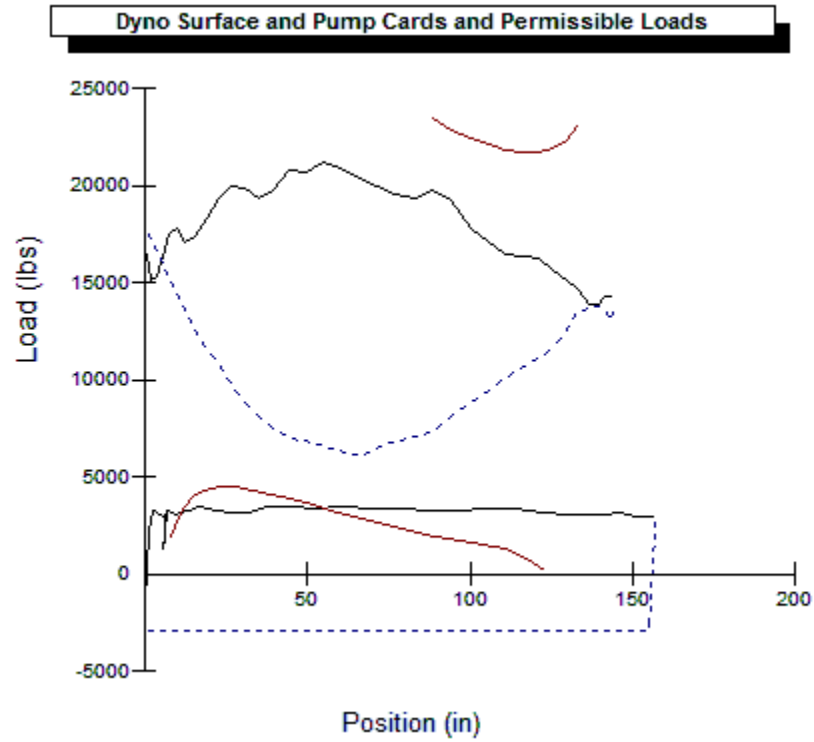
**** WARNINGS / NOTIFICATIONS ****

Slimhole couplings have been added.

Slimhole couplings have been added.

**** DYN0 GRAPH ****

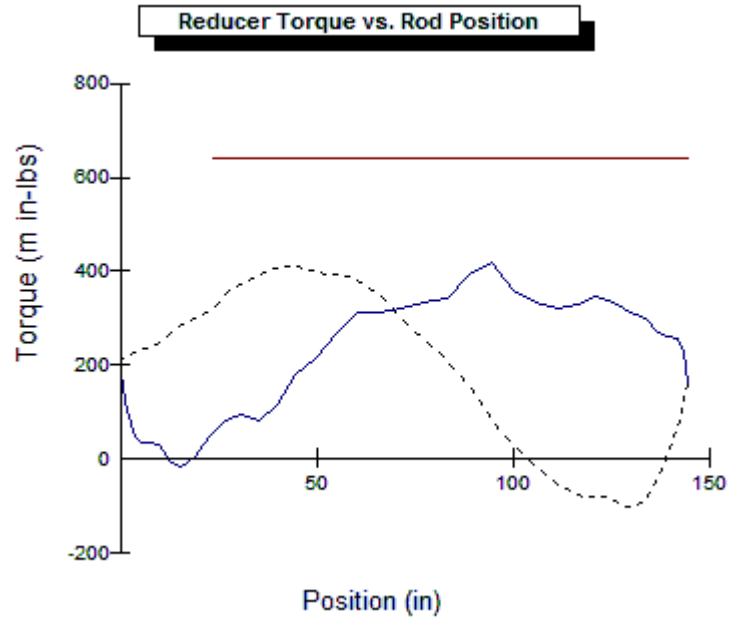
WELL NAME : Well 2
ANALYST : Scott Malone
DATE/TIME : 9/10/2014 5:35:50 PM
DATA FILE : Sandia Data Well 2(FG).inp6e (BASE CASE) COMPANY : Sandia Data
COMMENTS : Test Number: 02. Test Date Oct, 1995 WELL TYPE : Deviated



**** REDUCER TORQUE ****

WELL NAME : Well 2
ANALYST : Scott Malone
DATA FILE : Sandia Data Well 2(FG).inp6e (BASE CASE)
COMMENTS : Test Number: 02. Test Date Oct, 1995

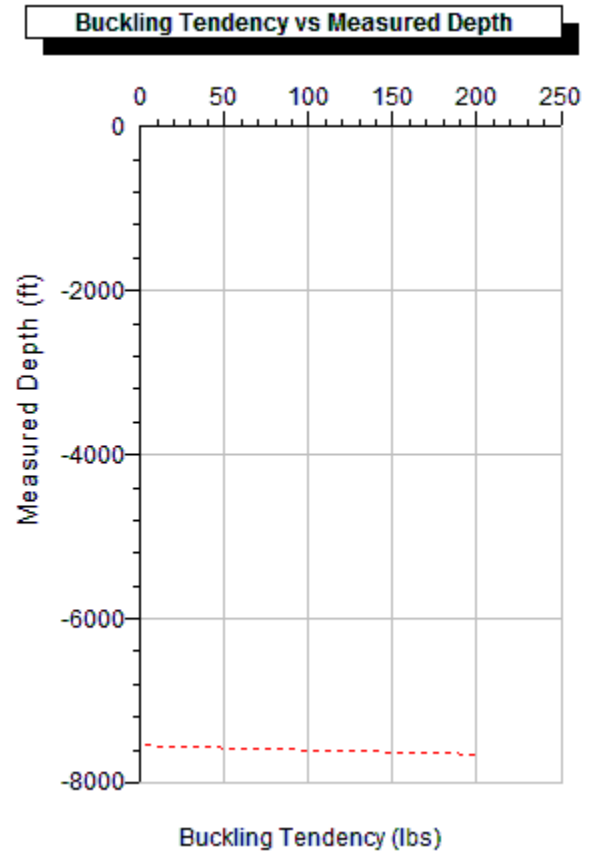
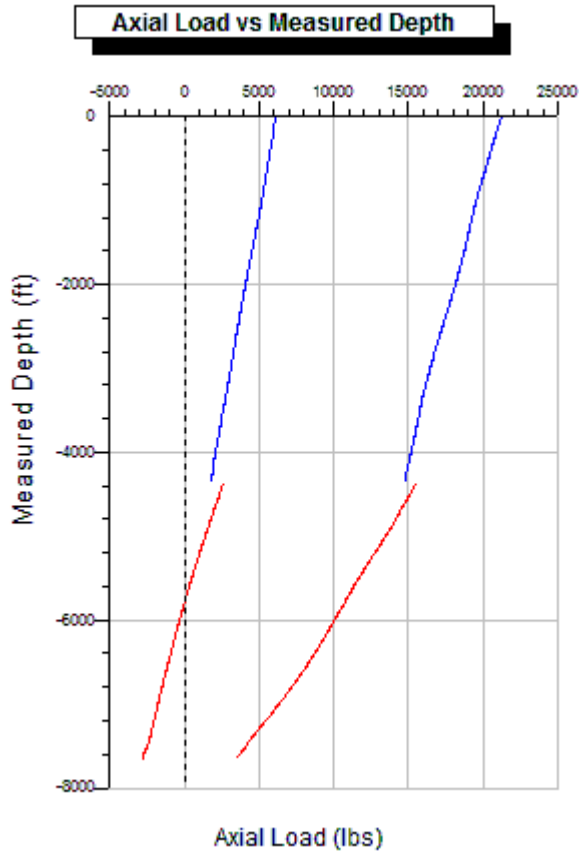
DATE/TIME : 9/10/2014 5:35:50 PM
COMPANY : Sandia Data
WELL TYPE : Deviated



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

WELL NAME : Well 2
 ANALYST : Scott Malone
 DATA FILE : Sandia Data Well 2(FG).inp6e (BASE CASE)
 COMMENTS : Test Number: 02. Test Date Oct, 1995

DATE/TIME : 9/10/2014 5:35:50 PM
 COMPANY : Sandia Data
 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. FIBERFLEX	1.24	21121	6174	17490	5112	62
2. API C	1	15527	2622	19770	3338	78

Max Buckling (lbs) : 202
 Location of Max Buckling (ft) : 7655
 Buckling Starts at (ft) : 7553
 Buckling tendency does not include buoyancy forces because buoyancy forces do not cause buckling.

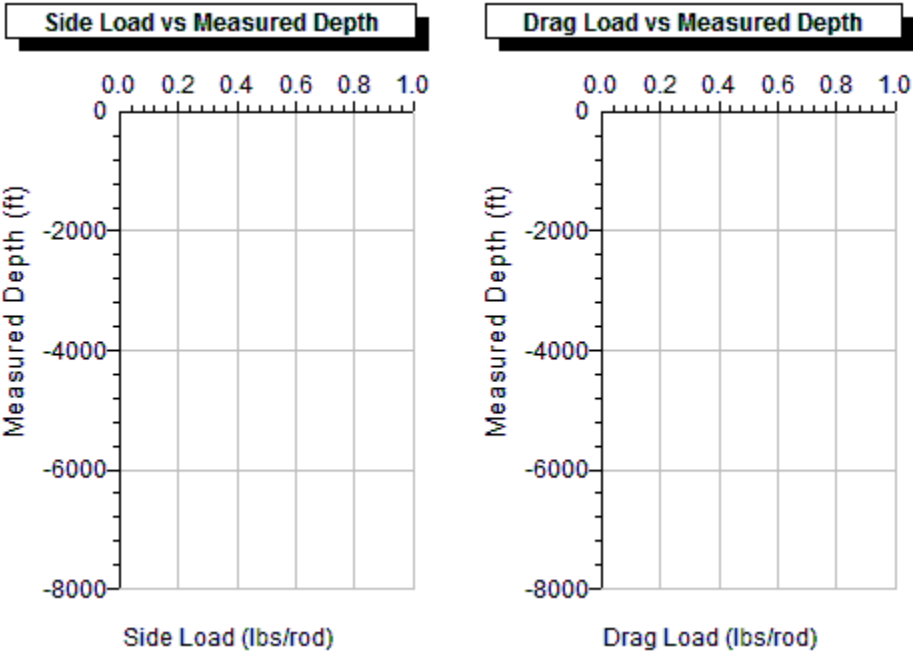
*** Neutral Point in Rod String (Buoyancy Considered) ***

Measured Depth (ft) : 5805
 Rod Diameter (in) : 1
 Max/Min Load (lbs) : 10677/-17
 Buckling Tendency (lbs) : 0

**** SIDE/Drag Load ****

WELL NAME : Well 2
ANALYST : Scott Malone
DATA FILE : Sandia Data Well 2(FG).inp6e (BASE CASE)
COMMENTS : Test Number: 02. Test Date Oct, 1995

DATE/TIME : 9/10/2014 5:35:50 PM
COMPANY : Sandia Data
WELL TYPE : Deviated



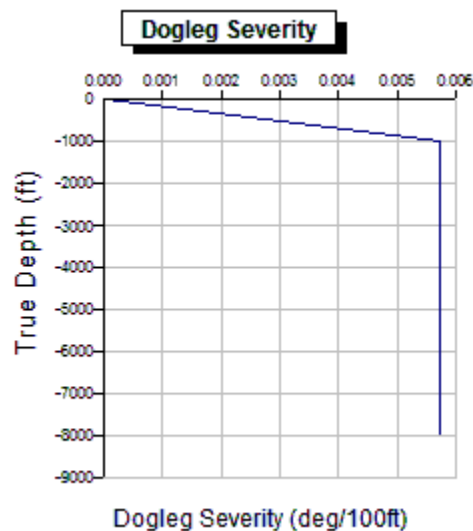
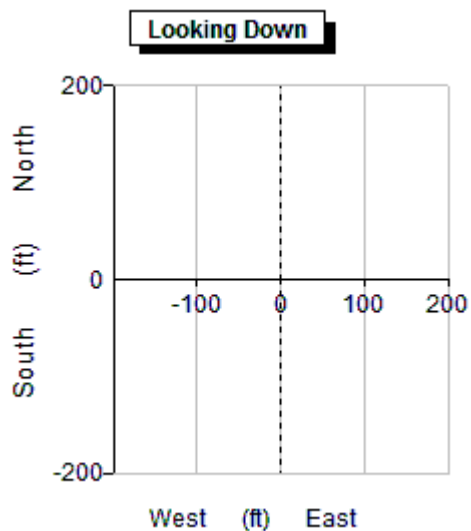
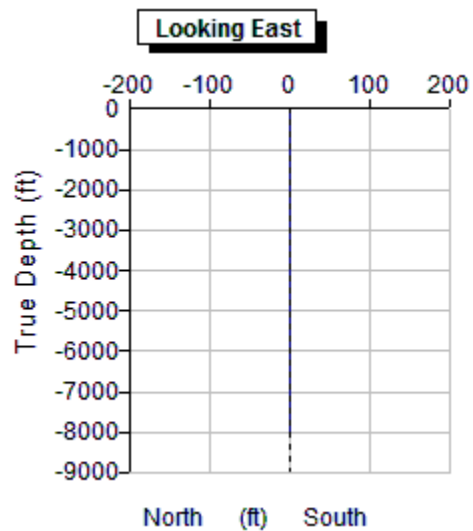
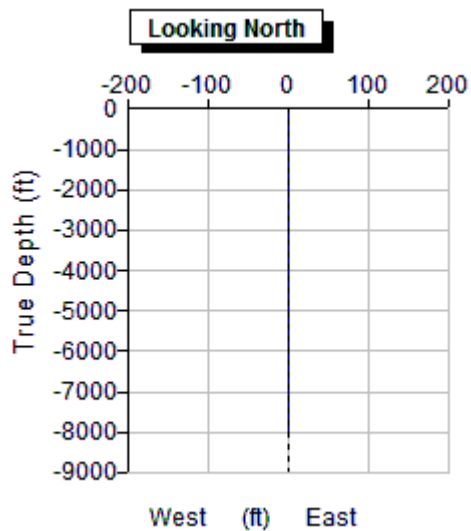
Max Side Load (lbs/rod)
Max Drag Load (lbs/rod)
Rod Length for Steel/Fiberglass (ft/ft)

: 0
: 0
: 25/37.5

**** WELL DEVIATION ****

WELL NAME : Well 2
ANALYST : Scott Malone
DATE/TIME : 9/10/2014 5:35:50 PM
DATA FILE : Sandia Data Well 2(FG).inp6e (BASE CASE)
COMMENTS : Test Number: 02. Test Date Oct, 1995

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