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SROD v6.8.6 - PREDICTION OF ROD PUMPING SYSTEM PERFORMANCE

WELL NAME : 6
ANALYST : Scott Malone
DATA FILE : Sandia Data Well 6.inp6e (BASE CASE)
COMMENTS :
DATE/TIME : 9/10/2014 8:38:32 PM
COMPANY : Sandia Data
WELL TYPE : Vertical

**** PRIME MOVER ****

Mfgr and Type : ROBBINS & MYERS 75 HP ND BHW6
Max Speed (rpm) : 1210
Min Speed (rpm) : 1170
Power Required (hp) : 28.05
Motor Load (% of Rating) : 37.4
Sheave Ratio (Unit/ Prime Mover) : 5.726
Speed Variation (%) : 3.3
Cyclic Load Factor : 1.531
Peak Regenerative Power (hp) : -22.03
Prime Mover Output (hp) : 18.16

**** PUMPING UNIT ****

Mfgr and Type : AMCOT C456-305-144 WITH KA-117 CRANKS (CC'WISE)
Actual Max Load (lbs) : 15276
Average Pumping Speed (spm) : 7.11
Polished Rod Power (hp) : 16.35
Computed Surface Stroke (in) : 144.1
Actual Min Load (lbs) : 4485
Max Load (% of Rating) : 50.1
Unit and Drive Train Loss (hp) : 1.82

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

	<u>IN BALANCE</u>
Max Torque (m in-lbs)	406.8
Min Torque (m in-lbs)	-182.3
Counterbalance Moment (m in-lbs)	730.2
Counterbalance Effect (X100 lbs)	106.29
Percent of Reducer Rating	89.2

**** ROD LOADING ****

	<u>Diameter (in)</u>	<u>Length (ft)</u>	<u>Modulus (MM psi)</u>	<u>Rod Loading (%)</u>
1)	0.875	2409	30.5	39
2)	1.5	500	30.5	19

Max Stress (surf.) (psi) : 25238
Min Stress (surf.) (psi) : 7626

ROD LOADING AT SURFACE AS % OF RATING

<u>Service Factor</u>	<u>Class C,K</u>	<u>Class D</u>	<u>NORRIS 97</u>
1	92	69	39
0.9	107	80	44
0.8	128	94	51
0.7	158	114	60

**** DOWNHOLE PERFORMANCE ****

	<u>Stroke (in)</u>	<u>BPD at 100% eff.</u>	<u>BPD at 85% eff.</u>
Gross:	139.1	584 (24h/d)	496 (24h/d)
Net:	138.9	583 (24h/d)	496 (24h/d)

Tubing Stretch (in)	: 0.3	Lost Displacement (bpd)	: 1
Loss Along Rod String (hp)	: 5.03	Pump Power (hp)	: 11.31
Tubing Size (in)	: 2.875	Tubing Anchor Location (ft)	: 2603
Pump Spacing Guide (in)	: 1	Pump Fillage (%)	: 100

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

Fo/S/Kr : 0.05
N/No' : 0.11

**** OTHER BASIC DATA ****

Reducer Rating (in-lbs)	: 456	Crank Rotation	: (CC'WISE) - Well to right
Overall Speed Ratio	: 167.5	Rod Damping Factors (up/down)	: 0.05 / 0.15
Min/Max Tubing Head Press. (psi)	: N/A	Buoyant Rod Weight (lbs)	: 7079
Total Load on Pump (lbs)	: 4542	Pump Bore Size (in)	: 2.25
Pump Load Adjustment (lbs)	: 290	Tubing Gradient (psi/ft)	: 0.433
Pump Depth (ft)	: 2909	Pump Intake Pressure (psi)	: 395
Pump Friction (lbs)	: 200	SV Load (lbs)	: 6633
TV Load (lbs)	: 11920		

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

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Interval : 1

Depth (ft) : 0
 Max Stress (psi) : 25238
 Min Stress at Bottom (psi) : 1136
 Rod Diameter (in) : 0.875
 Min Stress (psi) : 7626
 Rod Weight (lbs/ft) : 2.224

ROD LOADING AS % OF RATING

<u>Service Factor</u>	<u>Class C,K</u>	<u>Class D</u>	<u>NORRIS 97</u>
1	92	69	39
0.9	107	80	44
0.8	128	94	51
0.7	158	114	60

Interval : 2

Depth (ft) : 2409
 Max Stress (psi) : 3888
 Min Stress at Bottom (psi) : -1578
 Rod Diameter (in) : 1.5
 Min Stress (psi) : -437
 Rod Weight (lbs/ft) : 6

ROD LOADING AS % OF RATING

<u>Service Factor</u>	<u>Class C,K</u>	<u>Class D</u>	<u>User Defined API C</u>
1	19	15	19
0.9	21	17	21
0.8	24	19	24
0.7	27	21	27

Note: if this section is a sinker bar, the rod loading at elevator neck 1" at 1 service factor will be 42%

**** Electric and Power Summary ****

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 WELL TYPE : Vertical

Prime Mover Description : ROBBINS & MYERS 75 HP ND BHW6 (92 Amps)

Output of Motor (hp)	: 18.16	Input to Motor (detent hp)	: 23.53
Input to Motor (true hp)	: 21.08	Peak Downstroke Amps	: 63.9
Peak Upstroke Amps	: 64.2	Average Power Factor	: 0.524
Thermal Current (amps)	: 43.3	Min Power Factor	: -0.421
Max Power Factor	: 0.834	Motor Load (% of rated amps)	: 47.1
Demand (kw) (100% run in 15 min.)	: 15.7	Rated Voltage (volts)	: 460
Electrical CLF	: 1.0373	Run Time (h/d)	: 24
KVA (kilovolt amps)	: 30		

Cost Basis (\$/kwh)	Monthly Power Bills(\$)		Cost/Barrel/1000ft(\$)	
	<u>Non-Detent</u>	<u>Detent</u>	<u>Non-Detent</u>	<u>Detent</u>
0.01	115	128	0.0026	0.0029
0.02	229	256	0.0052	0.0059
0.04	459	512	0.0105	0.0117
0.06	688	769	0.0157	0.0176
0.08	918	1025	0.021	0.0234
0.1	1147	1281	0.0262	0.0293

Power costs do not include transformer and surface transmission line losses. Also, power factor penalty and demand charges, if any, are not considered. Lifting cost is based on net pump stroke and BPD at 100% efficiency.

Fixed Capacitors for Power Factor Correction

<u>Max Power Factor Desired</u>	<u>KVAR Required</u>	<u>Resulting Average Power Factor</u>
0.834	0	0.524
0.873	4.3	0.596
0.911	8.9	0.688
0.95	14.2	0.811

Losses in Surface Unit and Drive Train (hp)	: 1.82
Polished Rod Power (hp)	: 16.35
Losses Along Rod String (hp)	: 5.03
Useful Downhole Pump Output (hp)	: 11.31
Overall Surface Equipment Efficiency (%)	: 77.5
Motor Efficiency (%)	: 86.2
Rod Efficiency (%)	: 69.2
Overall System Efficiency (%)	: 53.7

Caution: A good electrical power prediction requires a good prediction of polished rod power. Motor manufacturers may not always use the same rating criteria. Thus, electrical comparisons between different manufacturers should be used with caution.

**** INPUT DATA SUMMARY ****

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PUMPING UNIT ID : AC456-305-144
 (Description) (AMCOT C456-305-144 WITH KA-117 CRANKS)
 MOTOR ID : RM75E
 (Description) (ROBBINS & MYERS 75 HP ND BHW6)
 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) : 2909
 PUMP DIAMETER (in) : 2.25
 PUMP INTAKE PRESSURE (psi) : 395.3
 PERCENT COMPLETE PUMP FILLAGE : 100
 PUMPING SPEED (SPM) : 7.1
 TUBINGHEAD PRESSURE (psi) : 205
 TUBING ANCHOR DEPTH (ft) : 2603
 TUBING GRADIENT (psi/ft) : 0.433
 TUBING SIZE : 3 - 2 7/8 in.

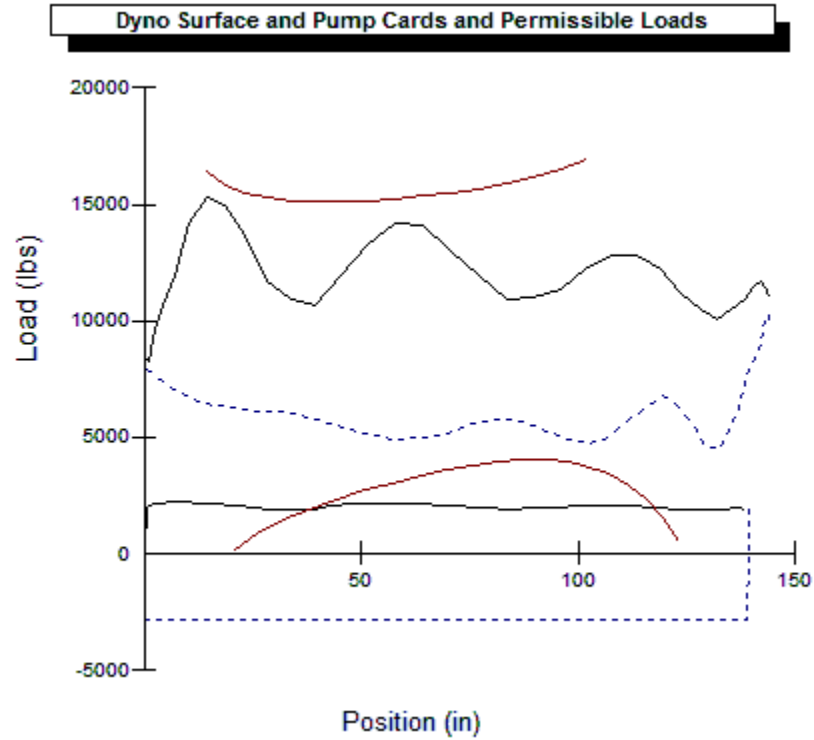
Rod/Taper Information:

ROD STRING DESIGN OPTION				SPECIFY ROD DESIGN		
	<u>Diameter (in)</u>	<u>Length (ft)</u>	<u>Tensile (psi)</u>	<u>Modulus (MM psi)</u>	<u>Weight (lbs/ft)</u>	<u>Guide Type</u>
1)	NORRIS 97					
	0.875	2409	140000	30.5	2.224	N
2)	API C					
	1.5	500	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) : 290
 BUOYANT WEIGHT ADJUSTMENT (lbs) : -146
 PUMP LOAD COEFFICIENT (lbs/ft/sec) : 5
 Run Time (h/d) : 24

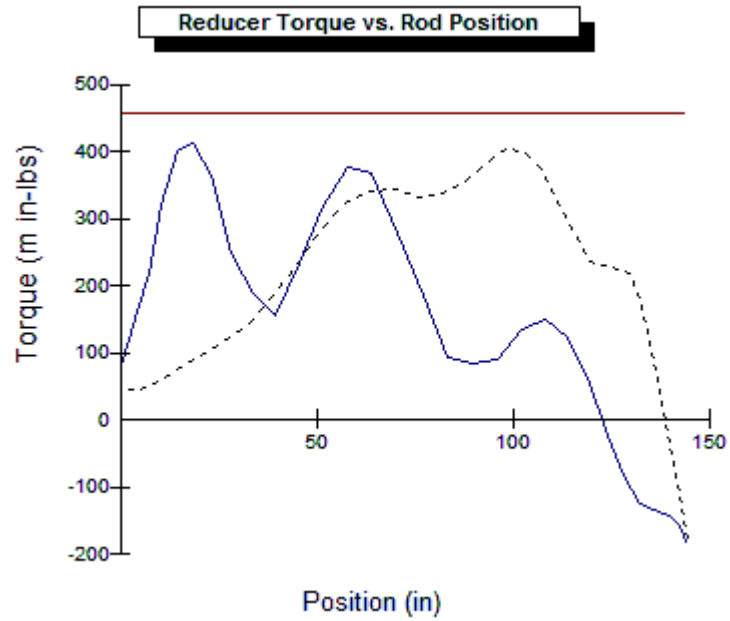
**** DYNO GRAPH ****

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COMMENTS :	



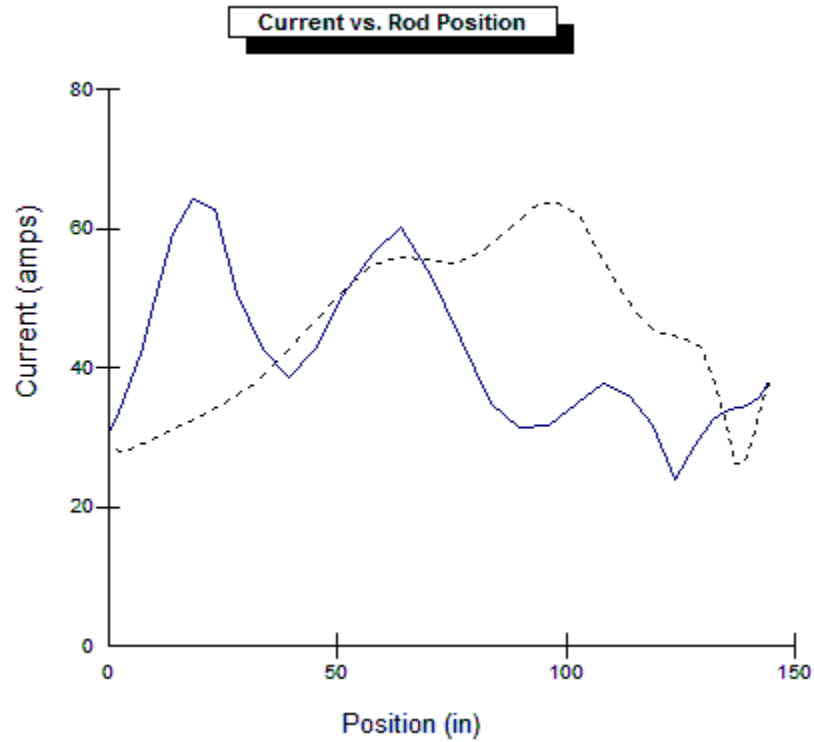
**** REDUCER TORQUE ****

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DATA FILE : Sandia Data Well 6.inp6e (BASE CASE)	WELL TYPE : Vertical
COMMENTS :	



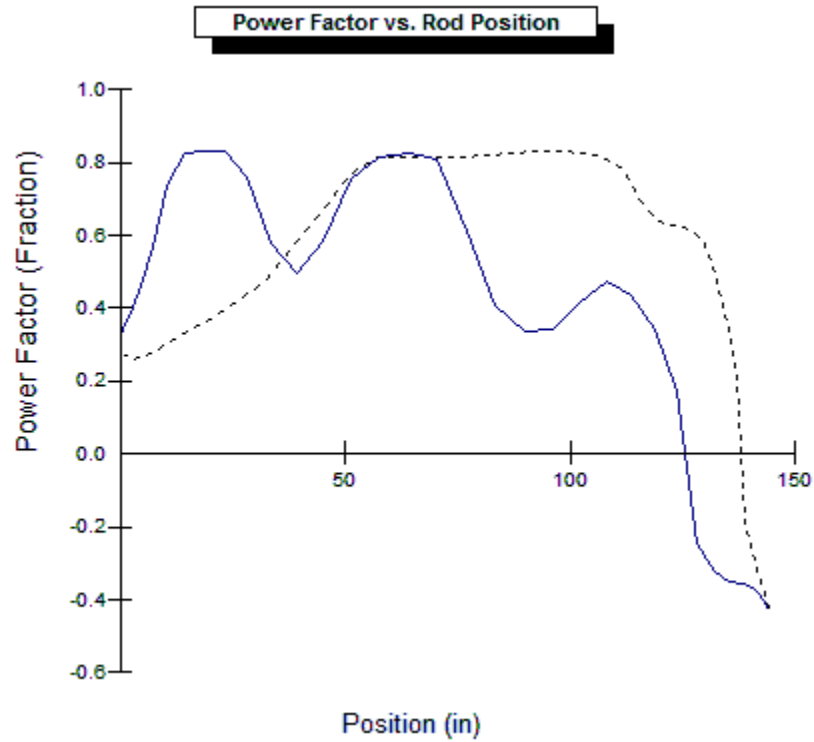
**** MOTOR CURRENT ****

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COMMENTS :	



**** MOTOR Power Factor ****

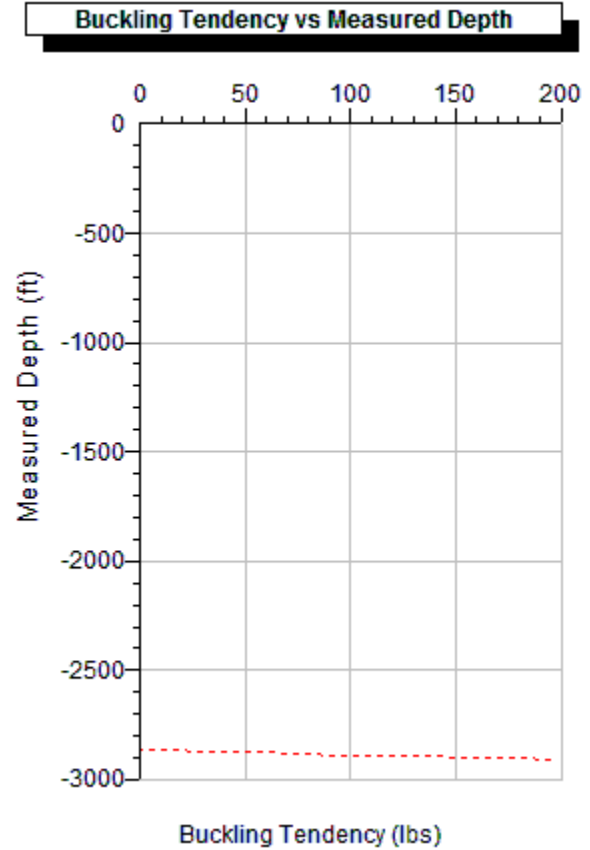
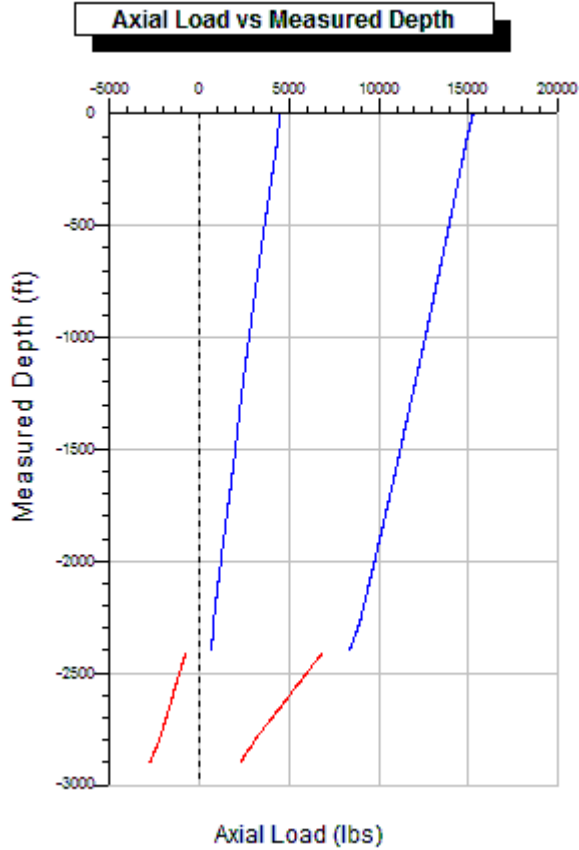
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**** AXIAL LOAD ~ BUCKLING TENDENCY ****

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Rod Type	Rod Diam in (in)	Max Load (lbs)	Min Load (lbs)	Max Stress (psi)	Min Stress (psi)	Rod Load @ 1 %
1. NORRIS 97	0.875	15176	4585	25238	7626	39
2. API C	1.5	6871	-772	3888	-437	19

Max Buckling (lbs) : 198

Location of Max Buckling (ft) : 2909

Buckling Starts at (ft) : 2865

Buckling tendency does not include buoyancy forces because buoyancy forces do not cause buckling.

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

Measured Depth (ft) : 2410

Rod Diameter (in) : 1.5

Max/Min Load (lbs) : 6862/-775

Buckling Tendency (lbs) : 0