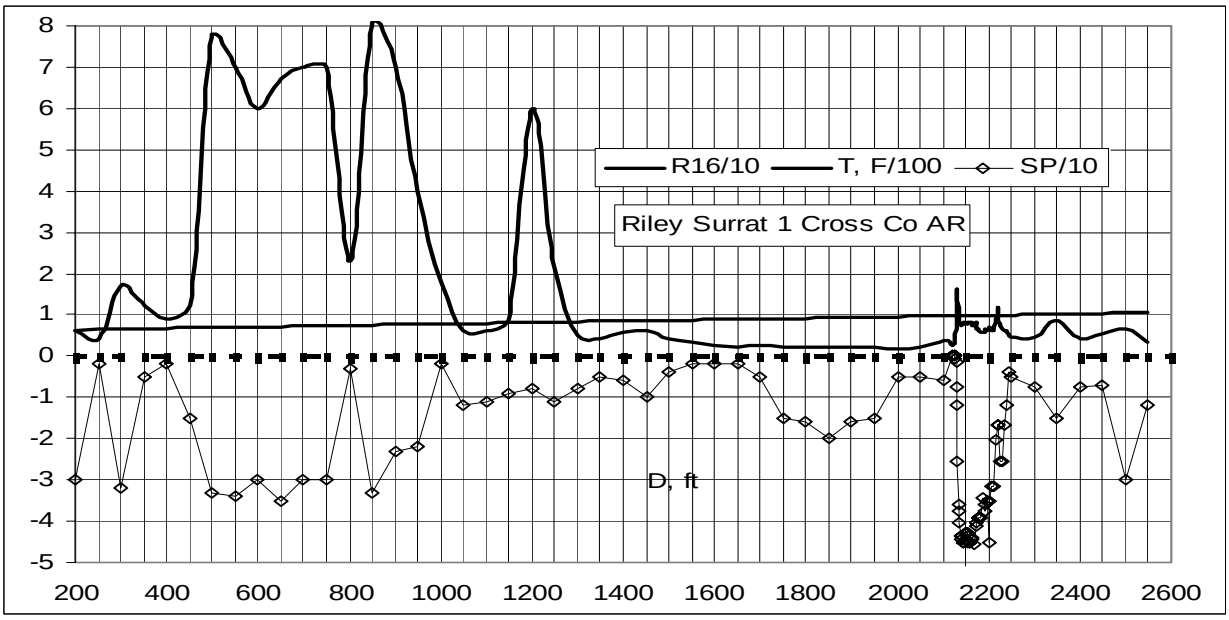
RS2 Prognosis for offset to Riley-Surrat Well Number One, (RS-1)

prepared:: OP Armstrong P.E.

Objective: Confirm or deny speculation on presence or absence of oil in the post-Paleozoic formations in the lease area near Ellis Chapel east of Wynne Ar. The RS-1 well was spuded Thursday June 19, 1952 and logged Tuesday June 24, 1952. After evening of June 20, 1952, speculation exists of small quantities of oil coming from this well. Drillers log reports no surface casing in the 7-7/8 hole.

Target Zones:



Particular attention to cuttings for oil signs between a depth of 800 and 1,300 feet should be observed. Also from analysis of ES tool data, formations below the limestone cap of the Nacatoch should have careful examination at depths of: a) 2130 to 2140 feet, B) 2220-2230 ft, and possibly: C) 2355-2365, D) 2465-2475, E) 2495-2505.

DRILLING PLAN OF RS WELL 2

Below are Drilling and Completion Specifications. Previous well was drilled to depth of 2550 feet.

Location-approximately 150 feet south-southeast of Ellis Chapel, Arkansas

Elevation- Approximately 220feet, ground

Drilling Measurement Datum- Kelly Bushing

Surface Casing: 1200'± 5½x4.83" drift casing.15.5# w/ 8inch long x6.05od coupled

Permitted Depth 2275ft, drill stem, 2560'± 2-7/8" 6.5# J-55 EUE tubing

Hole deviation: Maximum of 2° to T.D.

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DRILLING PROGRAM

1. Set with cement to top and plumb 1200' ± 5-1/2" casing as conductor pipe with top 4" ± above grade.
2. Drill 4-3/4" hole to TD '. Pull bit laying down D.P.
3. Run GR & ND log surface to T.D.

MUD PROGRAM NL Baroid 817-239-0514 , BH 601-649-4400 Mr.Billbow

- Surface to 1200ft, with mud of 8.5-9.5ppg *in* fresh water with synthetic polysol mud (1part/800part water) and Bentonite then change over in open hole to
- 9.5-9 # fresh water Bentonite/synthetic polysol mud treated with sufficient soda ash to maintain pH at 9.5, water loss at 8 cc API in 30 minutes or less and Marsh funnel viscosity of 55-65 seconds. Keep 120MF visc pills available for hole flush.
- Maintain sand content at 4% or less.
- TDS Hardness Min Spec <100ppm, with ~ 35#Bentonite per 100gal
- Adjust pH with 2#NaHCO3 /100gal to between 8.6-9.7pH & >11.5pH problem
- Use mud gun to mix mud w/H2O and a Mix tank at 1 turnover in less than 3 minutes
- Normal Drilling #B/c-gal for a 15x15x5 pit at 35#/C-gal tons of B is 3000 lbs.
- for lost circulation either ground nut shells, sawdust or cottonseed hulls can be added at 3-20#/bbl of mud.

	norm drill:	cavi'g: stablzn	circ loss:
API Ben	30-50	60-80#/c-gal	70-90
HiYld Ben	15-25	25-40#/c-gal	35-45
MF sec	35-55	55-70 sec	65-75

Mud Pit

A 3 foot suction pit depth is selected to accommodate smaller flows for the 4.75 hole with length increased to 15 feet. Estimated mud volume for the two pits is about 1 metric tonne and 130 lbs of soda ash.

Mud circulation rate & Mud-pump pressure:

Original pump was Failing duplex 4x5 GD rated 40-120gpm 450# MAWP 800# Test, 12.5 - 22.5 BHP 90 RPM Crank at 450 RPM on Jack & 4380# max tie rod load.

Gaso1847-A or 1849	1.5std V	max dp	max q	surf csg		piston	gal/stk	*max dpsi
summary	4.75"hole	4.75"hole	4.75"hole	5-7/8 |	6.5	2.5	0.460	990
gpm	67	77	134	82	106	3.0	0.684	685
fpm annular	90	104	180	60	60	3.5	0.944	505
dpsi	247	385	743			4.0	1.252	385
depth	2540	2540	2540	1250	1250	test psi	1.8x	mawp
spm 4x6	42	62	107	65	85	2"i x 4"o	4650# rod	
rpm pinion	216	314	546	360	465	max V	100spm	

The 4x5 GD is replaced by two 4x6 Gaso 1847A (2.5 - 4.25 bore, available sizes: 2.5" & 4" on 1-1/8 rods). The Gaso 1849, is a 1847 bored to accommodate 6" brass liner. Gaso recommended max speed is 100 SPM or about 550 RPM on pinion. With 4 inch liners, max dpsi is 385. Gears are 4/5DP w/4.5" face width, crank pins 3" dia x 2.5"wide, Pinion shaft at gears 1-15/16 & 1.75 at sheave, crossheads 6x6" w/ 1.5"pins, splash lube from 5 gal crank case, inlet by outlet flanges are, 4"-150ansi x 2"-600#ansi. The table estimates Gaso working speed, under various conditions.

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When drilling surface casing with 7-7/8 bit on 2-7/8 pipe, the limiting factor is pump speed of 550 rpm on pinion gear. Under this limitation the flow is 134 gpm, with annular velocity of 63fpm.

When drilling deep, 2550ft, with 2-7/8 pipe and 4.75 bit, the limiting factor is pump discharge pressure of 385 psid. This limits flow to 77gpm, 129fpm annular velocity, 314 rpm on the pinion gear. If minimum recommended flow is 60fpm or 35gpm, 150 rpm.

A Mission 4x3-13inch feed and mix pump, driven by a 13HP diesel engine is used between mud pit & duplex pump. It has rated capacity of 500 gpm 70ft TDH, at 1000RPM, 200gpm at 90ft TDH and 1200 RPM but a larger driver could deliver 500gpm 350ft TDH at 2400rpm.

Pipe:

Conductor: 8 inch x 7ft, Surface: 40 Joints, 1210ft. of 14#/ft 5- 1/2 od long coupled (6.05od) casing, 9 tons Drill & Production: 2-7/8 J55. 6.5-lb EUE tubing 90jts, 2700ft, 8.8tons. A pipe tally shall be kept in fractional inches when drilling in, see Table for preliminary tally. Collars: 7pc 10ft/ea 3in. X 2in.13.5#/ft or 945#, w/ 3inch NPT bit end thread w/2-7/8API connector, 30 ft of 3.5"Square 25#/ft w/2-7/8EUE ends collar 745#, total collar wt of 1690#. A straight hole is obtained by running pipe in tension. 1700# WOB. Hold WOB to 1700# + 1/8 of weight of 2-7/8 pipe in hole.

Bits:

A 12 inch drag bit is for Spud & conductor drilling, Pilot for surface, 6-1/8" tricone rock bit, casing 7in , rock bit, cleanout and final hole 4-3/4in. -tooth tri-cone jet with three 3/8" in. jet or equal area. Calculate maximum WOB as 3500lbs/inch of bit diameter.

Rig Data: Failing, Enid OK 580-234-4141, fax 233-6807 Shop number 564,

The Failing was originally fabricated for USA-CoE circa '48 refurbished Oct 78 and demil 2001. Known upgrades: hydraulic system from 385# to 800#set Jayco PZV, hydraulic pull down cylinder from 1" to 2-3/8" upgrade rotary gear box to 3.5"Hex with Heavy Duty gear box for 2-7/8"Kelly,.replc sand reel clutch from dog ear type & upgrade to both Twindisk draw clutches. Replace Buda 4 cylinder with 6 cyl. Ford industrial. Revised rating, "exploration drilling w/ 2-3/8 drill pipe from 2500-3500feet" Driller's Depth Rating: 3000 feet with 2-3/8" 10.6# drill pipe.

Table: - Hacker fax 903-657-3817 tel 214-657-3546

- Rotary Table: Model Hacker H6, 6- ¼ " opening 320# 4.7/1 gear ratio, Speed Range (RPM) 100 -300 service to 3300ft. 5000ft service depth, Type Drive : Independent
- Modified Failing 34 foot 2x2x ¼ square kelly w/Hex Drive bushing measuring 4" on outside chord and 3.5" across outside flats, also a 15foot 2x2 pilot kelly is available for 2JW Swivel.
-

Kelly Options

- 35 foot 2"x ¼ wall w/ 2"NPTLmx2-3/8API pin A500 Gr.B
- 35 foot 2-7/8 8rEUE J55 w/ 4 square angles welded to side
- standard F1500 kelly 2-3/8 28ft 285# fluted kelly N-L/R thrd on 38 ft mast of p/n #14066 2-3/8" round 3 flute drive bushing
- standard F2500 3-3/8" 34ft 609# fluted kelly w/ 2-3/8"API L/R IF thrd on 42ft mast of p/n #25066A round 3 flute 10" rotary table
- Kelly's used 15 foot 2x2x¼ & 34 foot 2x2x¼

Swivels GEFCO, Don Rowe at 580-234-4141 x275

- Failing 1275C (KING OIL Tool # N15KF181-1), 114#, w/ 2-3/8 API, IF LH TJ Pin rated 10 ton w/o bells or 20ton w/bells, 1-3/4 passage, 29" MOL w/o bells, 114# 1.5" to Goose neck to Spindle
- Western Rubber 2JW 2x2LnptF, 300psi mawp, 1.5"water coarse 7000# static load 500foot drill depth at 100rpm w/2-3/8 drill pipe. 16"MOL, service parts 1-503-649-5626

Mast & Rigging

Masts Model — Jack Knife
28foot A frame rated 40,000# gross load, Max Single Line pull bare drum 15,000#
42foot A frame rated 60,000# gross load, Max Single Line pull bare drum 15,000#
Capacity — (Max. Hook Load) 60,000# (20T on 28foot) mast rated using 75 mph wind load, Constructed from 2-3/8 od x 3/32 t mains and 1-1/4 od minors
Racking Capacity — 2700' *2-7/8 "* Drill Tubing
*Wire Rope***:** Main & Sandline Drums 9/16 IPS-Rot-Res 25,000 break strength 5800 lbs at SF4 and 7700lbs at SF of 3, *Wire Rope* Size & Type—9/16" — 6 x 19 ips-rot res No. of Lines Strung — 4 line & 2 line block Make & Model of Blocks — Failing

Line Scale

45,000# Packer Jr Scale w/settings for 2,3,4 & 6part line
Scale load readings are specific to configuration of number of support lines, traveling and static sheaves, number of traveling drums and use or nonuse of dead line. It reads a calculated load from tension measurement in a single line and calibrated for the above factors. When configuration changes, line scale calibration must be changed, by moving U clamp to specified line holes.
When using dead line, subtract 2 times single pull drum line load from mast rating to arrive at allowable hook load, i.e. 16,000# bare drum pull times 2 less 60,000, leaves 28,000 # hook load. If dead line is tied back to block, subtract only fast line load from mast rating, ie 60k less 15k is 45k (22.5t) max hook and on 3 traveling lines is 15k/line available from mast. Rarely will bare drum pull be achieved due to clutch slippage and wire on drum. When determining fast line load, the effect of friction must be accounted for line load when load is in motion.. This effect is a factor of load support lines and revolving sheaves.
When using 3 support lines and 3 rotating sheaves with a hook load of 14.3 ton, a mast load of 20 ton is obtained with a single drum fast line dynamic pull of 5.52ton. If 91 joints of 2-7/8" 6.5# pipe (8.8ton) is hung from hook, 5.5 tons of pick-up is available in a stuck pipe situation, with a safety

factor of the pipe buoyancy in the hole, approximately 10%., 0.9 ton, the safety factor on ½" wire rope is about 190%.

Drawworks
o Failing 1500 Hoisting Drum 525' of ½" line, Sand reel drum 700' of ½" line on 15,000# bare drum single line pull

Mfgrs. Input Rating — 100 H.P.

Transmission Splicer Geared

No. Speeds 3 forward 1 reverse

Mfgrs. Rating 300CID Ford inline 6. HP Rating -215 HP @2100 RPM 4 speed trans, Type of Fuel: Gasoline

Auxbrake no Hydrotarder

Hydraulic Pump ph.402-474-4055
Original was a Vickers Vane 31gpm at 1800engine rpm 1000psi, 800psi RV setting on pump discharge going back to feed tank. use 150-225SSU at 100F oil pump mounted on PTO of Ford inline 6 cylinder engine. It has since been replaced with a gear type Hydreco on pto of 1/1 and 5.197cid 1500psi max 36.4gpm at 1800 rpm max 2000 rpm w/2" 4bolt npt flange driven by 6t spline 1". Feed line: 1-1/2 inch-12" long wire re-rubber hose.
Mud Pump drives, ph402-474-4055
2.5 liner FD750ccD-AS08 Kawasaki twin cylinder 27BHP@3600RPM 1-1/8"keyed shaft, 4" liner on rig Gresen 144ft# torque 25gpm 600rpm1250psid w/ ¾ in ports 1-1/8 keyed shaft T (ft#)=5250HP/RPM at 500 rpm=>14hp
alt is 23bHP w/c diesel Carrol Engine 248-628-4638
Aux Pump Engines:
Make & Model — PTO from M35 6x6 Kaiser 1966
Desanders — none
Standpipe Size — 2" Rotary Hose Size — 2" x 45'

Air Slips Slip Service 432-332-9892 Odessa Tx
Guiberson model 60T-F1-U, 60 ton air slips with teeth for 2-3/8" and 2-7/8 pipe. It can handle pipe sizes between 1.32 and 4.5 inch od, with appropriate teeth and spider assembly. The bowl has a minimum opening of 5-7/8 inch and gate has opening of 4 ¾ inches. The plain gate minimizes vertical clearances, 12 inch max height. The base flange is 17inches, centralizer rubbers p/n 56871& 56925 are available to stop down hole drops of tools & debris. Weight of the basic assembly is 175#. Air pressure for lift cylinder should be regulated between 40 and 80 psig.

Power Tongs
A set of remanufactured Heilman-Kelly power tongs with jaws for 2-7/8 tubing is provided. The power tongs are driven by hydraulic fluid power via ¾" 2300psi hose. In addition 36" chain tongs and pipe wrenches are available.

B.O.P. — Guiberson type G for 2-7/8 EUE, integral to 5-½ collar

Productivity Maximization
Productivity maximization is facilitated by a) observe safety guidelines b) keep equipment in good working order, c) use good work planning, d) use environmentally safe mud mixes and lubricants and e) avoid stuck pipe & dropping items into well bore.
Under ideal conditions, drilling crew consists of the rig foreman on a 24-hour basis working on a 10 to 4 off schedule; a 2-man crew working tours; plus a driver working until TD is reached and the rig is moved. Drilling personnel shall use OSHA approved safety equipment, steel toe shoes, hard hats, gloves, climbing harness, eye protection and follow safe work guidelines, such as: maintain organization of area, return used tools to storage, keep area picked-up, regularly lubricate machinery with proper oils & grease, clean or avoid leaving slick spots or at least cover with adsorbents, avoid lines of momentum by working "around" not in the line of action, use proper tool for the job, use correct lighting and grounded electrical connections, avoid horseplay and watch out for the welfare of other crew members. Making a habit of these guidelines will maximize performance by avoiding accidents and allow devotion of resources into planning and execution of the basic drilling program.

Post Drilling Operations

Location cleaning shall suffice to permit placing the well on production and/or returning site to grade using a small rubber-tire-mounted tractor. Covering sumps is delayed until end of summer to take advantage of natural drying by the hot summer and autumn. If a field is developed, the greater part of the liquid mud remaining in previous sump will be pumped out and hauled to make up for mud losses in future wells. Leaving the sumps open to dry and recovering the mud gives a double saving.

Operations required after the rig moves out include, putting the well on production and cleaning up the location. .Significant savings involve the pumping-unit foundations. A rectangular foundation shall be poured on top of a compacted, level location. Using robust design of tie-down pipe and bolts allows any pumping unit for this well depth to be installed. One load of redi-mix concrete will make the base. The form sets are made up prior to foundation pouring. The tie-down pipes, bars, and bolts, plus cutting reinforcing shall be fabricated all at one time. Soil and traffic conditions preclude surfacing at the location or the access road.

BENTONITE CEMENT SURFACE CASING

Cementation of surface casing will be accomplished by a mixture of neat cement slurried with Bentonite-Lignosulfate water. The objective of the cementation is to fill the 1200 foot annular area between the 7-7/8 hole and the 2-7/8 casing to surface, 243gallons. This mixture of cement + 15% bentonite + 0.50% Lignosulfate by weight of the cement is selected for the pumpable time of 4.5hours and to keep a uniform cement slurry and set

To achieve this goal, 15.3 sacks of neat Portland cement will be mixed with a bentonite-Lignosulfate mud. The mud slurry will be premixed from 172.3 gallon of water, 348.3 pounds of bentonite and 11.6 pounds of Lignosulfate resulting in about 215.3 gallons of mud slurry. Upon addition of 15.3 sacks of neat Portland. 243 gallons of cement mud slurry of 13.3pound/gallon. After pumping the 243 gallons of cement mixture, a chaser of 200 gallons of water will be used behind wiper plug to make final displacement to surface. Casing will be shut in for 24 hours to get a set strength of 200psi tensile.

Slurry Composition API Class A cement + 15% bentonite + 0.50% Lignosulfate by weight of the cement Mixing Water — gal per sk. of cmt. 9 Slurry Density — lbs. per gal — 13.34

Slurry Properties Thickening Time Test Schedule — 4,000 API Casing Test 24hrs Pumping Times (hrs:min) 4:25 Compressive strengths (psi) 80°F. 24 hours — 250 Flow Properties: Annulus of 5.5" casing in 7-7/8" hole n' 0.22 K' 0.10

Critical Velocity — ft. per second 6.1 Critical Flow Rate — cu. ft. per min. 37.5

200 feet of 5.5”OD CSG in 7-7/8” hole, 1.216 gal/ft, or 243.2 gal slurry. Internal volume 1gal/ft

use 1 centrilizer/jt and 2 plugs and one shoe Ref: Morgan BE, Dumbauld GK (Esso Houston), A Modified Low Strength Cement, ASME Aug17 1950 Fall meeting New Orleans TP3062

							sak 94#
Basis=	1CF=94#	cement	bulk	basis	lb cmt mix	1799.6	
H20/cemt	9	gal/sack	.	total gal	lbcmt neat	1439.7	15.3
Sgsolid mx	3.04	g/cc	,	243	lb aqu mix	1802.7	
bulk den	94	lb/cf solid	,	sacks cmt	lb bent&LS	359.9	
den liq	8.37	lb/gal	,	19.14	lb bentonite	348.3	
slurry wt	13.34	lb/gal	.	lbs bent	lb LigS'ate	11.6	
yield	1.697	cf/sack	.	269.94	lb H2O	1437.0	
Absol.Vol	3.7	gal/sack		lbs LigS	check	1796.9	
%mix	80.2	%H2O by	Wt Cement	9.00	avg	1799.8	
%solid	55.6	%solid by	total wt&=	3242.4	gal H2O	172.3	
Esso mix	15%bent	0.5% LigS			%dsmixW	0.20	
pump t	hrs=4.5		3.04sg at	15%bentnt	gal WBL	215.5	

Neat Cement

Production String Cementation *Slurry Composition*

API Class G cement + 3% salt + 2% calcium chloride mixing water — 0.67 cu. ft. per sack of cement

Slurry Properties Slurry Volume Slurry Density Thickening Time Compressive Strengths

- 1.15 cu. ft./sack cement — 118 Ibs./cu. ft.
- 1 hr. 14 min. — 4000' API csg. test— 100 psi
- 4 hrs — 920 psi 8 hrs — 2500 psi 16 hrs — 3390 psi 24 hrs — 5050 psi

Flow Properties N' = 0.37 K' = 0.10 Critical Velocity — 8.1 ft./sec.
Critical Flow Rate — 49.8 cu. ft./min. ~-

Cementing Surface, original permit

Surface Casing 7-7/8 hole w/ 5.5" pipe Cemented to surface
Annular Volume (between surface casing and hole): 1.3gal/ft with 210 feet is 272gal (36cf mix) of cement mix in annulus. to come to surface

Using a conventional mix, the Bags of Cement at 1.1cf mix /cf dry is 33 cf of dry cement, 31sacks cement mixed neat w/ 4.7gal per sack, 16.1lb/gal, (5gal/sack 15.8ppg, 1.15cf/sack, 94pps)

Use of Bentonite as an extender and thinning the cement to 9gal/bag (175gal water total) to give 13.5ppg with 15# bentonite/bag allows the bags of cement to be reduced by almost ½ (15.3sacks cement and 350lbs of bentonite) (yield of 1.7cf/sack of solids) and extends pumpability time to 4.5hours.
Use one 5.5" casing centralizer every-other joint and 1 on top joint or 4 centralizer
Use one 5.5" casing bottom discharge drillable float and guide shoe
Use one 5.5" casing bottom wipe plug and one top wipe plug.
Casing Volume 5.5od 15.5ppf is 1gal/ft
Surface Casing 7-7/8hole w/ 5.5" pipe Cemented to surface
Annular Volume (between surface casing and hole): 1.3gal/ft with 210 feet is 272gal (36cf mix) of cement mix in annulus. to come to surface
Bags of Cement at 1.1cf mix /cf dry is 33 cf of dry cement, 31sacks cement mixed neat w/ 4.7gal per sack, 16.1lb/gal, (5gal/sack 15.8ppg, 1.15cf/sack, 94pps)

Pipe Tally and Weight Schedule

sg Line Scale Wt Table 6.5#/ft 2-7/8 5-1/2 in casing
1.05 Drill wt =Hole wt -1000

jts	dx	wt/ft	wi	bouy	D wt	depth	jts	dx	wt/ft	wi	bouy	D wt	depth
col	70	17.1	1200	-160	1040	70	38	30	6.5	195	-26	7462	1210
1	30	6.5	195	-26	1209	100	39	30	6.5	195	-26	7631	1240
2	30	6.5	195	-26	1378	130	40	30	6.5	195	-26	7800	1270
3	30	6.5	195	-26	1547	160	41	30	6.5	195	-26	7969	1300
4	30	6.5	195	-26	1716	190	42	30	6.5	195	-26	8138	1330
5	30	6.5	195	-26	1885	220	43	30	6.5	195	-26	8307	1360
6	30	6.5	195	-26	2054	250	44	30	6.5	195	-26	8476	1390
7	30	6.5	195	-26	2223	280	45	30	6.5	195	-26	8645	1420
8	30	6.5	195	-26	2392	310	46	30	6.5	195	-26	8814	1450
9	30	6.5	195	-26	2561	340	47	30	6.5	195	-26	8983	1480
10	30	6.5	195	-26	2730	370	48	30	6.5	195	-26	9152	1510
11	30	6.5	195	-26	2899	400	49	30	6.5	195	-26	9321	1540
12	30	6.5	195	-26	3068	430	50	30	6.5	195	-26	9490	1570
13	30	6.5	195	-26	3237	460	51	30	6.5	195	-26	9659	1600
14	30	6.5	195	-26	3406	490	52	30	6.5	195	-26	9828	1630
15	30	6.5	195	-26	3575	520	53	30	6.5	195	-26	9997	1660
16	30	6.5	195	-26	3744	550	54	30	6.5	195	-26	10166	1690
17	30	6.5	195	-26	3913	580	55	30	6.5	195	-26	10335	1720
18	30	6.5	195	-26	4082	610	56	30	6.5	195	-26	10504	1750
19	30	6.5	195	-26	4251	640	57	30	6.5	195	-26	10673	1780
20	30	6.5	195	-26	4420	670	58	30	6.5	195	-26	10842	1810
21	30	6.5	195	-26	4589	700	59	30	6.5	195	-26	11011	1840
22	30	6.5	195	-26	4758	730	60	30	6.5	195	-26	11180	1870
23	30	6.5	195	-26	4927	760	61	30	6.5	195	-26	11349	1900
24	30	6.5	195	-26	5096	790	62	30	6.5	195	-26	11518	1930
25	30	6.5	195	-26	5265	820	63	30	6.5	195	-26	11687	1960
26	30	6.5	195	-26	5434	850	64	30	6.5	195	-26	11856	1990
27	30	6.5	195	-26	5603	880	65	30	6.5	195	-26	12025	2020
28	30	6.5	195	-26	5772	910	66	30	6.5	195	-26	12194	2050
29	30	6.5	195	-26	5941	940	67	30	6.5	195	-26	12363	2080
30	30	6.5	195	-26	6110	970	68	30	6.5	195	-26	12532	2110
31	30	6.5	195	-26	6279	1000	69	30	6.5	195	-26	12701	2140
32	30	6.5	195	-26	6448	1030	70	30	6.5	195	-26	12870	2170
33	30	6.5	195	-26	6617	1060	71	30	6.5	195	-26	13039	2200
34	30	6.5	195	-26	6786	1090	72	30	6.5	195	-26	13208	2230
35	30	6.5	195	-26	6955	1120	73	30	6.5	195	-26	13377	2260
36	30	6.5	195	-26	7124	1150							
37	30	6.5	195	-26	7293	1180	stretch	max		dL	inch=		6.42

jts	dx	wt/ft	wi	bouy	D wt	depth
1	30	15.5	465	-62	403	30
2	30	15.5	465	-62	806	60
3	30	15.5	465	-62	1209	90
4	30	15.5	465	-62	1612	120
5	30	15.5	465	-62	2015	150
6	30	15.5	465	-62	2418	180
7	30	15.5	465	-62	2821	210
8	30	15.5	465	-62	3224	240
9	30	15.5	465	-62	3627	270
10	30	15.5	465	-62	4030	300
11	30	15.5	465	-62	4433	330
12	30	15.5	465	-62	4836	360
13	30	15.5	465	-62	5239	390
14	30	15.5	465	-62	5642	420
15	30	15.5	465	-62	6045	450
16	30	15.5	465	-62	6448	480
17	30	15.5	465	-62	6851	510
18	30	15.5	465	-62	7254	540
19	30	15.5	465	-62	7657	570
20	30	15.5	465	-62	8060	600
21	30	15.5	465	-62	8463	630
22	30	15.5	465	-62	8866	660
23	30	15.5	465	-62	9269	690
24	30	15.5	465	-62	9672	720
25	30	15.5	465	-62	10075	750
26	30	15.5	465	-62	10478	780
27	30	15.5	465	-62	10881	810
28	30	15.5	465	-62	11284	840
29	30	15.5	465	-62	11687	870
30	30	15.5	465	-62	12090	900
31	30	15.5	465	-62	12493	930
32	30	15.5	465	-62	12896	960
33	30	15.5	465	-62	13299	990
34	30	15.5	465	-62	13702	1020
35	30	15.5	465	-62	14105	1050
36	30	15.5	465	-62	14508	1080
37	30	15.5	465	-62	14911	1110
38	30	15.5	465	-62	15314	1140
39	30	15.5	465	-62	15717	1170
39	30	15.5	465	-62	16120	1200

APPENDIX 1: ESTIMATION RATIONALE

DRILLING VELOCITY & MUD FLOW RATE

Shallow hole standard flow at 40fpm is GPM=$2(D_h^2-d_p^2)$ diameters inches, (h-ole, p-ipe). By which, max hole size of a 4x6 Gaso 1847 running 100SPM is approximately 9 inch on 2-7/8 pipe. In deeper 6500 foot deep wells 90-110fpm velocity is used. At 100fpm, the largest hole of a 4x6 Gaso 1847 running 100SPM is approximately 5.75 inch on 2-7/8 pipe.

DRILL RATE

In consolidated rocks, rate of penetration may be estimated by ft/hr=RPM$(W/D/C)^2$ With RPM as pipe rotation per min, W as weight on bit in pounds and C, a factor related to formation consolidation. For hard formations, C maybe around 1400, soft formations a value of 700 or less is applicable. In soft or loose formations RPM speeds between 100 and 200, (peripheral speed of bit edge 270-450 ft/min) with W between 150 to 1000 pounds/inch of bit diameter recommended. For example at 4.75 inch bit run at 2000# and 150 rpm calculates to penetrate at 54 feet per hour in medium soft formation. In unconsolidated formations, drilling rate is related more to nozzle and hole fluid velocity, as seen by application of hole washing, which can be accomplished with any rotation nor weight.

Pipe dp

Woods & Pigott presented a simple formula for mud friction losses in *Mud Flow in Drilling*, "API Drilling & Production Practices 1941 pp91-103", valid for 9.5ppg & 3cp mud, as
dPSI/1000ft = $0.6(gpm)^{1.86}/(id\ inch)^{4.86}$
Total dp is can be estimated as C*ID.dp + nozzle, typical C is 2. ID dp for various length of 2-7/8 are given in above table.

L	id	gpm	dPSI-	gpm	dPSI-
500	2.44	150	44	100	21
1000	2.44	150	88	100	41
1500	2.44	150	132	100	62
2000	2.44	150	175	100	83
2500	2.44	150	219	100	103

STEEL PIPE WEIGHT

The following relationship gives approximate weight per foot of steel pipe (connection weights neglected) , #/ft =$2.7(D_o^2-d_i^2)$ diameters of inches,

CABLE LENGTH ON SPOOLED DRUM

Approximate Spooled Line length, on drum, L, w/ other line od's: use $L_2=L_1(d_1/d_2)^{1.9}$.

Fuel usage is estimated as below.

	Fuel	usage	
engine	bhp	gpd/bhp	dly fuel gal
gasol	125	1.2	150
diesel	32	0.7	22.4

Mud Programs of Other Nearby Wells

well	sec	#/gal	cc/30min	Rm	T,F	Dmax'	type
MM-Park.Ginseck 10/14/37	20	9.5		8.0	210	4026	cilox-lime
PPC-Engler- 08/24/47				3.0	177	2725	
Ramsey.Poinsett- 11/21/48	47	10.3		2.0	120	3512	Aquagel
Riley.Surrat1-CCO 06/24/52	45	9.5		4.9	105	2548	Aquagel
Newman- CCO 07/1/52	44	10.6		1.3	114	2020	Aquagel
Rhodes1-CCO 07/26/52	40	10.0		1.3	108	1869	Aquagel
Smith - CCO 12/21/52	383	10.3	11.5	7.6	121	2800	Aquagel
Seaboard C - 07/4/53	58	10.3		6.0	104	2125	Aquagel
Seaboard G - 09/14/53	55	9.7		1.9	115	3280	queb-gel-caustic
Whitby1-CCO 09/29/53	50	12.0		7.4	120	2806	Aquagel
Patton.Armstrong - 06/3/64	40	10.0	LC mtrl	2.8	118	3284	queb-gel-caustic
Warren.Malkin - 01/20/61	50	9.6	8.0 pH=10	3.9	132	3531	queb-gel-caustic
HOM Singer1 - 1/27/79	46	8.9	8.8	7.7	115	3015	LSND 10pH
HOM Singer1 - 3/31/79	40	9.1	3.2	0.94	180	11,151	LSND 9pH
Penz.Morris 09/28/82	30	8.6	16.0	2.3	116	4790	chem 9.0pH
Lines - 06/9/86	45	8.9	17.6	1.1	121	4235	gel 9.5pH

Not listed in table are wells drilled but lost to stuck pipe. They were, Brown-CCO Oct.1952, 2.2 miles west, Seaboard Core D of 1953, 2.3 miles NE, Bowen-Tucker drilled 1961, 11.5 miles SE between Forrest City & Colt. The record depth is CNG-Carter at 14,881 feet deep drilled 1971 and 15 miles S-SE.

The Tannin Lime type muds enjoyed a brief period of popularity but are rarely used today. A typical low water loss, 13cc, would be Quebaceo 8#/bbl bentonite 8#/b lime4#/b, NaOH2#/b CLS2#/b starch1.2#/b with viscosity of 3cp.apparent and 8.6ppg at 12pH.

Tannin muds are replaced by limed calcium Lignosulfate (CLS) muds. A modern mud used in this area is CLS Bentonite with 55-65 MF sec 9pH and 9.5 ppg with cedar bark splinters for LCM. A synthetic 120MFS visc pill of 1 pipe joint volume is added before each brake & make to flush hole.

Marsh Funnel, MF or API, seconds is the time to drain 1liter thru a 6"odx12" cone with 3/16 inch hole. Approximate relationships are:

- MF sec = 35.7**LN*(#Bentonite/100gal)-61
- cp,centipoise = 0.50exp(0.05MF-sec)
- ppg=8.34+0.0058#B/100gal,
- API spec Bentonite produces a minimum of 15cp at 25#/BBL.
- Hi Yield bentonite contain viscosity extenders to yield 15cp viscosity with reduced amounts of bentonite clay.

#B/100gal	MF sec	Den
15	36	8.4
25	54	8.5
35	66	8.5
40	71	8.6
45	75	8.6
90	100	8.9

Lime or soda ash for pH adjustment is preferred for pH adjustment due to the aggressive nature of caustic. The use of pH adjustment chemicals maybe estimated as follows, 0.6#NaOH/Cgal=11.8pH, (0.25#/bbl=9-10.5pH) or use 0,6# Na2CO3 /c-gal=9.5pH, 60#NaHCO3/cgal=8.3pH, lime has max pH of 12 and typically added with CaLigSulf up to 14.3 lbs/100gal to minimize thickening of Lime muds, (min 2#CLS/cgal). All chemicals, and especially Caustic should be applied only with due regard to safety, such as gloves, apron, respiration mask, and eye protection. The principle working tools of mud adjustment are Marsh Funnel, Mud Balance, pH papers. Planning, with patience in mixing chemicals, prevents over addition and costly readjustment.

Other Mud Considerations

Mud Pit Sizing

Hole Volume in CF is $L(D_h^2-d_p^2)/182$, L is in feet and diameters are inches, the controlling hole is that of surface casing, using 7 inch bit 1200 feet long is 2400 gal. Pit width is $0.5(gal)^{0.33}$ or 6.5 feet., and ideal suction pit L is 1.25W (8 foot) with depth of 0.85W or 5.5 feet. and settling pit L is twice the suction length, 16 foot, with same depth, with a shallow ditch connecting the two pits.

A Failing Slush Pit is 150 gal measuring 42"W-117"L-11"H, this yields 113 to 75 second of retention, Weir Rate 30gpm/inch width, velocity range: 18-38gpm/Sfxa. A square weir of about one foot width provides flow gage. At one inch of head the flow is 35gpm and at 2 inches, 99gpm, being proportional to the 1.5 power of head.

Thiotoxic Considerations

Bentonite mud, as often mixed in measure used for drilling, is a thiotoxic substance, e.g. it needs motion to prevent setting up like cold jello. Once jelled, some type of shearing is required to re-establish fluidity. When flow is stopped, the jelling effect is not instantaneous, but is related to mud concentration, time of quiescence, and chemical additives. After motion ceases, gravity settles out mud particles and mud concentration increases in lower layers. In a few hours, a jell can form within concentrated muds. Breaking this jell back to suspension is accomplished by shearing. Examples of jelling can be seen on bottom of mud pits or bottom of a mud filled hole. This jelling property helps bentonite muds support drill hole wall caving and reduces settling rate of drill cuttings during "break-make". Any momentum imparted to the jell, such as fluid jet from a hose or drill bit nozzle, vibration from hammering, rotation acceleration, linear acceleration of, and or in, the system will re-fluidize mud. It is established that earth quake vibrations have caused mud slides by combination of jell breaking and pre-stress loads. Mud jell strength adds to fluid pressure surges when re-establishing mud flow or when moving pipe inside a hole. Establishing mud flow slowly will minimize pressure stresses in mud flow system. Likewise, moving pipe slowly will minimize stresses to borehole wall.

Mud Mixing

Use of a mud mixing hopper is essential to quickly disperse Bentonite into water. Once dispersed, keeping the bentonite in suspension is achieved by proper agitation. Correct water conditions (pH, TDS, & additives addition) shall be established prior to adding mud to water. As drilling progresses, it may be necessary to adjust by make-up of various mud system chemicals. Makeup of components is best accomplished with a mixing tank. A mud pan is typically 4 welded components: 1)dry mud hopper made of 10 gauge steel into the form of an inverted 30" base pyramid, the apex having a 2" close-open nipple seal welded; 2) mixing Tee of 3" sch 40 galvanized steel with 2 reducing bushing of 2"x3" and 1 bushing of 3"x1.5", at one tee straight side a 1.5" Sch 40 x 12" threaded nipple with 2" hose connector, at the other straight side is placed the ¾" mixing nozzle with 2 inch hose connector for inlet water flow; and to the top is attached to dry mud hopper; 3) the ¾" inlet mixing nozzle extending under hopper throat to ½ " just outside the opposite straight; 4) the 36" long support legs welded outside the open edges of inverted pyramid, with cross bracing of legs added for stability. The mud pan discharge goes to mixing tank top with bottom going to pump and on to inlet of mud gun.

RS2 Prognosis for offset to Riley-Surrat Well Number One, (RS-1)

prepared:: OP Armstrong P.E.

Drilling Rates

The drilling comparison table is for Lost Hills field of Kern county California. Rotary drill penetration rates were known to vary between 40 and 115 feet per hour. The 115 fph rates were obtained using WOB of 1500#/inch of bit diameter, 45 API sec of 8.8ppg mud, annular velocity of 150fpm and a rotation of 250RPM, 1-2% max sand and 4.5% max solids in the slightly consolidated formation.

Recent drilling in adjacent counties to RS-2 have obtained 100fph rates by using 60MF sec mud at annular velocity of 95fpm.

Drilling time in feet/hr for the No.1 LW Robinson drilled 1948, in Lee Co. AR are provided below. The average drill time was 19 feet/hour. The median variance range of max feet/hour was 45f/h and minimum of 13f/h. Absolute maximum rates were un-sustained at 100fph.

Drilling Comparison, soft for'mn	Good	Better
Drilling rig % total $/ft	25.9%	22.6%
Drilling fluids % total $/ft	2.8%	2.9%
Coring, testing, and logging.	3.3%	1.8%
Cementing % total $/ft	7.7%	5.3%
Casing, tubing, rods % total $/ft	37.4%	40.2%
Location Prep % total $/ft	4.2%	1.1%
Surface facilities % total $/ft	18.6%	26.1%
Total $/ft	80	50
Average depth, ft	1900	1852
Average rig time per well, hours	134	45

The called tops follow as: Unspecified alluvial at less than 250ft., Jackson 250 ft, Claiborne 740ft. Cain River member of Claiborne 1220ft, Wilcox 1430, Midway top Porter Creek member 2205, top Clayton member and base Porter creek Arkadelphia top 2725, Nacatoch top 2785, Saratoga Top 3075, Annova Marlbrook top 3175, Ozan top 3448 Atoka top 3545ft measured from elevation of 203ft. The well start was May10 and completed June 14 in Pennsylvanian Atoka at TD of 3643.

Geologic Formations

	dist	Elev	Plzc Top	Ark Top	Mid top	Wlcx top
LW Robsn	29mS188d	-203	-3545	-2725 t820	-2205 t520	-1430 t785
RS-1	0	-223	-2380?	-1745 t635	-1300 t445	-640 t660
delta	0	+20	+1165	+980	+905	+790

Using the Paleozoic top as a basement floor, the RS2 location is structurally elevated from locations to the south. Well RS-1 was drilled to 2550 ft, and from well log it does not appear to have encountered Paleozoic formations. Paleozoic top of RS location is estimated at 2600 ft measured depth, md, or -2380 above mean sea level. This places the younger formations updip approximately 800 to 1200 feet. Some of this difference can be accounted for in erosional deposition effects. This is seen by adding up the differences in layer thickness, 185ft Cretaceous, 75ft Midway, and 125 ft of Wilcox for a total of 385 ft. This however still leaves 785 ft of uplift in 29 miles of North-South travel. This uplift is an ideal situation for updip movement of hydrocarbon, h/c, and possible accumulations. A deposit will occur only if a trap zone or structural closure exist. Cretaceous age accumulations have been encountered locally, Cotton Plant, McCrory, Wheatly, Stutgart, and possibly RS1. Using this analysis, anticipated measured depth of tops in RS2 would be : 860' for first Wilcox sand by 550ft of total thickness, 1520' for Midway shale by 445' thick, and 1965' for Arkadelphia, with 60 feet of Arkadelphia Marl, and Nacatoch limestone top at 2020. Target zone 2220 feet.