

Project: Weld County, CO (NAD 83)
Site: Sec. 20-T6N-R62W (Wells Ranch AE PAD)
Well: Wells Ranch AE20-64HN
Wellbore: Plan A
Design: Final Surveys

Noble Energy

HALLIBURTON
Drilling

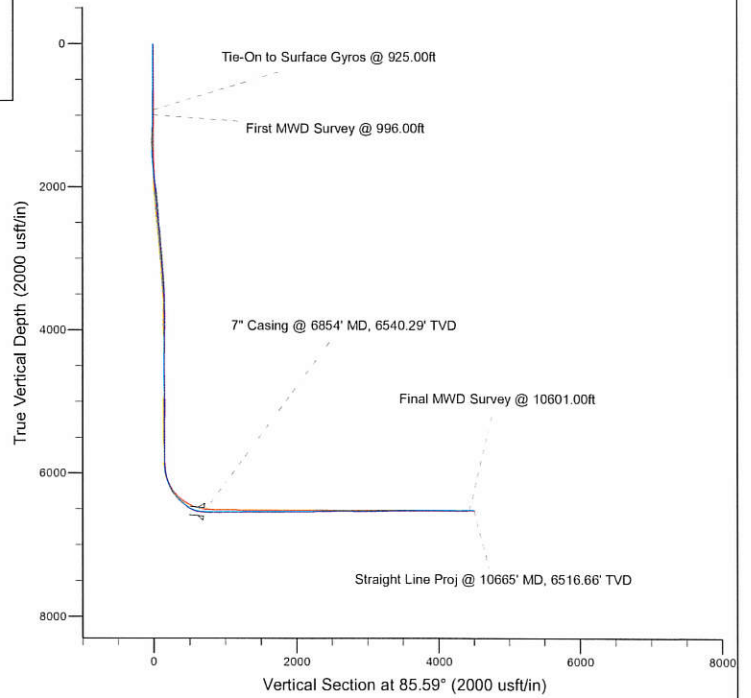
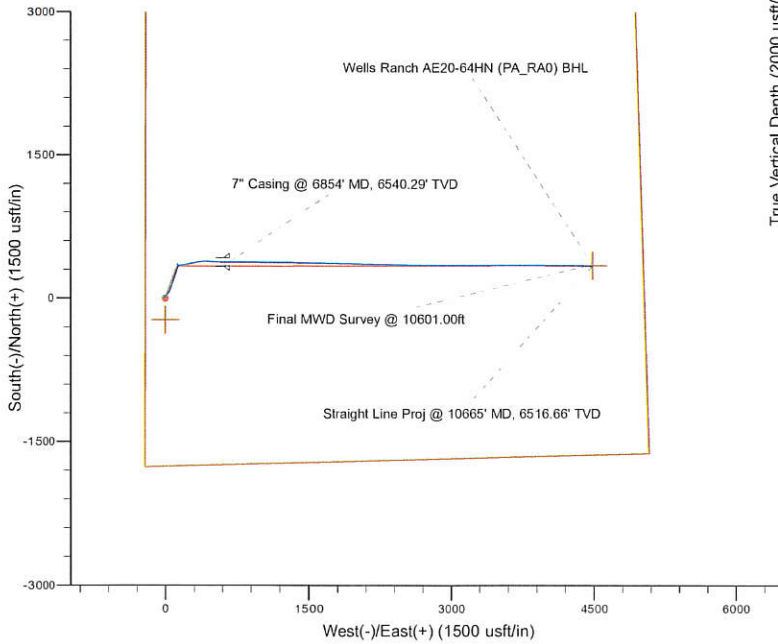
Platted SHL: 1756' FSL, 215' FWL
Platted Lat/Long: 40.46978° N, 104.35532° W
Location: Sec. 20-T6N-R62W

7" Casing: ~2112.20' FSL, ~889.55' FWL
Lat/Long: 40° 28' 14.856" N, 104° 21' 10.332" W
State Planes - CO Northern: 1,416,414.76' N, 3,319,145.02' E
Location: Sec. 20-T6N-R62W

BHL: ~1971.10' FSL, ~534.70' FEL
Lat/Long: 40° 28' 13.979" N, 104° 20' 21.049" W
State Planes - CO Northern: 1,416,375.57' N, 3,322,954.61' E
Location: Sec. 20-T6N-R62W

LEGEND

- Wells Ranch AE20-64HN, Plan A, Rev A0 V0
- Final Surveys



WELL DETAILS: Wells Ranch AE20-64HN

Ground Level: 4785.00
RKB 24 ft @ 4809.00usft (H&P 343)

Created By: Fred Hartmann
Created On: 11/14/2013

Noble Energy

Weld County, CO (NAD 83)

Sec. 20-T6N-R62W (Wells Ranch AE PAD)

Wells Ranch AE20-64HN - A7

Design: Final Surveys

Sperry Drilling Services

Final Survey Report

14 November, 2013

Well Coordinates: 1,416,036.77 N, 3,318,468.24 E (40° 28' 11.21" N, 104° 21' 19.15" W)

Ground Level: 4,785.00 usft

Local Coordinate Origin:

Viewing Datum:

TVDs to System:

North Reference:

Unit System:

Geodetic Scale Factor Applied

Version: 5000.1 Build: 70

Centered on Well Wells Ranch AE20-64HN - Slot A7

RKB 24 ft. @ 4809.00usft (H&P 343)

N

Grid

API - US Survey Feet - Custom

HALLIBURTON

Design Report for Wells Ranch AE20-64HN - Final Surveys

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
365.00	0.40	238.94	365.00	-0.66	-1.09	-1.14	0.11
645.00	0.60	342.14	644.99	0.23	-2.38	-2.35	0.28
925.00	0.80	282.74	924.97	2.06	-4.73	-4.56	0.26
Tie-On to Surface Gyros @ 925.00ft							
996.00	1.38	282.54	995.96	2.36	-6.05	-5.85	0.82
First MWD Survey @ 996.00ft							
1,088.00	1.29	282.48	1,087.93	2.82	-8.15	-7.90	0.10
1,181.00	1.36	270.44	1,180.91	3.05	-10.27	-10.01	0.31
1,274.00	1.58	265.63	1,273.88	2.97	-12.65	-12.39	0.27
1,367.00	0.65	96.87	1,366.87	2.80	-13.41	-13.15	2.39
1,460.00	0.71	99.93	1,459.86	2.64	-12.32	-12.08	0.08
1,555.00	3.86	42.27	1,554.78	4.91	-9.58	-9.18	3.72
1,650.00	5.64	26.23	1,649.46	11.46	-5.37	-4.47	2.32
1,745.00	7.39	36.68	1,743.84	20.55	0.34	1.92	2.22
1,840.00	9.13	42.98	1,837.86	30.96	9.13	11.49	2.06
1,935.00	11.18	44.36	1,931.36	43.06	20.71	23.96	2.17
2,030.00	11.22	36.61	2,024.56	57.07	32.66	36.96	1.58
2,124.00	9.86	28.48	2,116.98	71.49	41.96	47.33	2.14
2,219.00	11.46	23.73	2,210.33	87.28	49.63	56.20	1.92
2,314.00	10.82	16.62	2,303.55	104.46	55.98	63.85	1.59
2,409.00	11.35	15.33	2,396.78	122.02	61.00	70.21	0.62
2,504.00	11.09	20.87	2,489.96	139.57	66.73	77.27	1.17
2,599.00	13.29	20.87	2,582.82	158.32	73.88	85.84	2.32
2,694.00	12.20	19.75	2,675.47	177.97	81.16	94.61	1.18
2,789.00	11.00	19.00	2,768.53	195.99	87.50	102.32	1.27
2,884.00	13.09	18.96	2,861.43	214.73	93.95	110.19	2.20
2,979.00	12.67	17.48	2,954.04	234.84	100.57	118.34	0.56
3,074.00	11.60	17.89	3,046.92	253.87	106.64	125.85	1.13
3,169.00	10.02	16.33	3,140.23	270.89	111.89	132.40	1.69
3,264.00	8.76	15.14	3,233.96	285.81	116.11	137.75	1.34
3,359.00	7.02	14.89	3,328.05	298.40	119.49	142.09	1.83
3,454.00	7.44	24.00	3,422.30	309.63	123.48	146.93	1.28
3,549.00	7.36	25.44	3,516.51	320.75	128.60	152.89	0.21
3,644.00	6.33	17.39	3,610.83	331.24	132.78	157.86	1.48
3,739.00	4.50	8.21	3,705.41	339.93	134.87	160.62	2.13
3,834.00	2.35	338.88	3,800.24	345.43	134.70	160.88	2.85
3,929.00	3.02	319.12	3,895.14	349.14	132.37	158.83	1.19
4,023.00	1.02	293.42	3,989.07	351.35	129.98	156.62	2.28
4,118.00	0.79	271.90	4,084.06	351.70	128.55	155.22	0.43
4,213.00	0.72	328.60	4,179.06	352.23	127.58	154.30	0.76
4,308.00	1.09	313.03	4,274.04	353.36	126.61	153.42	0.46
4,403.00	1.41	303.02	4,369.02	354.61	124.97	151.88	0.41
4,498.00	1.00	306.34	4,464.00	355.74	123.32	150.32	0.44
4,593.00	0.68	65.53	4,558.99	356.47	123.17	150.22	1.53
4,688.00	1.38	69.35	4,653.98	357.10	124.75	151.85	0.74
4,783.00	1.65	137.31	4,748.95	356.50	126.75	153.80	1.80
4,878.00	0.88	129.65	4,843.93	355.03	128.24	155.17	0.83
4,973.00	0.36	152.19	4,938.92	354.30	128.94	155.81	0.59
5,068.00	0.44	150.71	5,033.92	353.72	129.26	156.08	0.08

Design Report for Wells Ranch AE20-64HN - Final Surveys

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)
5,162.00	1.57	183.88	5,127.91	352.12	129.34	156.05	1.30
5,257.00	0.98	188.77	5,222.88	350.02	129.13	155.68	0.63
5,352.00	1.08	181.70	5,317.87	348.32	128.98	155.40	0.17
5,447.00	1.01	232.93	5,412.85	346.92	128.29	154.60	0.95
5,542.00	0.96	201.40	5,507.84	345.68	127.33	153.54	0.57
5,637.00	0.83	177.24	5,602.83	344.25	127.07	153.18	0.42
5,732.00	0.90	181.44	5,697.82	342.81	127.09	153.08	0.10
5,812.00	0.63	107.33	5,777.81	342.06	127.49	153.43	1.18
5,918.00	2.27	102.93	5,883.77	341.41	130.09	155.97	1.55
6,013.00	9.62	92.35	5,978.20	340.66	139.87	165.66	7.79
6,108.00	16.13	81.47	6,070.77	342.30	160.88	186.73	7.28
6,203.00	23.57	76.89	6,160.07	348.57	192.47	218.72	8.00
6,298.00	31.45	79.40	6,244.27	357.45	235.40	262.20	8.38
6,393.00	39.74	76.92	6,321.45	368.91	289.44	316.96	8.86
6,488.00	48.22	79.43	6,389.76	382.30	353.96	382.32	9.11
6,583.00	51.95	90.99	6,450.82	388.17	426.35	454.95	10.11
6,678.00	63.58	95.18	6,501.43	383.66	506.42	534.43	12.79
6,726.00	72.78	93.43	6,519.25	380.34	550.80	578.43	19.46
6,772.00	80.83	91.37	6,529.74	378.48	595.51	622.86	18.03
6,810.00	82.17	90.18	6,535.36	377.98	633.09	660.29	4.69
6,854.00	84.95	89.74	6,540.29	378.00	676.81	703.88	6.40
7" Casing @ 6854' MD, 6540.29' TVD							
6,928.00	89.63	89.02	6,543.79	378.80	750.70	777.61	6.40
6,973.00	90.65	90.14	6,543.68	379.13	795.69	822.50	3.37
7,066.00	91.11	90.74	6,542.25	378.42	888.68	915.16	0.81
7,159.00	90.00	89.60	6,541.35	378.14	981.67	1,007.85	1.71
7,251.00	90.18	89.46	6,541.21	378.90	1,073.67	1,099.63	0.25
7,344.00	91.20	90.34	6,540.09	379.06	1,166.66	1,192.36	1.45
7,437.00	91.82	91.92	6,537.64	377.23	1,259.61	1,284.89	1.82
7,530.00	89.51	92.69	6,536.56	373.49	1,352.52	1,377.24	2.62
7,622.00	88.58	90.80	6,538.09	370.68	1,444.46	1,468.69	2.29
7,716.00	89.14	90.63	6,539.96	369.51	1,538.43	1,562.30	0.62
7,808.00	89.63	90.17	6,540.95	368.87	1,630.42	1,653.97	0.73
7,900.00	92.10	91.06	6,539.56	367.88	1,722.40	1,745.60	2.85
7,991.00	91.85	91.32	6,536.42	365.99	1,813.33	1,836.11	0.40
8,084.00	89.48	92.05	6,535.34	363.26	1,906.27	1,928.57	2.67
8,179.00	90.06	92.25	6,535.72	359.70	2,001.20	2,022.94	0.65
8,274.00	90.06	91.74	6,535.62	356.39	2,096.15	2,117.35	0.54
8,369.00	91.76	92.51	6,534.12	352.87	2,191.06	2,211.72	1.96
8,464.00	90.86	91.07	6,531.94	349.90	2,285.99	2,306.13	1.79
8,559.00	91.45	91.02	6,530.03	348.17	2,380.95	2,400.68	0.62
8,654.00	91.02	90.61	6,527.98	346.82	2,475.92	2,495.26	0.63
8,748.00	89.32	89.92	6,527.70	346.38	2,569.92	2,588.95	1.95
8,843.00	90.25	90.38	6,528.06	346.13	2,664.91	2,683.64	1.09
8,938.00	89.11	89.80	6,528.59	345.98	2,759.91	2,778.35	1.35
9,033.00	89.26	90.07	6,529.94	346.09	2,854.90	2,873.06	0.33
9,128.00	89.63	90.05	6,530.86	345.99	2,949.90	2,967.77	0.39
9,223.00	90.55	90.35	6,530.71	345.66	3,044.89	3,062.46	1.02
9,318.00	91.54	90.18	6,528.98	345.22	3,139.88	3,157.13	1.06
9,413.00	92.44	90.51	6,525.68	344.65	3,234.82	3,251.74	1.01
9,508.00	90.49	89.61	6,523.25	344.55	3,329.78	3,346.42	2.26

Design Report for Wells Ranch AE20-64HN - Final Surveys

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)
9,603.00	91.26	90.12	6,521.80	344.78	3,424.77	3,441.14	0.97
9,698.00	90.80	90.06	6,520.09	344.63	3,519.75	3,535.83	0.49
9,793.00	88.67	90.05	6,520.53	344.53	3,614.74	3,630.54	2.24
9,888.00	89.69	89.92	6,521.89	344.56	3,709.73	3,725.25	1.08
9,983.00	90.77	89.21	6,521.51	345.28	3,804.73	3,820.01	1.36
10,077.00	90.31	91.03	6,520.62	345.08	3,898.72	3,913.71	2.00
10,172.00	89.57	89.89	6,520.72	344.32	3,993.71	4,008.37	1.43
10,267.00	91.17	90.31	6,520.11	344.16	4,088.71	4,103.07	1.74
10,362.00	88.49	89.97	6,520.39	343.92	4,183.70	4,197.76	2.84
10,457.00	89.48	91.24	6,522.08	342.92	4,278.68	4,292.38	1.69
10,552.00	91.54	91.04	6,521.23	341.03	4,373.65	4,386.92	2.18
10,601.00	92.53	91.15	6,519.49	340.09	4,422.61	4,435.66	2.03

Final MWD Survey @ 10601.00ft

10,665.00	92.53	91.15	6,516.66	338.81	4,486.53	4,499.30	0.00
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Straight Line Proj @ 10665' MD, 6516.66' TVD

Design Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
925.00	924.97	2.06	-4.73	Tie-On to Surface Gyros @ 925.00ft
996.00	995.96	2.36	-6.05	First MWD Survey @ 996.00ft
10,601.00	6,519.49	340.09	4,422.61	Final MWD Survey @ 10601.00ft
10,665.00	6,516.66	338.81	4,486.53	Straight Line Proj @ 10665' MD, 6516.66' TVD

Vertical Section Information

Angle Type	Target	Azimuth (°)	Origin Type	Origin +N/-S (usft)	Origin +E/-W (usft)	Start TVD (usft)
Target	Wells Ranch AE20-64HN (PA_RA0) BHL	85.59	Slot	0.00	0.00	0.00

Survey tool program

From (usft)	To (usft)	Survey/Plan	Survey Tool
365.00	925.00	Surface Gyros	Flexi-Shot
996.00	6,810.00	MWD Surveys - Vert/Build	MWD+IFR1+MS_WY
6,928.00	10,601.00	MWD Surveys - Lateral	MWD+IFR1+MS_WY

Casing Details

Measured Depth (usft)	Vertical Depth (usft)	Name	Casing Diameter (")	Hole Diameter (")
6,854.00	6,540.29	7" Casing @ 6854' MD, 6540.29' TVD	7	8-3/4

Design Report for Wells Ranch AE20-64HN - Final Surveys

Wellbore Targets

Target Name - hit/miss target - Shape	Dip Angle (°)	Dip Dir. (°)	TVD (usft)	+N/-S (usft)	+E/-W (usft)	Northing (usft)	Easting (usft)	Latitude	Longitude
Wells Ranch AE20-64H - actual wellpath hits target center - Point	0.00	0.00	0.00	0.00	0.00	1,416,036.77	3,318,468.24	40° 28' 11.208 N	104° 21' 19.152 W
Wells Ranch AE (SL) F - actual wellpath misses target center by 222.25usft at 0.40usft MD (0.40 TVD, 0.00 N, 0.00 E) - Polygon	0.00	0.00	0.00	-222.25	0.09	1,415,814.53	3,318,468.33	40° 28' 9.012 N	104° 21' 19.188 W
Point 1				0.00	-1,536.69	-216.70	1,414,277.89	3,318,251.63	
Point 2				0.00	-1,394.93	5,079.85	1,414,419.65	3,323,547.99	
Point 3				0.00	3,915.17	4,921.18	1,419,729.56	3,323,389.33	
Point 4				0.00	3,764.67	-207.18	1,419,579.06	3,318,261.15	
Point 5				0.00	-1,536.69	-216.70	1,414,277.89	3,318,251.63	
Wells Ranch AE (SB) F - actual wellpath misses target center by 222.25usft at 0.40usft MD (0.40 TVD, 0.00 N, 0.00 E) - Polygon	0.00	0.00	0.00	-222.25	0.09	1,415,814.53	3,318,468.33	40° 28' 9.012 N	104° 21' 19.188 W
Point 1				0.00	-1,064.69	243.30	1,414,749.87	3,318,711.62	
Point 2				0.00	-945.93	4,607.35	1,414,868.63	3,323,075.51	
Point 3				0.00	3,443.17	4,474.83	1,419,257.57	3,322,943.00	
Point 4				0.00	3,319.17	251.02	1,419,133.58	3,318,719.34	
Point 5				0.00	-1,064.69	243.30	1,414,749.87	3,318,711.62	
Wells Ranch AE20-64H - actual wellpath misses target center by 7.95usft at 10664.73usft MD (6516.68 TVD, 338.82 N, 4486.27 E) - Point	0.00	0.00	6,519.71	346.16	4,486.55	1,416,382.92	3,322,954.62	40° 28' 14.052 N	104° 20' 21.048 W

Directional Difficulty Index

Average Dogleg over Survey:	1.98 °/100usft	Maximum Dogleg over Survey:	19.46 °/100usft at 6,726.00 usft
Net Tortosity applicable to Plans:	0.91 °/100usft	Directional Difficulty Index:	6.219

Audit Info

North Reference Sheet for Sec. 20-T6N-R62W (Wells Ranch AE PAD) - Wells Ranch AE20-64HN

All data is in US Feet unless otherwise stated. Directions and Coordinates are relative to Grid North Reference.

Vertical Depths are relative to RKB 24 ft. @ 4809.00usft (H&P 343). Northing and Easting are relative to Wells Ranch AE20-64HN - Slot A7

Coordinate System is US State Plane 1983, Colorado Northern Zone using datum North American Datum 1983, ellipsoid GRS 1980

Projection method is Lambert Conformal Conic (2 parallel)

Central Meridian is 105° 30' 0.000 W°, Longitude Origin: 0° 0' 0.000 E°, Latitude Origin: 40° 47' 0.000 N°

False Easting: 3,000,000.00usft, False Northing: 1,000,000.00usft, Scale Reduction: 0.99996413

Grid Coordinates of Well: 1,416,036.77 usft N, 3,318,468.24 usft E

Geographical Coordinates of Well: 40° 28' 11.21" N, 104° 21' 19.15" W

Grid Convergence at Surface is: 0.74°

Based upon Minimum Curvature type calculations, at a Measured Depth of 10,665.00usft the Bottom Hole Displacement is 4,499.31usft in the Direction of 85.68° (Grid).

Magnetic Convergence at surface is: -7.64° (30 August 2013, , BGGM2013)

