

Project: Weld County, CO (NAD 83)
Site: Sec. 14-T5N-R64W (Cockroft B15-69-1HNM)
Well: Cockroft B15-69-1HNM
Wellbore: Plan A
Design: Final Field Surveys

Noble Energy

HALLIBURTON
Sperry Drilling

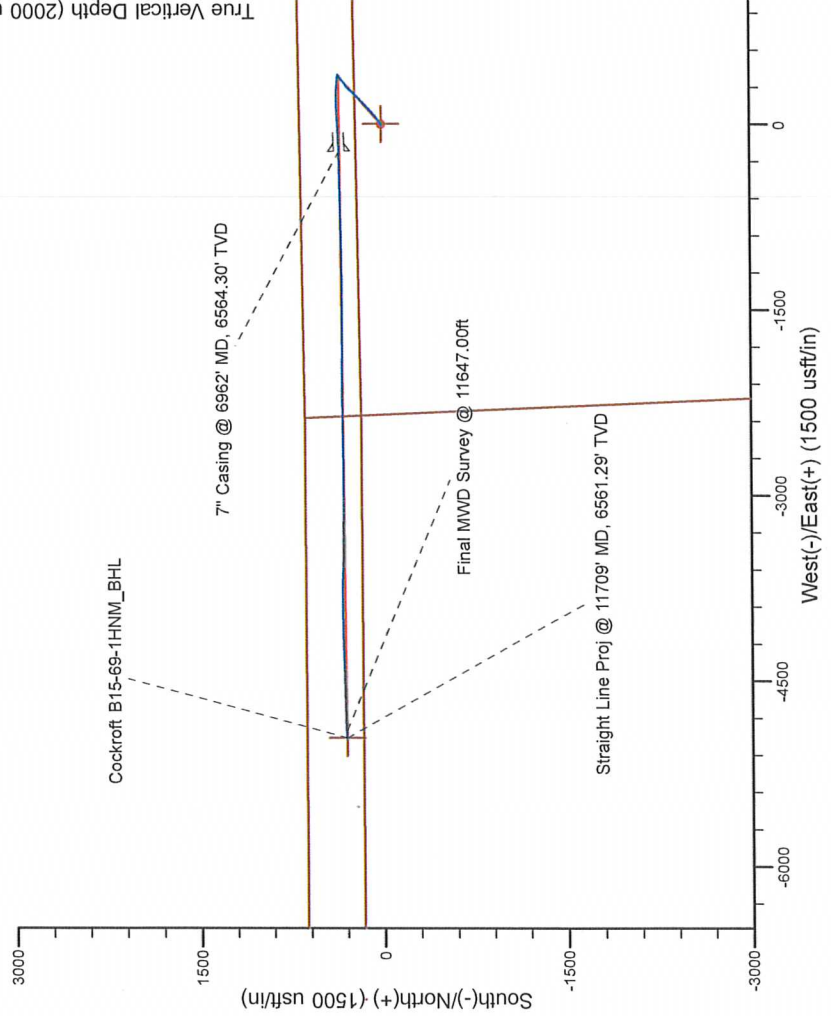
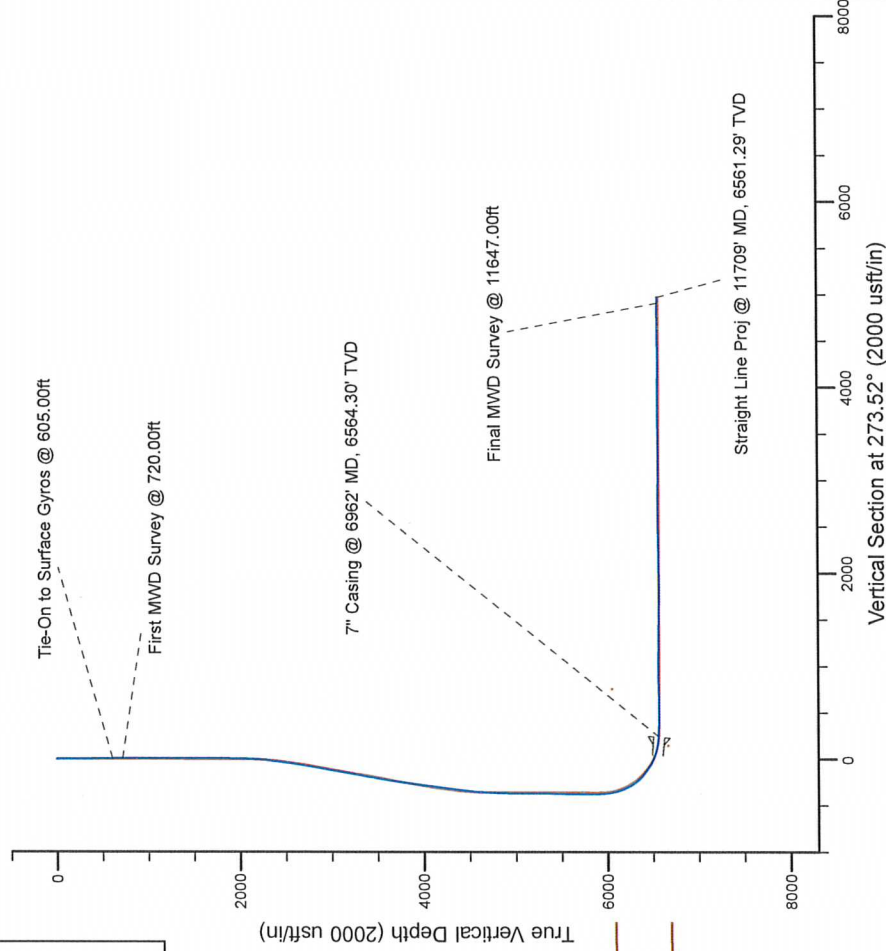
Platted SHL: 674' FNL, 2348' FEL
Platted Lat/Long: 40.40465° N, 104.51854° W
Location: Sec. 14-T5N-R64W

7" Casing: ~316.95' FNL, ~2144.07' FWL
Lat/Long: 40° 24' 20.199" N, 104° 31' 9.514" W
State Planes - CO Northern: 1,392,114.59' N, 3,273,104.28' E
Location: Sec. 14-T5N-R64W

BHL: ~321.96' FNL, ~2598.25' FEL
Lat/Long: 40° 24' 20.292" N, 104° 32' 10.857" W
State Planes - CO Northern: 1,392,072.03' N, 3,268,359.16' E
Location: Sec. 15-T5N-R64W

LEGEND

- Cockroft B15-69-1HNM, Plan A, Rev A0 Proposal V0
- Final Field Surveys



WELL DETAILS: Cockroft B15-69-1HNM

Ground Level: 4565.00
RKS=24 @ 4609.00usft (HP315)

Created By: Fred Hartmann
Created On: 11/08/2013

Noble Energy

Weld County, CO (NAD 83)

Sec. 14-T5N-R64W (Cockroft B15-69-1HNM)

Cockroft B15-69-1HNM

Design: Final Field Surveys

Sperry Drilling Services

Final Survey Report

08 November, 2013

Well Coordinates: 1,391,766.96 N, 3,273,322.44 E (40° 24' 16.74" N, 104° 31' 06.74" W)

Ground Level: 4,585.00 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 Cockroft B15-69-1HNM

RKB=24 @ 4609.00usft (HP315)

N

Grid

API - US Survey Feet - Custom

HALLIBURTON

Design Report for Cockroft B15-69-1HNM - Final Field 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
306.00	1.30	287.01	305.97	1.02	-3.32	3.38	0.42
605.00	0.30	172.31	604.95	1.23	-6.46	6.52	0.49
Tie-On to Surface Gyros @ 605.00ft							
720.00	0.13	120.97	719.95	0.87	-6.31	6.35	0.21
First MWD Survey @ 720.00ft							
812.00	0.31	162.50	811.95	0.58	-6.14	6.17	0.25
904.00	0.20	193.01	903.95	0.18	-6.10	6.10	0.19
996.00	0.07	188.68	995.95	-0.03	-6.15	6.13	0.14
1,088.00	0.19	243.09	1,087.95	-0.15	-6.29	6.27	0.17
1,179.00	0.17	167.86	1,178.95	-0.36	-6.40	6.36	0.24
1,272.00	0.10	267.47	1,271.95	-0.49	-6.45	6.41	0.23
1,365.00	0.22	235.26	1,364.95	-0.60	-6.68	6.63	0.16
1,458.00	0.33	212.49	1,457.94	-0.93	-6.97	6.90	0.16
1,553.00	0.17	174.70	1,552.94	-1.30	-7.10	7.01	0.23
1,648.00	0.18	288.39	1,647.94	-1.39	-7.23	7.13	0.31
1,743.00	0.47	286.29	1,742.94	-1.23	-7.75	7.66	0.31
1,838.00	0.64	229.42	1,837.94	-1.47	-8.52	8.42	0.58
1,932.00	0.68	170.30	1,931.93	-2.36	-8.83	8.67	0.69
2,027.00	1.69	79.28	2,026.92	-2.66	-7.36	7.18	1.93
2,122.00	3.45	54.43	2,121.82	-0.73	-3.66	3.60	2.15
2,217.00	5.23	53.37	2,216.54	3.51	2.14	-1.93	1.88
2,312.00	7.83	58.32	2,310.92	9.50	11.13	-10.52	2.80
2,407.00	9.54	55.47	2,404.83	17.36	23.12	-22.01	1.86
2,502.00	10.70	50.97	2,498.35	27.37	36.46	-34.71	1.48
2,597.00	12.20	53.72	2,591.46	38.87	51.40	-48.92	1.68
2,692.00	13.54	47.32	2,684.07	52.35	67.67	-64.33	2.06
2,787.00	13.42	51.12	2,776.46	66.81	84.43	-80.17	0.94
2,881.00	14.12	44.76	2,867.76	81.80	101.00	-95.79	1.77
2,976.00	14.63	43.53	2,959.79	98.72	117.42	-111.14	0.63
3,071.00	14.41	48.13	3,051.76	115.31	134.48	-127.16	1.24
3,166.00	14.69	50.70	3,143.71	130.83	152.61	-144.29	0.74
3,261.00	15.47	45.66	3,235.44	147.32	170.99	-161.63	1.61
3,356.00	12.25	47.59	3,327.66	162.97	187.50	-177.15	3.42
3,451.00	13.62	48.45	3,420.25	177.19	203.31	-192.06	1.46
3,546.00	15.85	46.21	3,512.12	193.59	221.05	-208.76	2.42
3,641.00	14.66	43.44	3,603.77	211.30	238.68	-225.27	1.47
3,736.00	13.47	39.39	3,695.93	228.58	253.97	-239.47	1.62
3,830.00	12.69	40.92	3,787.49	244.84	267.68	-252.16	0.91
3,925.00	11.32	40.66	3,880.41	259.80	280.59	-264.12	1.44
4,020.00	10.87	52.05	3,973.64	272.38	293.73	-276.47	2.35
4,115.00	11.57	53.07	4,066.83	283.61	308.41	-290.43	0.77
4,210.00	9.15	53.93	4,160.27	293.79	322.13	-303.50	2.55
4,305.00	10.45	52.87	4,253.88	303.44	335.11	-315.86	1.38
4,400.00	9.72	50.78	4,347.41	313.71	348.19	-328.29	0.86
4,495.00	7.64	51.08	4,441.32	322.75	359.32	-338.84	2.19
4,590.00	6.97	48.47	4,535.55	330.53	368.55	-347.57	0.79
4,685.00	4.47	47.11	4,630.07	336.88	375.58	-354.20	2.64
4,779.00	4.15	68.38	4,723.81	340.62	381.42	-359.81	1.72
4,874.00	1.51	83.71	4,818.69	342.03	385.86	-364.15	2.87

Design Report for Cockroft B15-69-1HNM - Final Field Surveys

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)
5,159.00	0.94	35.52	5,103.63	344.34	390.95	-369.09	0.40
5,443.00	1.48	27.00	5,387.56	349.51	393.97	-371.79	0.20
5,728.00	0.47	79.30	5,672.52	353.00	396.79	-374.39	0.44
5,886.00	0.36	212.56	5,830.52	352.70	397.16	-374.77	0.48
5,933.00	0.38	220.14	5,877.52	352.46	396.98	-374.61	0.11
6,057.00	7.16	277.89	6,001.19	353.21	389.05	-366.65	5.62
6,104.00	10.53	276.40	6,047.62	354.24	381.90	-359.45	7.17
6,152.00	14.63	279.58	6,094.46	355.89	371.58	-349.04	8.56
6,198.00	17.66	275.85	6,138.64	357.57	358.91	-336.29	6.96
6,246.00	21.78	275.35	6,183.82	359.14	342.79	-320.11	8.59
6,293.00	26.04	274.20	6,226.77	360.71	323.81	-301.07	9.12
6,341.00	29.85	274.39	6,269.17	362.40	301.38	-278.58	7.94
6,388.00	35.25	271.19	6,308.77	363.57	276.14	-253.32	12.06
6,436.00	43.26	269.76	6,345.91	363.79	245.80	-223.01	16.79
6,483.00	49.42	271.10	6,378.34	364.07	211.81	-189.08	13.27
6,531.00	50.40	270.43	6,409.26	364.56	175.09	-152.40	2.30
6,578.00	52.92	268.82	6,438.41	364.31	138.24	-115.63	6.00
6,626.00	57.19	268.26	6,465.90	363.30	98.91	-76.44	8.95
6,673.00	61.75	267.06	6,489.77	361.64	58.48	-36.18	9.95
6,721.00	66.74	265.82	6,510.62	358.94	15.34	6.71	10.65
6,768.00	71.39	265.69	6,527.41	355.69	-28.42	50.19	9.90
6,816.00	75.76	267.58	6,540.98	353.00	-74.37	95.89	9.86
6,863.00	78.38	267.74	6,551.49	351.13	-120.14	141.45	5.58
6,919.00	83.58	267.94	6,560.27	349.05	-175.39	196.47	9.29
6,962.00	85.66	268.30	6,564.30	347.64	-218.17	239.09	4.91
7" Casing @ 6962' MD, 6564.30' TVD							
7,034.00	89.14	268.90	6,567.57	345.89	-290.06	310.74	4.91
7,127.00	88.06	268.43	6,569.84	343.72	-383.01	403.38	1.27
7,219.00	89.23	268.12	6,572.02	340.95	-474.94	494.96	1.32
7,314.00	91.26	268.28	6,571.61	337.97	-569.89	589.55	2.14
7,409.00	91.32	268.85	6,569.47	335.59	-664.83	684.17	0.60
7,504.00	91.76	268.95	6,566.92	333.77	-759.78	778.83	0.47
7,599.00	90.99	268.55	6,564.64	331.70	-854.73	873.47	0.91
7,693.00	90.00	268.02	6,563.83	328.88	-948.68	967.07	1.19
7,788.00	89.88	268.82	6,563.93	326.26	-1,043.65	1,061.70	0.85
7,883.00	89.20	270.29	6,564.69	325.53	-1,138.64	1,156.46	1.70
7,978.00	89.29	269.96	6,565.94	325.73	-1,233.63	1,251.29	0.36
8,073.00	89.04	269.46	6,567.33	325.25	-1,328.62	1,346.07	0.59
8,168.00	90.06	270.20	6,568.07	324.97	-1,423.61	1,440.87	1.33
8,263.00	88.58	270.09	6,569.20	325.21	-1,518.60	1,535.69	1.56
8,358.00	88.67	270.50	6,571.48	325.70	-1,613.57	1,630.52	0.44
8,453.00	88.61	270.37	6,573.73	326.42	-1,708.54	1,725.35	0.15
8,548.00	90.22	270.55	6,574.70	327.18	-1,803.53	1,820.21	1.71
8,643.00	90.31	270.39	6,574.26	327.96	-1,898.53	1,915.07	0.19
8,737.00	90.96	270.28	6,573.22	328.51	-1,992.52	2,008.92	0.70
8,832.00	91.76	270.00	6,570.97	328.74	-2,087.49	2,103.73	0.89
8,927.00	91.60	269.74	6,568.18	328.53	-2,182.45	2,198.50	0.32
9,022.00	90.25	269.53	6,566.65	327.92	-2,277.44	2,293.26	1.44
9,117.00	90.49	268.74	6,566.04	326.49	-2,372.42	2,387.98	0.87
9,212.00	91.45	269.05	6,564.43	324.66	-2,467.39	2,482.66	1.06
9,307.00	90.65	269.02	6,562.69	323.06	-2,562.36	2,577.35	0.84

Design Report for Cockroft B15-69-1HNM - Final Field Surveys

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)
9,402.00	89.69	269.32	6,562.40	321.68	-2,657.35	2,672.08	1.06
9,496.00	89.97	269.85	6,562.68	321.00	-2,751.34	2,765.86	0.64
9,591.00	88.76	269.33	6,563.74	320.32	-2,846.33	2,860.62	1.39
9,686.00	88.92	269.75	6,565.66	319.56	-2,941.31	2,955.38	0.47
9,781.00	88.89	269.81	6,567.47	319.19	-3,036.29	3,050.16	0.07
9,876.00	89.82	271.11	6,568.54	319.96	-3,131.28	3,145.01	1.68
9,971.00	90.46	270.88	6,568.31	321.61	-3,226.27	3,239.92	0.72
10,066.00	90.00	270.41	6,567.93	322.68	-3,321.26	3,334.80	0.69
10,161.00	89.81	269.98	6,568.09	323.00	-3,416.26	3,429.64	0.49
10,255.00	90.40	270.48	6,567.92	323.38	-3,510.26	3,523.48	0.82
10,350.00	91.36	272.34	6,566.46	325.71	-3,605.21	3,618.40	2.20
10,445.00	91.45	272.69	6,564.13	329.88	-3,700.09	3,713.36	0.38
10,540.00	90.68	270.40	6,562.36	332.44	-3,795.03	3,808.28	2.54
10,635.00	88.86	268.54	6,562.74	331.56	-3,890.02	3,903.03	2.74
10,730.00	88.61	268.66	6,564.84	329.24	-3,984.97	3,997.66	0.29
10,825.00	88.55	268.77	6,567.19	327.11	-4,079.91	4,092.30	0.13
10,920.00	89.20	268.46	6,569.06	324.82	-4,174.87	4,186.93	0.76
11,015.00	90.00	268.42	6,569.72	322.23	-4,269.83	4,281.56	0.84
11,110.00	90.96	268.62	6,568.93	319.78	-4,364.79	4,376.19	1.03
11,205.00	92.29	268.70	6,566.23	317.56	-4,459.73	4,470.81	1.40
11,300.00	91.39	268.81	6,563.18	315.49	-4,554.65	4,565.43	0.95
11,394.00	91.02	267.88	6,561.21	312.78	-4,648.59	4,659.03	1.06
11,489.00	90.25	268.47	6,560.15	309.75	-4,743.54	4,753.61	1.02
11,584.00	89.97	268.53	6,559.97	307.27	-4,838.51	4,848.24	0.30
11,647.00	89.20	269.16	6,560.43	306.00	-4,901.49	4,911.03	1.58
Final MWD Survey @ 11647.00ft							
11,709.00	89.20	269.16	6,561.29	305.09	-4,963.48	4,972.85	0.00
Straight Line Proj @ 11709' MD, 6561.29' TVD							

Design Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
605.00	604.95	1.23	-6.46	Tie-On to Surface Gyros @ 605.00ft
720.00	719.95	0.87	-6.31	First MWD Survey @ 720.00ft
11,647.00	6,560.43	306.00	-4,901.49	Final MWD Survey @ 11647.00ft
11,709.00	6,561.29	305.09	-4,963.48	Straight Line Proj @ 11709' MD, 6561.29' TVD

Vertical Section Information

Angle Type	Target	Azimuth (°)	Origin Type	Origin +N/-S (usft)	Origin +E/-W (usft)	Start TVD (usft)
TD	No Target (Freehand)	273.52	Slot	0.00	0.00	0.00

Survey tool program

From (usft)	To (usft)	Survey/Plan	Survey Tool
306.00	605.00	Surface Gyros	Flexi-Shot
720.00	6,919.00	MWD Surveys - Vert/Build	MWD
7,034.00	11,647.00	MWD Surveys - Lateral	MWD

Design Report for Cockroft B15-69-1HNM - Final Field Surveys

Casing Details

Measured Depth (usft)	Vertical Depth (usft)	Name	Casing Diameter (")	Hole Diameter (")
6,962.00	6,564.30	7" Casing @ 6962' MD, 6564.30' TVD	7	8-3/4

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
Cockroft B15-69-1HNM	0.00	0.00	0.00	0.01	0.00	1,391,766.97	3,273,322.44	40° 24' 16.740 N	104° 31' 6.744 W
- actual wellpath misses target center by 0.01usft at 0.00usft MD (0.00 TVD, 0.00 N, 0.00 E)									
- Polygon									
Point 1				0.00	249.81	2,431.43	1,392,016.77	3,275,753.78	
Point 2				0.00	173.23	-2,377.15	1,391,940.19	3,270,945.39	
Point 3				0.00	160.86	-7,077.80	1,391,927.82	3,266,244.92	
Point 4				0.00	-4,190.05	-6,990.42	1,387,577.08	3,266,332.30	
Point 5				0.00	-4,146.93	-2,377.15	1,387,620.20	3,270,945.39	
Point 6				0.00	-4,108.50	2,507.18	1,387,658.63	3,275,829.53	
Point 7				0.00	249.81	2,431.43	1,392,016.77	3,275,753.78	
Cockroft B15-69-1HNM	0.00	0.00	0.00	0.01	0.00	1,391,766.97	3,273,322.44	40° 24' 16.740 N	104° 31' 6.744 W
- actual wellpath misses target center by 0.01usft at 0.00usft MD (0.00 TVD, 0.00 N, 0.00 E)									
- Polygon									
Point 1				0.00	709.83	2,891.45	1,392,476.77	3,276,213.78	
Point 2				0.00	633.25	-2,377.15	1,392,400.19	3,270,945.39	
Point 3				0.00	620.88	-7,537.82	1,392,387.82	3,265,784.92	
Point 4				0.00	-4,650.07	-7,450.44	1,387,117.08	3,265,872.30	
Point 5				0.00	-4,606.95	-2,144.15	1,387,160.20	3,271,178.38	
Point 6				0.00	633.25	-2,377.15	1,392,400.19	3,270,945.39	
Point 7				0.00	-4,606.95	-2,144.15	1,387,160.20	3,271,178.38	
Point 8				0.00	-4,568.52	2,967.20	1,387,198.63	3,276,289.53	
Point 9				0.00	709.83	2,891.45	1,392,476.77	3,276,213.78	
Cockroft B15-69-1HNM	0.00	0.00	0.00	0.01	0.00	1,391,766.97	3,273,322.44	40° 24' 16.740 N	104° 31' 6.744 W
- actual wellpath misses target center by 0.01usft at 0.00usft MD (0.00 TVD, 0.00 N, 0.00 E)									
- Point									
Cockroft B15-69-1HNM	0.00	0.00	6,570.00	298.97	-4,963.67	1,392,065.92	3,268,358.97	40° 24' 20.232 N	104° 32' 10.860 W
- actual wellpath misses target center by 10.64usft at 11709.00usft MD (6561.29 TVD, 305.09 N, -4963.48 E)									
- Point									

Directional Difficulty Index

Average Dogleg over Survey:	1.68 °/100usft	Maximum Dogleg over Survey:	16.79 °/100usft at 6,436.00 usft
Net Tortousity applicable to Plans:	0.67 °/100usft	Directional Difficulty Index:	6.317

Audit Info

North Reference Sheet for Sec. 14-T5N-R64W (Cockroft B15-69-1HNM) - Cockroft B15-69-1HNM

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 @ 4609.00usft (HP315). Northing and Easting are relative to Cockroft B15-69-1HNM

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: 0.99996044

Grid Coordinates of Well: 1,391,766.96 usft N, 3,273,322.44 usft E

Geographical Coordinates of Well: 40° 24' 16.74" N, 104° 31' 06.74" W

Grid Convergence at Surface is: 0.63°

Based upon Minimum Curvature type calculations, at a Measured Depth of 11,709.00usft the Bottom Hole Displacement is 4,972.85usft in the Direction of 273.52° (Grid).

Magnetic Convergence at surface is: -7.81° (30 October 2013, , BGGM2013)

