

Tug Hill Operating LLC

Hodgeman County, Kansas (NAD 83)

Sec 31, T23S, R22W

Imel #1-31H

Original Wellbore

Survey: MWD Surveys

Standard Survey Report

22 September, 2012



Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Site Sec 31, T23S, R22W
Project:	Hodgeman County, Kansas (NAD 83)	TVD Reference:	WELL @ 2359.0usft
Site:	Sec 31, T23S, R22W	MD Reference:	WELL @ 2359.0usft
Well:	Imel #1-31H	North Reference:	Grid
Wellbore:	Original Wellbore	Survey Calculation Method:	Minimum Curvature
Design:	Original Wellbore	Database:	EDM 5000.1 Single User Db

Project	Hodgeman County, Kansas (NAD 83)		
Map System:	US State Plane 1983	System Datum:	Mean Sea Level
Geo Datum:	North American Datum 1983		
Map Zone:	Kansas Southern Zone		

Site	Sec 31, T23S, R22W				
Site Position:		Northing:	1,805,497.39 usft	Latitude:	38° 0' 51.026 N
From:	Map	Easting:	945,503.39 usft	Longitude:	99° 46' 24.082 W
Position Uncertainty:	0.0 usft	Slot Radius:	13-3/16 "	Grid Convergence:	-0.78 °

Well	Imel #1-31H					
Well Position	+N/-S	0.0 usft	Northing:	1,805,497.39 usft	Latitude:	38° 0' 51.026 N
	+E/-W	0.0 usft	Easting:	945,503.39 usft	Longitude:	99° 46' 24.082 W
Position Uncertainty		0.0 usft	Wellhead Elevation:	usft	Ground Level:	2,336.0 usft

Wellbore	Original Wellbore				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010	8/22/2012	5.68	65.79	52,208

Design	Original Wellbore				
Audit Notes:					
Version:	1.0	Phase:	ACTUAL	Tie On Depth:	0.0
Vertical Section:	Depth From (TVD) (usft)	+N/-S (usft)	+E/-W (usft)	Direction (°)	
	0.0	0.0	0.0	180.69	

Survey Program	Date	9/22/2012			
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
100.0	837.0	Gyro Surveys (Original Wellbore)	NS-GYRO-SS	NS Gyro single shots	
875.0	9,193.0	MWD Surveys (Original Wellbore)	MWD	MWD - Standard	

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)	
837.0	0.49	186.30	837.0	2.6	-4.8	-2.5	0.00	0.00	0.00	
875.0	0.50	173.50	875.0	2.3	-4.8	-2.2	0.29	0.03	-33.68	
First MWD Survey										
967.0	0.50	182.90	967.0	1.5	-4.8	-1.4	0.09	0.00	10.22	
1,059.0	0.60	200.50	1,059.0	0.6	-5.0	-0.6	0.21	0.11	19.13	
1,151.0	0.50	193.50	1,151.0	-0.2	-5.3	0.3	0.13	-0.11	-7.61	
1,243.0	0.60	184.40	1,243.0	-1.1	-5.4	1.1	0.14	0.11	-9.89	
1,335.0	0.70	194.80	1,334.9	-2.1	-5.6	2.2	0.17	0.11	11.30	
1,428.0	0.70	190.90	1,427.9	-3.2	-5.8	3.3	0.05	0.00	-4.19	
1,520.0	0.60	8.60	1,519.9	-3.3	-5.9	3.4	1.41	-0.11	193.15	

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Site Sec 31, T23S, R22W
Project:	Hodgeman County, Kansas (NAD 83)	TVD Reference:	WELL @ 2359.0usft
Site:	Sec 31, T23S, R22W	MD Reference:	WELL @ 2359.0usft
Well:	Imel #1-31H	North Reference:	Grid
Wellbore:	Original Wellbore	Survey Calculation Method:	Minimum Curvature
Design:	Original Wellbore	Database:	EDM 5000.1 Single User Db

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)	
1,612.0	0.40	8.20	1,611.9	-2.5	-5.8	2.6	0.22	-0.22	-0.43	
1,705.0	0.50	5.40	1,704.9	-1.8	-5.7	1.8	0.11	0.11	-3.01	
1,797.0	0.50	6.50	1,796.9	-1.0	-5.6	1.0	0.01	0.00	1.20	
1,890.0	0.40	341.30	1,889.9	-0.3	-5.6	0.3	0.24	-0.11	-27.10	
1,983.0	0.50	344.50	1,982.9	0.4	-5.9	-0.4	0.11	0.11	3.44	
2,074.0	0.60	355.40	2,073.9	1.3	-6.0	-1.2	0.16	0.11	11.98	
2,166.0	0.40	343.20	2,165.9	2.1	-6.1	-2.0	0.25	-0.22	-13.26	
2,258.0	0.20	356.50	2,257.9	2.5	-6.2	-2.5	0.23	-0.22	14.46	
2,350.0	0.40	341.90	2,349.9	3.0	-6.3	-2.9	0.23	0.22	-15.87	
2,442.0	0.40	332.40	2,441.9	3.6	-6.6	-3.5	0.07	0.00	-10.33	
2,535.0	0.50	327.60	2,534.9	4.2	-7.0	-4.2	0.11	0.11	-5.16	
2,630.0	0.40	337.70	2,629.9	4.9	-7.3	-4.8	0.13	-0.11	10.63	
2,725.0	0.40	343.70	2,724.9	5.5	-7.5	-5.4	0.04	0.00	6.32	
2,819.0	0.40	321.60	2,818.9	6.1	-7.8	-6.0	0.16	0.00	-23.51	
2,914.0	0.40	334.10	2,913.9	6.6	-8.2	-6.5	0.09	0.00	13.16	
3,009.0	0.40	331.50	3,008.9	7.2	-8.5	-7.1	0.02	0.00	-2.74	
3,103.0	0.50	316.00	3,102.9	7.8	-8.9	-7.7	0.17	0.11	-16.49	
3,198.0	0.60	312.90	3,197.9	8.5	-9.6	-8.3	0.11	0.11	-3.26	
3,292.0	0.50	332.20	3,291.9	9.2	-10.1	-9.0	0.22	-0.11	20.53	
3,386.0	0.80	324.80	3,385.9	10.1	-10.7	-9.9	0.33	0.32	-7.87	
3,481.0	0.70	205.80	3,480.9	10.1	-11.3	-9.9	1.36	-0.11	-125.26	
3,575.0	0.60	202.40	3,574.9	9.1	-11.8	-9.0	0.11	-0.11	-3.62	
3,669.0	0.60	92.40	3,668.9	8.6	-11.5	-8.5	1.05	0.00	-117.02	
3,763.0	1.50	135.00	3,762.8	7.7	-10.1	-7.6	1.21	0.96	45.32	
3,858.0	1.50	145.50	3,857.8	5.8	-8.5	-5.7	0.29	0.00	11.05	
3,953.0	1.50	163.40	3,952.8	3.6	-7.5	-3.5	0.49	0.00	18.84	
4,047.0	1.10	182.30	4,046.8	1.5	-7.1	-1.4	0.62	-0.43	20.11	
4,099.0	3.70	184.30	4,098.7	-0.6	-7.3	0.7	5.00	5.00	3.85	
4,130.0	8.40	182.10	4,129.5	-3.9	-7.4	4.0	15.18	15.16	-7.10	
4,161.0	12.70	178.60	4,160.0	-9.6	-7.4	9.7	14.02	13.87	-11.29	
4,193.0	16.20	177.60	4,191.0	-17.6	-7.2	17.6	10.96	10.94	-3.13	
4,224.0	19.50	177.60	4,220.5	-27.0	-6.8	27.1	10.65	10.65	0.00	
4,256.0	21.70	178.70	4,250.4	-38.3	-6.4	38.4	6.98	6.88	3.44	
4,287.0	23.90	181.50	4,279.0	-50.3	-6.4	50.4	7.91	7.10	9.03	
4,319.0	26.90	182.30	4,307.9	-64.0	-6.9	64.1	9.44	9.38	2.50	
4,350.0	29.70	182.70	4,335.2	-78.7	-7.6	78.8	9.05	9.03	1.29	
4,382.0	31.90	183.30	4,362.7	-95.1	-8.4	95.2	6.94	6.88	1.88	
4,413.0	35.20	183.10	4,388.5	-112.2	-9.4	112.3	10.65	10.65	-0.65	
4,445.0	38.70	183.00	4,414.1	-131.4	-10.4	131.5	10.94	10.94	-0.31	
4,477.0	41.10	182.70	4,438.6	-151.9	-11.4	152.0	7.52	7.50	-0.94	
4,508.0	45.10	181.30	4,461.3	-173.0	-12.1	173.2	13.27	12.90	-4.52	
4,539.0	49.40	179.80	4,482.3	-195.8	-12.3	195.9	14.32	13.87	-4.84	
4,571.0	54.50	178.70	4,502.0	-221.0	-12.0	221.1	16.17	15.94	-3.44	

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Site Sec 31, T23S, R22W
Project:	Hodgeman County, Kansas (NAD 83)	TVD Reference:	WELL @ 2359.0usft
Site:	Sec 31, T23S, R22W	MD Reference:	WELL @ 2359.0usft
Well:	Imel #1-31H	North Reference:	Grid
Wellbore:	Original Wellbore	Survey Calculation Method:	Minimum Curvature
Design:	Original Wellbore	Database:	EDM 5000.1 Single User Db

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)	
4,602.0	58.00	179.30	4,519.3	-246.7	-11.6	246.9	11.40	11.29	1.94	
4,634.0	58.50	180.00	4,536.1	-274.0	-11.4	274.1	2.43	1.56	2.19	
4,665.0	59.00	180.20	4,552.2	-300.5	-11.4	300.6	1.70	1.61	0.65	
4,697.0	59.50	180.30	4,568.5	-328.0	-11.6	328.1	1.59	1.56	0.31	
4,728.0	62.00	180.30	4,583.7	-355.0	-11.7	355.1	8.06	8.06	0.00	
4,760.0	66.70	180.50	4,597.5	-383.8	-11.9	384.0	14.70	14.69	0.63	
4,792.0	70.00	180.80	4,609.3	-413.6	-12.2	413.7	10.35	10.31	0.94	
4,823.0	72.30	180.70	4,619.3	-442.9	-12.6	443.0	7.43	7.42	-0.32	
4,854.0	74.40	181.10	4,628.2	-472.6	-13.1	472.7	6.89	6.77	1.29	
4,886.0	75.60	180.70	4,636.5	-503.5	-13.6	503.6	3.94	3.75	-1.25	
4,917.0	78.40	180.00	4,643.5	-533.7	-13.8	533.8	9.30	9.03	-2.26	
4,948.0	80.00	180.30	4,649.3	-564.2	-13.8	564.3	5.25	5.16	0.97	
4,980.0	80.40	180.30	4,654.7	-595.7	-14.0	595.8	1.25	1.25	0.00	
5,011.0	82.20	180.00	4,659.4	-626.3	-14.1	626.5	5.88	5.81	-0.97	
5,043.0	85.30	179.20	4,662.9	-658.1	-13.9	658.3	10.00	9.69	-2.50	
5,074.0	88.30	178.90	4,664.6	-689.1	-13.4	689.2	9.73	9.68	-0.97	
5,106.0	89.10	179.30	4,665.4	-721.1	-12.8	721.2	2.79	2.50	1.25	
5,137.0	89.70	179.30	4,665.7	-752.1	-12.5	752.2	1.94	1.94	0.00	
5,169.0	90.20	179.40	4,665.7	-784.1	-12.1	784.2	1.59	1.56	0.31	
5,264.0	90.60	178.90	4,665.1	-879.1	-10.7	879.1	0.67	0.42	-0.53	
5,356.0	91.30	178.60	4,663.5	-971.0	-8.7	971.1	0.83	0.76	-0.33	
5,449.0	90.20	179.80	4,662.3	-1,064.0	-7.4	1,064.0	1.75	-1.18	1.29	
5,541.0	90.10	179.30	4,662.1	-1,156.0	-6.7	1,156.0	0.55	-0.11	-0.54	
5,633.0	88.60	180.10	4,663.1	-1,248.0	-6.2	1,248.0	1.85	-1.63	0.87	
5,725.0	87.60	181.50	4,666.2	-1,339.9	-7.5	1,339.9	1.87	-1.09	1.52	
5,817.0	88.80	182.00	4,669.1	-1,431.8	-10.3	1,431.9	1.41	1.30	0.54	
5,909.0	89.40	182.20	4,670.5	-1,523.8	-13.7	1,523.8	0.69	0.65	0.22	
6,002.0	87.80	181.70	4,672.8	-1,616.7	-16.8	1,616.8	1.80	-1.72	-0.54	
6,094.0	88.60	181.60	4,675.7	-1,708.6	-19.5	1,708.7	0.88	0.87	-0.11	
6,186.0	88.40	180.80	4,678.1	-1,800.5	-21.4	1,800.7	0.90	-0.22	-0.87	
6,279.0	88.80	180.50	4,680.3	-1,893.5	-22.4	1,893.6	0.54	0.43	-0.32	
6,372.0	89.70	179.70	4,681.6	-1,986.5	-22.6	1,986.6	1.29	0.97	-0.86	
6,464.0	91.10	179.30	4,680.9	-2,078.5	-21.8	2,078.6	1.58	1.52	-0.43	
6,556.0	90.70	181.00	4,679.5	-2,170.5	-22.0	2,170.6	1.90	-0.43	1.85	
6,647.0	89.80	181.20	4,679.1	-2,261.5	-23.8	2,261.6	1.01	-0.99	0.22	
6,739.0	89.90	181.50	4,679.3	-2,353.4	-26.0	2,353.6	0.34	0.11	0.33	
6,832.0	90.70	181.30	4,678.8	-2,446.4	-28.2	2,446.6	0.89	0.86	-0.22	
6,924.0	89.20	180.30	4,678.9	-2,538.4	-29.5	2,538.6	1.96	-1.63	-1.09	
7,016.0	89.70	181.00	4,679.8	-2,630.4	-30.6	2,630.5	0.94	0.54	0.76	
7,111.0	88.80	181.40	4,681.0	-2,725.3	-32.5	2,725.5	1.04	-0.95	0.42	
7,205.0	89.40	181.40	4,682.5	-2,819.3	-34.8	2,819.5	0.64	0.64	0.00	
7,300.0	88.60	180.90	4,684.2	-2,914.3	-36.8	2,914.5	0.99	-0.84	-0.53	
7,395.0	88.50	180.40	4,686.6	-3,009.2	-37.8	3,009.5	0.54	-0.11	-0.53	

Company:	Tug Hill Operating LLC	Local Co-ordinate Reference:	Site Sec 31, T23S, R22W
Project:	Hodgeman County, Kansas (NAD 83)	TVD Reference:	WELL @ 2359.0usft
Site:	Sec 31, T23S, R22W	MD Reference:	WELL @ 2359.0usft
Well:	Imel #1-31H	North Reference:	Grid
Wellbore:	Original Wellbore	Survey Calculation Method:	Minimum Curvature
Design:	Original Wellbore	Database:	EDM 5000.1 Single User Db

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)	
7,489.0	88.60	180.50	4,689.0	-3,103.2	-38.6	3,103.4	0.15	0.11	0.11	
7,584.0	89.50	180.60	4,690.5	-3,198.2	-39.5	3,198.4	0.95	0.95	0.11	
7,678.0	90.20	179.70	4,690.8	-3,292.2	-39.7	3,292.4	1.21	0.74	-0.96	
7,772.0	89.10	179.60	4,691.3	-3,386.2	-39.2	3,386.4	1.18	-1.17	-0.11	
7,867.0	89.30	179.80	4,692.7	-3,481.2	-38.7	3,481.4	0.30	0.21	0.21	
7,961.0	90.40	179.80	4,692.9	-3,575.2	-38.3	3,575.4	1.17	1.17	0.00	
8,056.0	89.10	179.50	4,693.3	-3,670.2	-37.7	3,670.3	1.40	-1.37	-0.32	
8,151.0	90.90	180.80	4,693.3	-3,765.1	-38.0	3,765.3	2.34	1.89	1.37	
8,245.0	90.50	181.00	4,692.2	-3,859.1	-39.5	3,859.3	0.48	-0.43	0.21	
8,340.0	89.60	181.10	4,692.1	-3,954.1	-41.2	3,954.3	0.95	-0.95	0.11	
8,434.0	87.00	181.50	4,694.9	-4,048.0	-43.3	4,048.3	2.80	-2.77	0.43	
8,529.0	87.70	182.40	4,699.3	-4,142.9	-46.6	4,143.1	1.20	0.74	0.95	
8,624.0	89.00	182.60	4,702.0	-4,237.7	-50.7	4,238.1	1.38	1.37	0.21	
8,718.0	89.60	180.70	4,703.2	-4,331.7	-53.4	4,332.0	2.12	0.64	-2.02	
8,813.0	89.80	180.00	4,703.7	-4,426.7	-54.0	4,427.0	0.77	0.21	-0.74	
8,907.0	88.80	179.80	4,704.8	-4,520.7	-53.8	4,521.0	1.08	-1.06	-0.21	
9,002.0	90.20	179.90	4,705.6	-4,615.7	-53.6	4,616.0	1.48	1.47	0.11	
9,097.0	91.40	179.70	4,704.3	-4,710.7	-53.3	4,711.0	1.28	1.26	-0.21	
Last MWD Survey										
9,193.0	91.40	179.70	4,702.0	-4,806.6	-52.8	4,806.9	0.00	0.00	0.00	
PTB										

Survey Annotations				
Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
875.0	875.0	2.3	-4.8	First MWD Survey
9,097.0	4,704.3	-4,710.7	-53.3	Last MWD Survey
9,193.0	4,702.0	-4,806.6	-52.8	PTB

Checked By: _____ Approved By: _____ Date: _____