



LWD MEMORY LOG

Gamma Ray

| <div><div><div><div></div><div>BAKER HUGHES</div></div></div><div>Gamma Ray</div></div> | | | | LWD MEMORY LOG | | | |
|---|-----------|--|------------------|---|---|----------------|--|
| Scale: 1:1200 MD | | Company: Noble Energy | | Well: Freedom Federal LC21-630 | | | |
| Depth Reference: Driller's Depth | | Field: Weld County | | Weld County | | | |
| | | Country: Weld | | Country: United States | | | |
| | | State: Colorado | | | | | |
| Status: Final Print | | Surface Location: Latitude: Longitude: | | Other Services: Wellbore Surveys | | | |
| API No: 0512342803 | | SEC: 22 TMN: 9N RGE: 59W | | Elev. KB: N/A | | | |
| Job ID: 8597123 | | Permanent Datum (P.D.): Mean Sea Level | | Elev. DF: 4912.00 ft | | | |
| Log Measured From: Rig Floor | | Elevation: Above P.D. 30.00 ft | | Elev. GL: 4882.00 ft | | | |
| Dates | | | | Interval Logged | | | |
| Date From: 2017-07-14 | | Top: (ft) 1926.00 | | Azi Reference North: Grid | | | |
| Date To: 2017-07-15 | | Bottom: (ft) 11073.00 | | Total Magnetic Field Strength: (nT) 7 | | | |
| Spud Date: 2017-07-13 | | | | Mag to Reference North Correction: (deg) 6.72 E | | | |
| Borehole Record | | | | Casing Record | | | |
| Hole Size (in) | From (ft) | To (ft) | Size (in) | Weight (lb/ft) | From (ft) | To (ft) | |
| 8.500 | 1938.00 | 11085.00 | 9.625 | 36.00 | 30.00 | 1928.00 | |
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| | | | | | | | |
| Type | From (ft) | To (ft) | Hole Size (in) | Interval (ft) | Inc Az (Start) | Inc Az (End) | |
| Oil Based Mud | 30.00 | 11085.00 | 8.500 | 9147.00 | 0.26 184.19 | 90.18 267.13 | |
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| Acquisition System | | | Software Version | | Other | | |
| Baker Hughes Cadence | | | RT4.1 | | Rig: H&P 524 | | |
| Plot Studio | | | 4.0.7570.8 | | Contractor: Helmerich & Payne Drilling Co | | |
| | | | | | District: RMA Unit: D&E | | |

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Log Run Summary

| Run No | Bit Run No. | Bit Size (in) | Bit Type | Bit Gauge Length (in) | Assembly Type | Logged Interval | | Bit Depth Interval | | Date / Time | | Circ. Hours (h) |
|--------|-------------|------------------|----------|--------------------------|----------------|-----------------|----------------|--------------------|------------|------------------|------------------|--------------------|
| | | | | | | Top (ft) | Bottom (ft) | From (ft) | To (ft) | Start Logging | End Logging | |
| 1 | 1 | 8.500 | PDC | 2.00 | AutoTrak Curve | 1926.00 | 6374.00 | 1938.00 | 6386.00 | 2017-07-13 09:28 | 2017-07-14 02:28 | 15.40 |
| 2 | 2 | 8.500 | PDC | 2.00 | AutoTrak Curve | 6374.00 | 11073.00 | 6386.00 | 11085.00 | 2017-07-14 11:55 | 2017-07-15 10:05 | 21.72 |

Crown

| Name | Arrive Wellsite | Depart Wellsite | Name | Arrive Wellsite | Depart Wellsite | Name | Arrive Wellsite | Depart Wellsite |
|-------------|--------------------|--------------------|------------|--------------------|--------------------|------|--------------------|--------------------|
| Steven Cano | 2017-07-12 | 2017-07-15 | Ty Jackson | 2017-07-12 | 2017-07-15 | | | |

Model Predictive Control

| Date / Time | Run No. | Measured Depth (ft) | Mud Type | Density (ppg) | Viscosity (cP) | pH | Fluid Loss (cm3) | Oil / Water | Source | Total Chlorides (ppm) | K+ (%) |
|------------------|---------|---------------------|---------------|---------------|----------------|-----|------------------|-------------|------------|-----------------------|--------|
| 2017-07-12 19:03 | 1 | 1938.00 | Oil Based Mud | 9.2 | 9 | N/A | N/A | 78.2/21.8 | Active Pit | 25000 | 0.00 |
| 2017-07-14 08:16 | 2 | 6385.00 | Oil Based Mud | 9.3 | 9 | N/A | N/A | 81.5/18.5 | Active Pit | 28000 | 0.00 |
| 2017-07-15 14:00 | 2 | 10000.00 | Oil Based Mud | 9.2 | 10 | N/A | N/A | 76.3/23.7 | Active Pit | 25000 | 0.00 |

Equipment and Service Data

| Run No. | Tool | Serial Number | Measurement | Sensor Offset (ft) | Bit Offset (ft) | Max O.D. (in) | Min I.D. (in) |
|---------|---------|---------------|----------------------|--------------------|-----------------|---------------|---------------|
| 1 | ATC_SU | 12273681 | Near Bit VSS | 5.93 | 6.76 | 7.000 | 4.330 |
| 1 | ATC_SU | 12273681 | Near Bit Inclination | 5.93 | 6.76 | 7.000 | 4.330 |
| 1 | ATC_MWD | 12599902 | Gamma (single) | 2.76 | 12.94 | 7.000 | 3.250 |
| 1 | ATC_MWD | 12599902 | Directional (mag) | 12.27 | 22.45 | 7.000 | 3.250 |
| 2 | ATC_SU | 14169980 | Near Bit Inclination | 5.93 | 6.76 | 7.000 | 4.330 |
| 2 | ATC_SU | 14169980 | Near Bit VSS | 5.93 | 6.76 | 7.000 | 4.330 |

| | | | | | | | |
|---|---------|----------|-------------------|-------|-------|-------|-------|
| 2 | ATC_SU | 14169980 | Near Bit VSS | 5.93 | 6.76 | 7.000 | 4.330 |
| 2 | ATC_MWD | 14219599 | Gamma (single) | 2.75 | 12.93 | 7.000 | 3.250 |
| 2 | ATC_MWD | 14219599 | Directional (mag) | 12.27 | 22.45 | 7.000 | 3.250 |

Service and Tool Mnemonics

| Mnemonic | Name | Description |
|----------|----------|-------------------------------|
| ATC_SU | ATC_SU | Auto Trak Curve Steering Unit |
| ATC_MWD | ATC_MWD | Auto Trak Curve MWD |
| ATC_LCPM | ATC_LCPM | Auto Trak Curve LCPM |

Comments

- 1

Depth measurements obtained from a depth control system not supplied or operated by Baker Hughes. Due to lack of control by Baker Hughes logging engineers, depth calibrations and measurements could not be independently verified.
- 2


Baker Hughes LWD run 1 and 2 utilized a 6 3/4 inch Navigamma services (Gamma Ray, and Directional) behind a 8 1/2 inch bit and rotary steerable assembly from 1938 to 11085 feet MD (1938 to 6075 feet TVD).

Remarks

| Number | Measured Depth (ft) | Hole Section (in) | Run No. | Remark |
|--------|---------------------|-------------------|---------|---|
| 1 | 11073.00 | 8.500 | 2 | The interval from 11073 to 11085 feet MD (6075 feet TVD) due to sensor to bit offset at well TD. |

Curve Mnemonics

| Presented Curves | Description | Units |
|------------------|-------------------------------------|-------|
| ROPA | Depth Averaged ROP 10 ft Average | ft/h |
| TVD | True Vertical Depth | ft |
| WOBA | Weight On Bit, Average 1 ft Average | klb |
| GRAM | Gamma Ray - Apparent 3 ft Average | API |
| GRTX | Gamma Time Since Drilled | min |
| TCDM | Downhole Temperature | degF |



Company

Well

Interval

Created

Noble Energy

Freedom Federal LC21-630

Date From:2017-07-14 03:28:10

Date To:2017-07-15 20:28:14

2017-07-16 12:49

Top:1925.00

Bottom:11085.00

