

2010 Rotary steerable drilling systems directory

Product trade name	Point-the-bit or Push-the-bit?	Length (ft)	O. D. & I. D. (inches)	Hole size (inches)	Max DLS capability (°/100')	Automated closed loop deviation control (yes/no) (+/-degrees)	Build rate increment	Is deviation force continuous?	Max temp (°C /°F)	Max internal pressure (psi)	Other special pressure limitations	Require configuration based on anticipated flow rate?
Baker Hughes http://www.bakerhughesdirect.com												
9.5" AutoTrak G3.0 RCLS	Hybrid of point and push	58 (fully inclusive of steering system & MWD/LWD) Steering head length = 8	OD: 9.5 ID: N/A	12.00 - 28.00	6.5	Yes Precise to within 0.125°	1.5%	Yes >7,000 Steering vectors continuously available	150/300 (175/347 on request)	25,000 (30,000 on request)	None	Steering system: No MWD system: Yes
8.25" AutoTrak G3.0 RCLS	Hybrid of point and push	57 (fully inclusive of steering system & MWD/LWD) Steering head length = 7	OD: 8.25 ID: N/A	10.625	6.5	Yes Precise to within 0.125°	1.5%	Yes >7,000 Steering vectors continuously available	150/300 (175/347 on request)	25,000 (30,000 on request)	None	Steering system: No MWD system: Yes
6.75" AutoTrak G3.0 RCLS	Hybrid of point and push	49 (fully inclusive of steering system & MWD/LWD) Steering head length = 7	OD: 6.75 ID: N/A	8.375 - 10.625	6.5	Yes Precise to within 0.125°	1.5%	Yes >7,000 Steering vectors continuously available	150/300 (175/347 on request)	25,000 (30,000 on request)	None	Steering system: No MWD system: Yes
4.75" AutoTrak G3.0 RCLS	Hybrid of point and push	47 (fully inclusive of steering system & MWD/LWD) Steering head length = 10.5	OD: 4.75 ID: N/A	5.75 - 6.75	10	Yes Precise to within 0.125°	1.5%	Yes >7,000 Steering vectors continuously available	150/300 (175/347 on request)	25,000 (30,000 on request)	None	Yes
9.5" AutoTrak X-treme (Integrated pre-contoured drilling motor)	Hybrid of point and push	82 (fully inclusive of steering system, motor power section & MWD/LWD) Steering head length = 8	OD: 9.5 ID: N/A	12.00 - 28	6.5	Yes Precise to within 0.125°	1.5%	Yes >7,000 Steering vectors continuously available	150/300 (175/347 on request)	25,000 (30,000 on request)	None	Steering system: No MWD system: Yes
6.75" AutoTrak X-treme (Integrated pre-contoured drilling motor)	Hybrid of point and push	70 fully inclusive of steering system, motor power section & MWD/LWD) Steering head length = 7	OD: 6.75 ID: N/A	8.375 - 10.625	6.5	Yes Precise to within 0.125°	1.5%	Yes >7,000 Steering vectors continuously available	150/300 (175/347 on request)	25,000 (30,000 on request)	None	Steering system: No MWD system: Yes
4.75" AutoTrak X-treme (Integrated pre-contoured drilling motor)	Hybrid of point and push	68 (fully inclusive of steering system, motor power section & MWD/LWD) Steering head length = 10.5	OD: 4.75 ID: N/A	5.875 - 6.75	10	Yes Precise to within 0.125°	1.5%	Yes >7,000 Steering vectors continuously available	150/300 (175/347 on request)	25,000 (30,000 on request)	None	Yes
9.5" AutoTrak eXpress RCLS (Base level RSS service)	Hybrid of point and push	64 (fully inclusive of steering system & MWD) Steering head length = 8	OD: 9.5 ID: N/A	12.00 - 28.00	6.5	Yes Precise to within 0.125°	Programmable from surface via downlink from 0-6.5° /100 ft	Yes Steering vectors continuously available	150/300	20,000	None	Steering system: No MWD system: Yes
6.75" AutoTrak eXpress RCLS (Base level RSS service)	Hybrid of point and push	54 (fully inclusive of steering system & MWD) Steering head length = 7	OD: 6.75 ID: N/A	8.375 - 10.625	8	Yes Precise to within 0.125°	Programmable from surface via downlink from 0-8° /100 ft	Yes Steering vectors continuously available	150/300	20,000	None	Steering system: No MWD system: Yes
4.75" AutoTrak eXpress RCLS (Base level RSS service)	Hybrid of point and push	57 BHA inclusive of steering system & MWD	OD: 4.75 ID: N/A	5.75 - 6.75	10	Yes Precise to within 0.125°	Programmable from surface via downlink from 0-10° /100 ft	Yes Steering vectors continuously available	150/300	20,000	None	Yes
Gyrodatta Western Hemisphere Jeff Weimer 713-461-3146 (jeffw@gyrodatta.com) www.gyrodatta.com												
Well-Guide 10-300	Point	31 collar	OD: 10.25 ID: 2.813	12.25 - 17.5	3.3	Yes inclination and azimuth to within 0.1°	0 to 100%	Yes	150/302	20,000	None	No
Gyrodatta Eastern Hemisphere Sandy Lawson 44-1224-823060 (sandy@gyrodatta.com) www.gyrodatta.com												
Well-Guide 7-100	Point	24 collar	OD: 7.25 ID: 2.25	8.375 - 9.875	7	Yes inclination and azimuth to within 0.1°	0 to 100%	Yes	150/302	20,000	None	No
Halliburton Sperry Drilling Mike Strachan, Global Product Champion - Drilling Optimization (michael.strachan@halliburton.com) www.halliburton.com												
Geo-Pilot System 5200 Series	Point	16.2 + 11.5 flex collar	OD: 5.25 ID: 1.125	5.825 - 6.75	10	No	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	140/284	20,000	None	No
Geo-Pilot XL System 5200 Series	Point	16.2 + 11.5 flex collar	OD: 5.25 ID: 1.125	5.825 - 6.75	10	No	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	140/284	20,000	None	No

Sensor distance (ft) Inc/Azm/GR/Res	Control from surface (Downlink)? (Y / N)	If yes, tool control method	Req'd to communicate change in target (minutes)	Minimum kickoff inclination (degrees)	Max RPM / WOB	Min flow rate (gpm)	Max flow rate (gpm)	LCM limits	Power source	Bit requirements	Integrated LWD?
3.9 / 32.4 / 24.3 / 25.6	Y	Negative pulse from surface skid unit	While drilling ahead	0	300 RPM 100 kbf	300	1,600	Steering system: None MWD system: 40 lb/bbl fineNutplug (higher conc. on request)	Turbine generator	Application specific	Yes
3.1 / 32.4 / 20.3 / 25.6	Y	Negative pulse from surface skid unit	While drilling ahead	0	400 RPM 57 kbf	300	1,290	Steering system: None MWD system: 40 lb/bbl fine nutplug (higher conc. on request)	Turbine generator	Application specific	Yes
3.1 / 27.5 / 17.7 / 21.6	Y	Negative pulse from surface skid unit	While drilling ahead	0	400 RPM 57 kbf	200	900	Steering system: None MWD system: 40 lb/bbl fine nutplug (higher conc. on request)	Turbine generator	Application specific	Yes
4.3 / 25.9 / 12.9 / 20.0	Y	Negative pulse from surface skid unit	While drilling ahead	0	400 RPM 22.5 kbf	125	350	40 lb/bbl fine nutplug (higher conc. on request)	Turbine generator	Application specific	Yes
Inc: 3.9 Others BHA dependent	Y	Negative pulse from surface skid unit	While drilling ahead	0	300 RPM 60 kbf	530	1,600	Steering system: None MWD system: 40 lb/bbl fine nutplug (higher conc. on request)	Turbine generator	Application specific	Yes
Inc: 3.1 Others BHA dependent	Y	Negative pulse from surface skid unit	While drilling ahead	0	400 RPM 36 kbf	265	660	Steering system: None MWD system: 40 lb/bbl fine nutplug (higher conc. on request)	Turbine generator	Application specific	Yes
Inc: 4.3 Others BHA dependent	Y	Negative pulse from surface skid unit	While drilling ahead	0	400 RPM 14.6 kbf	105	315	40 lb/bbl fine nutplug (higher conc. on request)	Turbine generator	Application specific	Yes
3.9 / 40.8 / 37.5 / -	Y	Flow rate change	While drilling ahead	0	300 RPM 100 kbf	300	1,600	Steering system: None MWD system: 40 lb/bbl fine nutplug (higher conc. on request)	Turbine generator	Application specific	No
3.1 / 34.6 / 31.3 / -	Y	Flow rate change	While drilling ahead	0	400 RPM 57 kbf	265	900	Steering system: None MWD system: 40 lb/bbl fine nutplug (higher conc. on request)	Turbine generator	Application specific	No
3.8 / 32.8 / 29.5 / -	Y	Flow rate change	While drilling ahead	0	400 RPM 22.5 kbf	125	350	40 lb/bbl fine nutplug (higher conc. on request)	Turbine generator	Application specific	No
9 Inc/Azm	Y	Rotary	0	0	150 RPM 70 kbf	none	none (2.813 bore - no restriction)	None	Lithium batteries/rotation	Best bit for formation	No - Can be operated below any LWD/MWD
7 Inc/Azm/GR	Y	Rotary	0	0	250 RPM 53 kbf	none	none (2.25 bore - no restriction)	None	Lithium batteries/rotation	Best bit for formation	No - Can be operated below any LWD/MWD
10/32/32/42	Y	Negative pulse from surface skid unit	0	5	180 RPM 25 kbf	Recommend 5005,000 lbs/min psi differential across MWD for telemetry	(e.g., 350 gpm @ 14.3 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
10/32/32/42	Y	Negative pulse from surface skid unit	0	5	180 RPM 25 kbf	Recommend 5005,000 lbs/min psi differential across MWD for telemetry	(e.g., 350 gpm @ 14.3 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes

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Geo-Pilot XL System 5200 Series Solar	Point	16.2 + 11.5 flex collar	OD: 5.25 ID: 1.125	5.825 - 6.75	10	No	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	175 / 347	20,000	None	No
Geo-Pilot System 7600 Series	Point	20	OD: 7.625 ID: 1.625	8.375 - 10.625	5	Yes within 0.100°	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	140/284	18,000	None	No
Geo-Pilot EDL System 7600 Series	Point	20	OD: 7.625 ID: 1.625	8.375 - 10.625	9	Yes within 0.100°	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	140/284	18,000	None	No
Geo-Pilot XL System 7600 Series	Point	20	OD: 7.625 ID: 1.625	8.375 - 10.625	5	Yes within 0.100°	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	140/284	18,000	None	No
Geo-Pilot XL System 7600 Series Solar	Point	20	OD: 7.625 ID: 1.625	8.375 - 10.625	5	Yes within 0.100°	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	175 / 347	25,000	None	No
Geo-Pilot XL System 7600 Series XHP	Point	20	OD: 7.625 ID: 1.625	8.375 - 10.625	5	Yes within 0.100°	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	140/284	30,000	None	No
Geo-Pilot XL System 9600 Series	Point	22	OD: 9.625 ID: 2.375	12.25 - 26	9	Yes within 0.100°	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	140/284	20,000	None	No
Geo-Pilot XL System 7600 Series Solar XHP	Point	20	OD: 7.625 ID: 1.625	8.375 - 10.625	5	Yes within 0.100°	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	175/347	30,000	None	No
Geo-Pilot System 9600 Series	Point	22	OD: 9.625 ID: 2.375	12.25 - 26	6	Yes within 0.100°	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	140/284	20,000	None	No
Geo-Pilot XL System 9600 Series	Point	22	OD: 9.625 ID: 2.375	12.25 - 26	6	Yes within 0.100°	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	140/284	20,000	None	No
Geo-Pilot XL System 9600 Series Solar	Point	22	OD: 9.625 ID: 2.375	12.25 - 26	6	Yes within 0.100°	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	175/347	25,000	None	No
Geo-Pilot XL System 9600 Series XHP	Point	22	OD: 9.625 ID: 2.375	12.25 - 26	6	Yes within 0.100°	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	140/284	30,000	None	No
Geo-Pilot GXT System 7600 Series (Integrated GeoForce even-wall power section)	Point	20 + 27.4 (power section)	OD: 7.625 ID: 1.625	8.375 - 10.625	5	Yes within 0.100°	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	140/284	18,000	None	No
Geo-Pilot GXT System 7600 Series Solar (Integrated GeoForce even-wall power section)	Point	20 + 27.4 (power section)	OD: 7.625 ID: 1.625	8.375 - 10.625	6	Yes within 0.100°	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	175/347	25,000	None	No
Geo-Pilot GXT System 9600 Series (Integrated GeoForce even-wall power section)	Point	22 + 29.7 (power section)	OD: 9.625 ID: 2.375	12.25 - 26	6	Yes within 0.100°	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	140/284	20,000	None	No
Geo-Pilot GXT System 9600 Series Solar (Integrated GeoForce even-wall power section)	Point	22 + 29.7 (power section)	OD: 9.625 ID: 2.375	12.25 - 26	6	Yes within 0.100°	0-100% in 1% increments, and 3° TF increments	Yes >12,000 Steering vectors continuously available	175/347	25,000	None	No
EZ-Pilot 1225 System	Point	11.7	OD: 10.63 ID: 2.0	12 - 14.75	5	No	Surface selectable from 0-5° /100 ft	Yes	150/302	18,000	None	No

Sensor distance (ft) Inc/Azm/GR/Res	Control from surface (Downlink)? (Y / N)	If yes, tool control method	Req'd to communicate change in target (minutes)	Minimum kickoff inclination (degrees)	Max RPM / WOB	Min flow rate (gpm)	Max flow rate (gpm)	LCM limits	Power source	Bit requirements	Integrated LWD?
10/32/32/42	Y	Negative pulse from surface skid unit	0	5	180 RPM 25klb	Recommend 500 psi differential across MWD for telemetry	5,000 lbs/min (e.g., 350 gpm @ 14.3 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
3/23/3/40	Y	Negative pulse from surface skid unit	0	0	250 RPM 55klb	Recommend 500 psi differential across MWD for telemetry	10,000 lbs/min (e.g., 1,000 gpm @10 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
3/23/3/40	Y	Negative pulse from surface skid unit	0	0	250 RPM 55klb	Recommend 500 psi differential across MWD for telemetry	10,000 lbs/min (e.g., 1,000 gpm @10 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
3/23/3/40	Y	Negative pulse from surface skid unit	0	0	250 RPM 55klb	Recommend 500 psi differential across MWD for telemetry	10,000 lbs/min (e.g., 1,000 gpm @10 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
3/23/3/40	Y	Negative pulse from surface skid unit	0	0	250 RPM 55klb	Recommend 500 psi differential across MWD for telemetry	10,000 lbs/min (e.g., 1,000 gpm @10 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
3/23/3/40	Y	Negative pulse from surface skid unit	0	0	250 RPM 55klb	Recommend 500 psi differential across MWD for telemetry	10,000 lbs/min (e.g., 1,000 gpm @10 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
3/23/3/40	Y	Negative pulse from surface skid unit	0	0	250 RPM 100klb	Recommend 500 psi differential across MWD for telemetry	20,000 lbs/min (e.g., 2,000 gpm @10 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
3/23/3/40	Y	Negative pulse from surface skid unit	0	0	250 RPM 55klb	Recommend 500 psi differential across MWD for telemetry	10,000 lbs/min (e.g., 1,000 gpm @10 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
3/23/3/40	Y	Negative pulse from surface skid unit	0	0	250 RPM 100klb	Recommend 500 psi differential across MWD for telemetry	20,000 lbs/min (e.g., 2,000 gpm @10 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
3/23/3/40	Y	Negative pulse from surface skid unit	0	0	250 RPM 100klb	Recommend 500 psi differential across MWD for telemetry	20,000 lbs/min (e.g., 2,000 gpm @10 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
3/23/3/40	Y	Negative pulse from surface skid unit	0	0	250 RPM 100klb	Recommend 500 psi differential across MWD for telemetry	20,000 lbs/min (e.g., 2,000 gpm @10 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
3/23/3/40	Y	Negative pulse from surface skid unit	0	0	250 RPM 100klb	Recommend 500 psi differential across MWD for telemetry	20,000 lbs/min (e.g., 2,000 gpm @10 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
3/23/3/56	Y	Negative pulse from surface skid unit	0	0	400 bit RPM 55klb	Recommend 500 psi differential across MWD for telemetry	10,000 lbs/min (e.g., 1,000 gpm @10 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
3/23/3/56	Y	Negative pulse from surface skid unit	0	0	400 bit RPM 55klb	Recommend 500 psi differential across MWD for telemetry	10,000 lbs/min (e.g., 1,000 gpm @10 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
3/23/3/58	Y	Negative pulse from surface skid unit	0	0	400 bit RPM 90klb	Recommend 500 psi differential across MWD for telemetry	12,000 lbs/min (e.g., 1,200 gpm @10 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
3/23/3/58	Y	Negative pulse from surface skid unit	0	0	400 bit RPM 90klb	Recommend 500 psi differential across MWD for telemetry	12,000 lbs/min (e.g., 1,200 gpm @10 ppg)	None	Lithium batteries	Extended gauge for predictable build rate	Yes
5.7/28/35	Y	Negative pulse from surface skid unit	0	0	280 RPM 88klb	Recommend 500 psi differential across MWD for telemetry	1,400	None	Lithium batteries	Application specific	No

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Product trade name	Point-the-bit or Push-the-bit?	Length (ft)	O. D. & I. D. (inches)	Hole size (inches)	Max DLS capability (°/100')	Automated closed loop deviation control (yes/no) (+/-degrees)	Build rate increment	Is deviation force continuous?	Max temp (°C /°F)	Max internal pressure (psi)	Other special pressure limitations	Require configuration based on anticipated flow rate?
EZ-Pilot 850 System	Point	13.3	OD: 7.25 ID: 2.0	8.375 - 9.875	5	No	Surface selectable from 0-5° /100 ft	Yes	150/302	20,000	None	No
Smith - Pathfinder Steve Jones steve.jones@pathfinderwd.com												
PathMaker 8in.	Hybrid of point and push	21	OD: 9.5 ID: 2.25	12.25 - 17.5	6	Yes +/- 0.1°	Programmable from surface via downlink from 0-6° /100 ft	Yes	150/302	15,000	None	No
PathMaker 6.75in	Hybrid of point and push	20	OD: 6.75 ID: 1.60	8.375 - 8.75	10	Yes +/- 0.1°	Programmable from surface via downlink from 0-10° /100 ft	Yes	150/302	20,000	None	No
PathMaker 4.75in	Hybrid of point and push	20	OD: 5.2 ID: 1.20	5.875 - 6.75	10	Yes +/- 0.1°	Programmable from surface via downlink from 0-10° /100 ft	Yes	175/350	25,000	None	No
Schlumberger Emma Bloor, Marketing Communications Manager ebloor@slb.com 281-285-8425												
PowerDrive Xceed 675	Point	25	OD: 6.75 ID: N/A	8.375 - 9.875	8	Yes +/- 0.1°	1% and 1° TF resolution	Adjustable	150/302	20,000	None	Yes
PowerDrive Xceed 900	Point	28	OD: 9.00 ID: N/A	12.25 - 17.5	6.5	Yes +/- 0.1°	1% and 1° TF resolution	Adjustable	150/302	20,000	None	Yes
PowerDrive X5 1100	Push	15.1	OD: 9.5 ID: N/A	16 - 26	4	Yes +/- 0.1°	1% and 1° TF resolution	Adjustable	150/302	25,000	Pressure drop at bit consideration required	Yes
PowerDrive X5 1100	Push	15.1	OD: 9.5 ID: N/A	16 - 26	4	Yes +/- 0.1°	1% and 1° TF resolution	Adjustable	150/302	25,000	Pressure drop at bit consideration required	Yes
PowerDrive X5 900	Push	16.5	OD: 9.0 ID: N/A	12 - 14.75	5	Yes +/- 0.1°	1% and 1° TF resolution	Adjustable	150/302	25,000	Pressure drop at bit consideration required	Yes
PowerDrive X5 825	Push	15.9	OD: 8.25 ID: N/A	10.625	6	Yes +/- 0.1°	1% and 1° TF resolution	Adjustable	150/302	25,000	Pressure drop at bit consideration required	Yes
PowerDrive X5 675	Push	13.4	OD: 6.75 ID: N/A	7.875 - 9.875	8	Yes +/- 0.1°	1% and 1° TF resolution	Adjustable	150/302	25,000	Pressure drop at bit consideration required	Yes
PowerDrive X5 650	Push	10	OD: 6.50 ID: N/A	7.875	8	Yes +/- 0.1°	1% and 1° TF resolution	Adjustable	150/302	20,000	Pressure drop at bit consideration required	Yes
PowerDrive X5 475	Push	14.6	OD: 4.75 ID: N/A	5.5 - 6.75	8	Yes +/- 0.1°	1% and 1° TF resolution	Adjustable	150/302	25,000	Pressure drop at bit consideration required	Yes
PowerDrive Xbow	Push	36.5	3.125	3.75 - 4.5	15	Yes +/- 0.1°	1% and 1° TF resolution	Adjustable	150/303	20,000	Pressure drop at bit consideration required	Yes
Weatherford International Ltd. John Niven, Global RSS Technical Manager john.niven@me.weatherford.com www.weatherford.com												
Revolution 825 rotary steerable system	Point	14.5	OD: 8.25 ID: 2.75	18.25 - 10.625	7.5	Yes	Variable	Yes	175/347 operating	25,000	None	No
Revolution 675 rotary steerable system	Point	12.7	OD: 6.75 ID: 2.0	8.375 - 9.875	10	Yes	Variable	Yes	175/347 operating	25,000	None	No
Revolution 475 rotary steerable system	Point	11.2	OD: 4.75 ID: 1.75	5.875 - 6.75	10	Yes	Variable	Yes	175/347 operating	25,000	None	No

Sensor distance (ft) Inc/Azm/GR/Res	Control from surface (Downlink)? (Y / N)	If yes, tool control method	Req'd to communicate change in target (minutes)	Minimum kickoff inclination (degrees)	Max RPM / WOB	Min flow rate (gpm)	Max flow rate (gpm)	LCM limits	Power source	Bit requirements	Integrated LWD?
7.5/28/35	Y	Negative pulse from surface skid unit	0	0	280 RPM 42.5klb	Recommend 500 psi differential across MWD for telemetry	1400	None	Lithium batteries	Application specific	No
Inc: 6, Cal 4 Others BHA dependent	Y	Rotary	While drilling ahead	0	250 RPM 60 klbs	No minimum requirement	1500	None	Lithium batteries	None	Yes
Inc: 6.5, Cal 3.3 Others BHA dependent	Y	Rotary	While drilling ahead	0	250RPM 50 klbs	No minimum requirement	750	None	Lithium batteries	None	Yes
Inc: 7.9, Cal 2.3 Others BHA dependent	Y	Rotary	While drilling ahead	0	300 RPM 25 klbs	No minimum requirement	350	None	Lithium batteries	None	Yes
Inc / Azm 12.8 / 12.8	Y	Flow rate change	While drilling ahead	0	350 RPM 55 klbf	290	800	50 lb/bbl med. nut plug	Turbine generator	Application specific - bi-center compatible	Modular
Inc / Azm 16.7 / 16.7	Y	Flow rate change	While drilling ahead	0	350 RPM 75 klbf	450	1,800	50 lb/bbl med. nut plug	Turbine generator	Application specific - bi-center compatible	Modular
Inc / Azm 8.8 / 10.9 GR 8.0	Y	Flow rate change	While drilling ahead	0	220 RPM 65 klbf	480	1,900	50 lb/bbl med. nut plug	Turbine generator	Application specific	Modular
Inc / Azm 8.8 / 10.9 GR 8.0	Y	Flow rate change	While drilling ahead	0	220 RPM 65 klbf	480	1,900	50 lb/bbl med. nut plug	Turbine generator	Application specific	Modular
Inc / Azm 8.4 / 10.5 GR 7.6	Y	Flow rate change	While drilling ahead	0	220 RPM 65 klbf	360	1,900	50 lb/bbl med. nut plug	Turbine generator	Application specific	Modular
Inc / Azm 8.4 / 10.5 GR 7.6	Y	Flow rate change	While drilling ahead	0	220 RPM 65 klbf	360	1,500	50 lb/bbl med. nut plug	Turbine generator	Application specific	Modular
Inc / Azm 7.3 / 9.4 GR 6.4	Y	Flow rate change	While drilling ahead	0	220 RPM 65 klbf	250	800	50 lb/bbl med. nut plug	Turbine generator	Application specific	Modular
N/A	Y	Flow rate change	While drilling ahead	0	220RPM 65 klbf	240	550	50 lb/bbl med. nut plug	Turbine generator	Application specific	Modular
Inc / Azm 6.7 / 8.8 GR 5.9	Y	Flow rate change	While drilling ahead	0	250 RPM 50 klbf	130	400	35 lb/bbl med. nut plug	Turbine generator	Application specific	Modular
Inc / Azm 16.9 / 16.9	Y	Flow rate change	While drilling ahead	0	400 RPM 5 klbf	80	140	35 lb/bbl med. nut plug	Turbine generator	Application specific	Modular
14/14/16/39	Y	Drillstring rotation or negative pulse from surface skid unit	Typically < 3	0	250 RPM 90 kb	No minimum requirement	1500	Steering system: None MWD system: 80 lb/bbl fine/med (higher conc. on request)	Lithium batteries	Medium/long passive gauge PDC or roller cone	Yes
12/12/14/39	Y	Drillstring rotation or negative pulse from surface skid unit	Typically < 3	0	250 RPM 50 kb	No minimum requirement	750	Steering system: None MWD system: 80 lb/bbl fine/med (higher conc. on request)	Lithium batteries	Medium/long passive gauge PDC or roller cone	Yes
9/9/16/39	Y	Drillstring rotation or negative pulse from surface skid unit	Typically < 3	0	250 RPM 25 kb	No minimum requirement	350	Steering system: None MWD system: 80 lb/bbl fine/med (higher conc. on request)	Lithium batteries	Medium/long passive gauge PDC or roller cone	Yes