2019 NAPS
NORTH AMERICA PERFORATING SYMPOSIUM
AND SAFETY FORUM

DALLAS - FORT WORTH. AUGUST 5-6, 2019.

ENERGETIC TESTING AND TECHNOLOGY DEVELOPMENTS SECTION I:

Improving Pumping Down Efficiency and Safety with Intelligent Assisting System

2019-NAPS-XX

AUTHORS: Zhao Xindi, Ma Ziqiang, Zhang Qingbin
China National Petroleum Corporation.

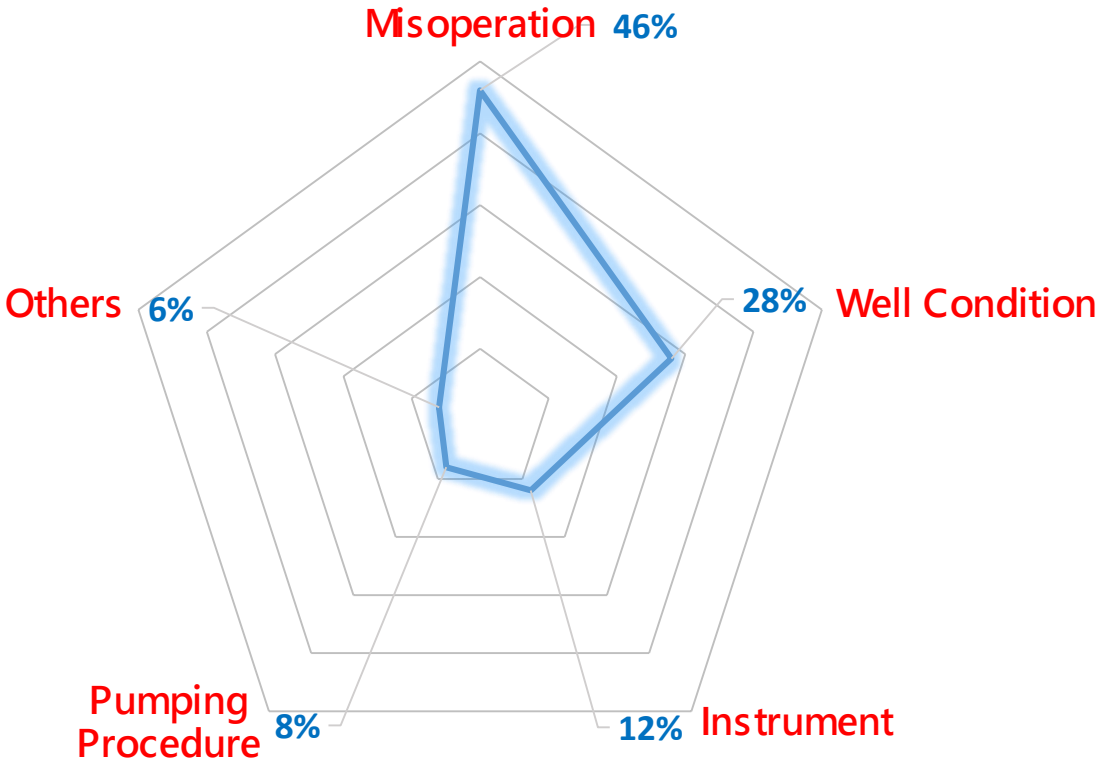
CONTENTS

Cause of Misoperation

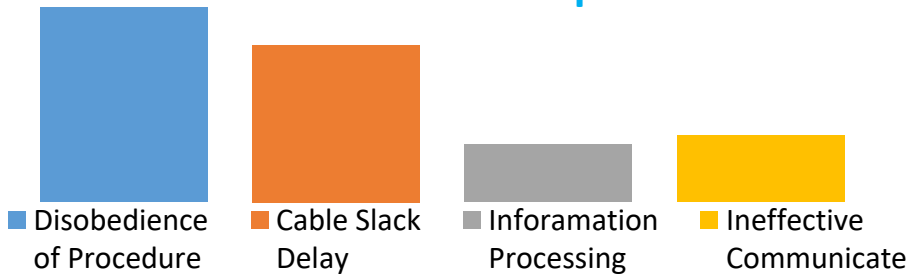
- The increase or decrease of pumping volume varies from person to person, depending on experience.
- Cable speed mismatching tool speed，wireline damaged caused by excessive tension of cable head or cable slack.
- Processing a lot of pumping down data instantaneously，adding crew member and increasing risk.
- Ineffective communication with winch driver and pump operator.

- **Pumping down failure causing great amount of cost loss.**

Failures of Pumping Down



Main Cause of Misoperation

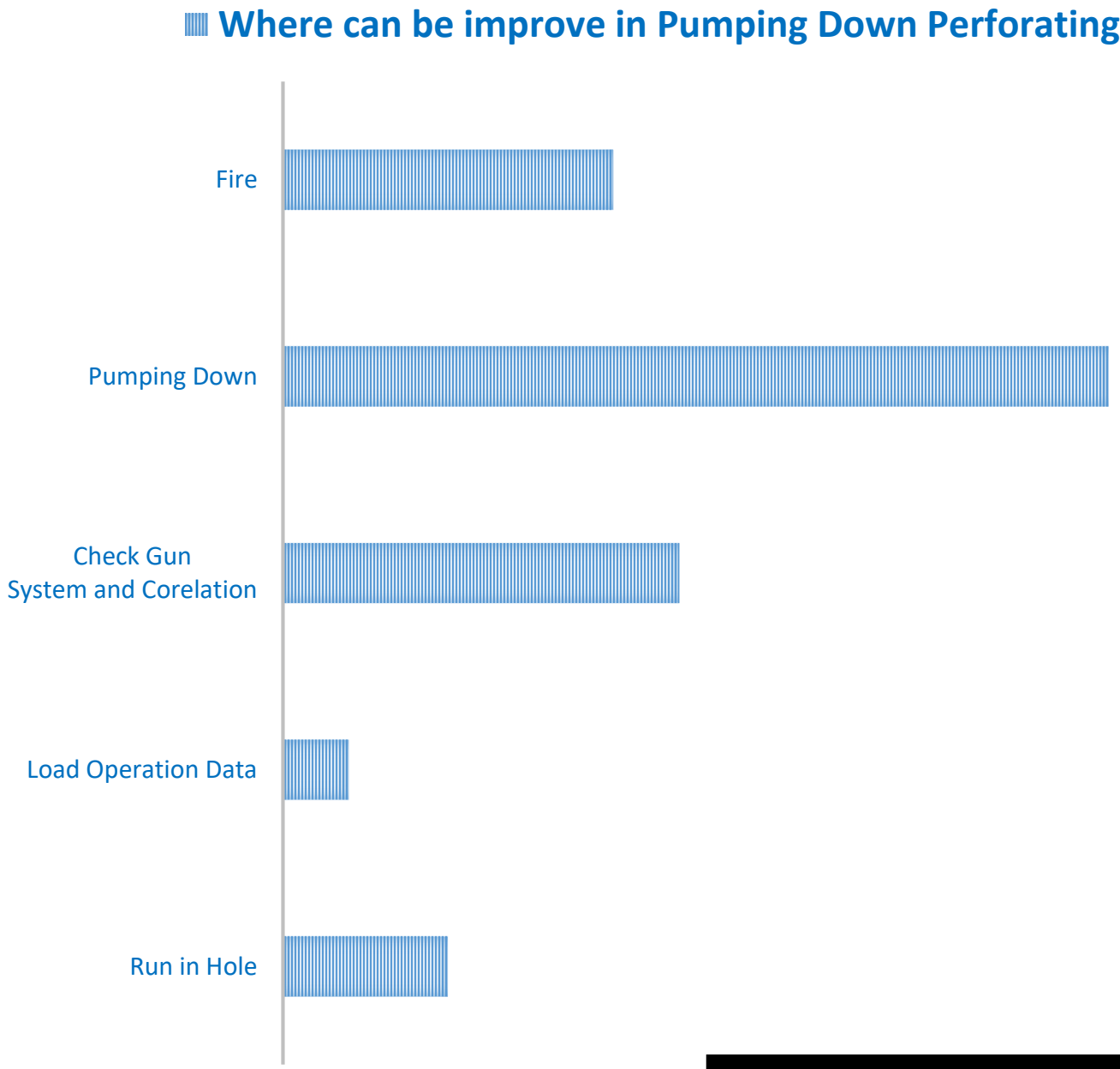


Plug and Perforating Process

- Run in Hole
- Load Operation Data
- Check Gun System and Corelation
- Pumping Down
- Fire

Efficiency

Safety



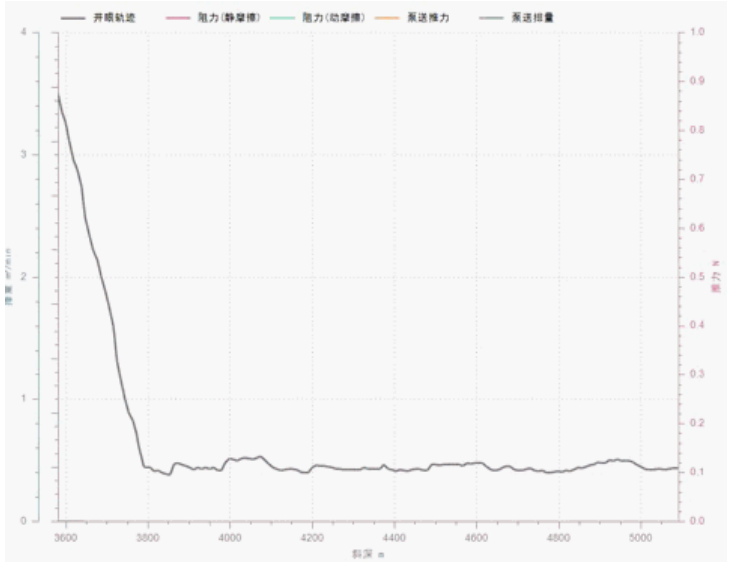
Programme

- Perforating data record
- Pumping down procedure
- Pumping volume control
- Wireline & string control
- Correlation
- Standardized operation report

SYSTEM COMPOSITION

- Pumping Down Simulation
- Pumping Down Assisting System
- Remote Supporting System

Winch Driver Assisting



Pumping Down Simulation

Pumping Down Assisting System

Remote Supporting System

SYSTEM COMPOSITION

- Basic Data
- Pumping Down Simulation
- Depth Correlation
- String Speed Calculation
- Wireline Status
- Voice Promoting
- Firing & Locating Control
- Remote Assisting

Basic Data

Basic Data Files of the Intelligent Assisting System

1	1+2	桥塞	9999	1
		1.5	5337-5338.5	0
		1.5	5317-5318.5	0
2	1+3	桥塞	5303	1
		1	5285-5286	0
		1	5262-5263	0
		1	5242-5243	0
3	1+3	桥塞	5230	1
		1	5217-5218	0
		1	5198-5199	0
		1	5180-5181	0
4	1+3	桥塞	5169	0
		1	5153-5154	0
		1	5136-5137	0
		1	5118-5119	0
5	1+3	桥塞	5106	0
		1	5091-5092	0
		1	5072-5073	0
		1	5053-5054	0

Perforating Interval

序号	井 深 (m)	井 斜 (°)	方 位 (°)	垂 深 (m)	N (m)	E (m)	狗腿度 (°/30m)	闭合方位 (°)	闭 合 距 (m)
81	2354.55	43.73	203.09	2321.82	22.07	-133.43	4.94	279.39	135.24
82	2383.36	49.80	202.45	2341.55	2.73	-141.55	6.34	271.10	141.57
83	2412.07	55.59	203.17	2358.94	-18.32	-150.39	6.08	263.06	151.51
84	2441.59	59.22	200.17	2374.84	-41.42	-159.58	4.50	255.45	164.86
85	2471.23	59.33	200.47	2389.98	-65.32	-168.42	0.28	248.80	180.65
86	2499.71	63.30	200.45	2403.65	-88.72	-177.16	4.18	243.40	198.13
87	2528.78	70.09	198.54	2415.15	-113.87	-186.06	7.24	238.53	218.14
88	2558.25	72.25	195.04	2424.66	-140.57	-194.12	4.03	234.09	239.67
89	2587.52	72.91	187.72	2433.42	-167.93	-199.62	7.19	229.93	260.86
90	2615.60	70.71	181.47	2442.19	-194.51	-201.76	6.76	226.05	280.25
91	2645.13	74.35	179.49	2451.05	-222.67	-201.99	4.17	222.21	300.64
92	2650.00	75.07	178.97	2452.33	-227.37	-201.93	5.41	221.61	304.09
93	2676.34	78.96	176.15	2458.25	-253.00	-200.84	5.42	218.44	323.03
94	2704.48	81.41	173.94	2463.05	-280.62	-198.44	3.49	215.27	343.70

Well Inclination

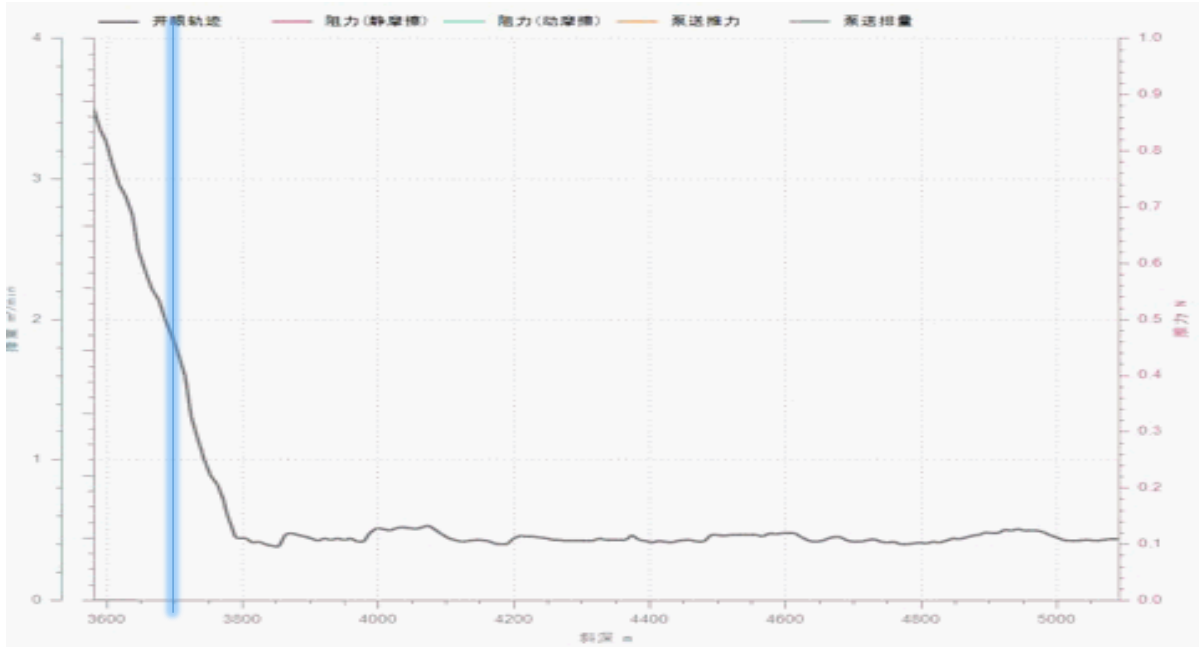
定位短节3	3319.325	10.64
1	3330.612	11.287
2	3341.908	11.296
3	3353.098	11.19
4	3364.387	11.289
5	3375.691	11.304
6	3387.004	11.313
7	3398.288	11.284
8	3409.57	11.282
9	3420.695	11.125
10	3431.965	11.27
11	3443.254	11.289
12	3454.451	11.197

Casing Data

Pumping Down Simulation

Well Condition

Perforating String



Well Depth(m)	Well Def(°)	Static friction resistance(N)	Dynamic friction resistance(N)	Pump thrust(N)	Pump displacement (m³/min)
3580.84	61.08	988.76	828.11	873.88	1.4
3590.29	62.4	1075.26	912.61	1070.72	1.5
3619.01	65.65	1289.78	1122.56	1287.54	1.6
3647.92	69.83	1567.99	1395.71	1524.34	1.7
3676.71	73.08	1785.23	1609.64	1781.12	1.8
3715.42	78.32	2135.23	1955.53	2057.88	1.9
3734.64	82.62	2427.81	2243.67	2354.62	2
3763.55	86.1	2673.94	2485.45	2671.33	2.1
3892.61	89.91	3014.44	2810.97	3008.03	2.2
4384.5	90.18	3369.71	3110.81	3364.7	2.3
4991.38	89.86	3747.82	3420.52	3741.36	2.4

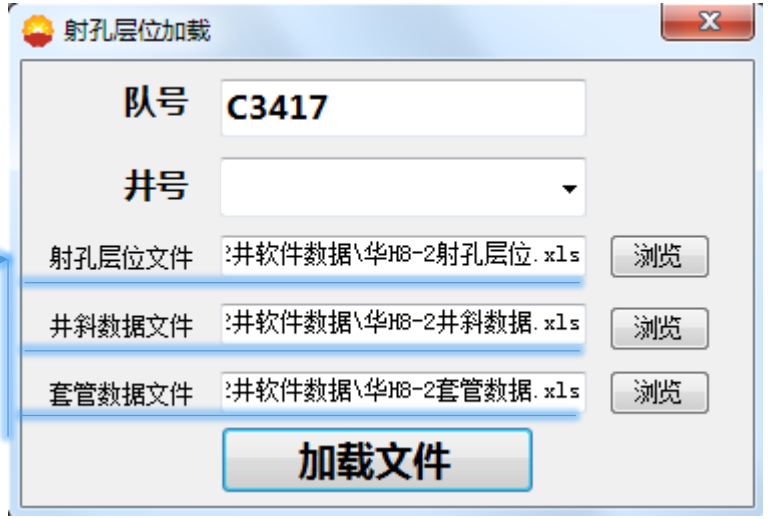
SYSTEM COMPOSITION

Software Preparing

- Load 3 data files
- Load Pump displacement data
- Collect data of Ground System
- *Active the Tracking System and Voice Promoting*

Well Depth(m)	Well Def(°)	Pump displacement (m^3/min)
3580.84	61.08	1.4
3590.29	62.4	1.5
3619.01	65.65	1.6
3647.92	69.83	1.7
3676.71	73.08	1.8
3715.42	78.32	1.9
3734.64	82.62	2
3763.55	86.1	2.1
3892.61	89.91	2.2
4384.5	90.18	2.3
4991.38	89.86	2.4

Pumping Rate

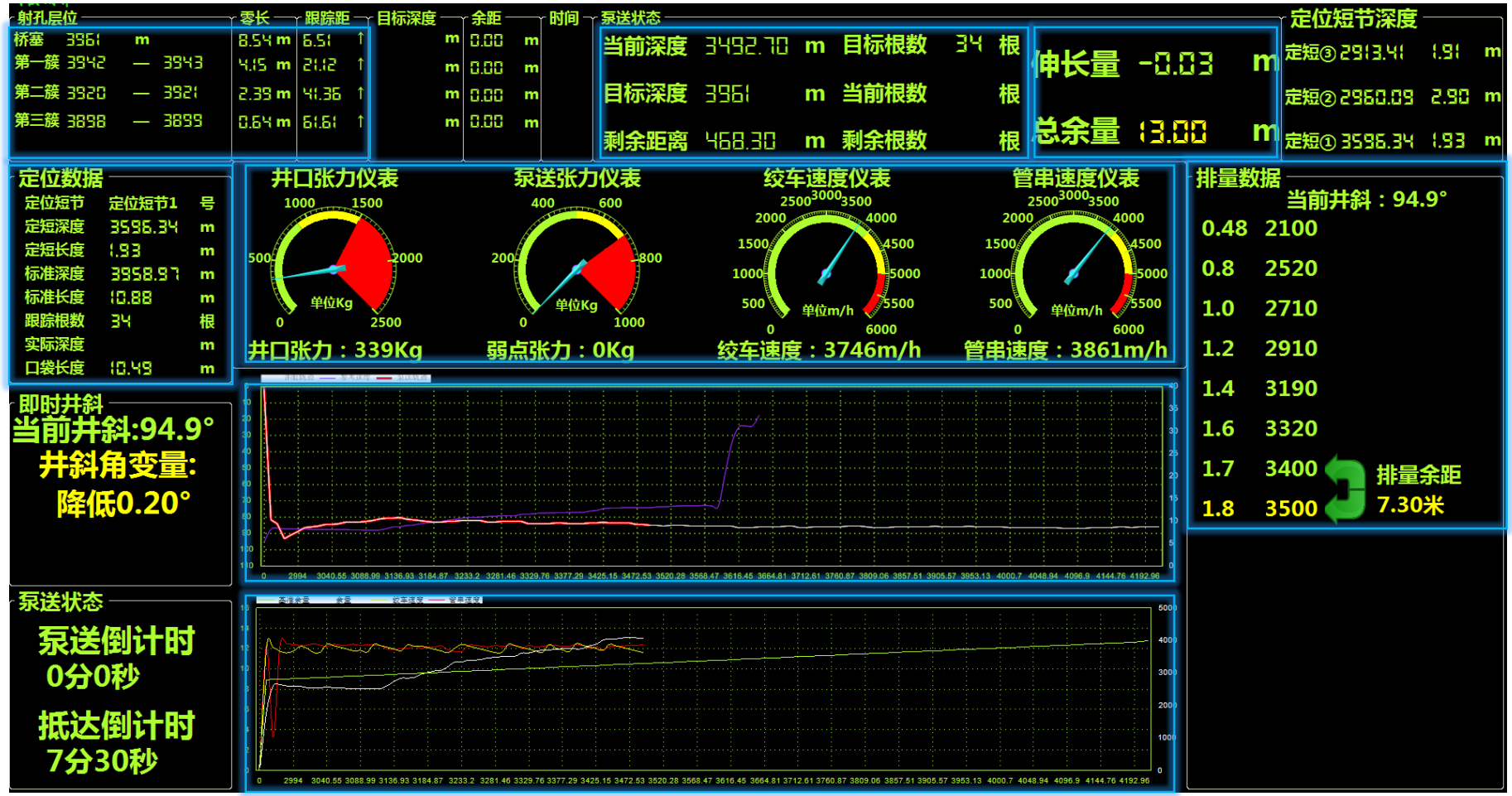


Data Files Loading

Depth
CCL
Cabel Speed
Downhole Temp
GR
Surface Tension
Downhole Tension
Downhole Pressure
Casing Depth

Collect Surface System Data

Control Pumping Down Status

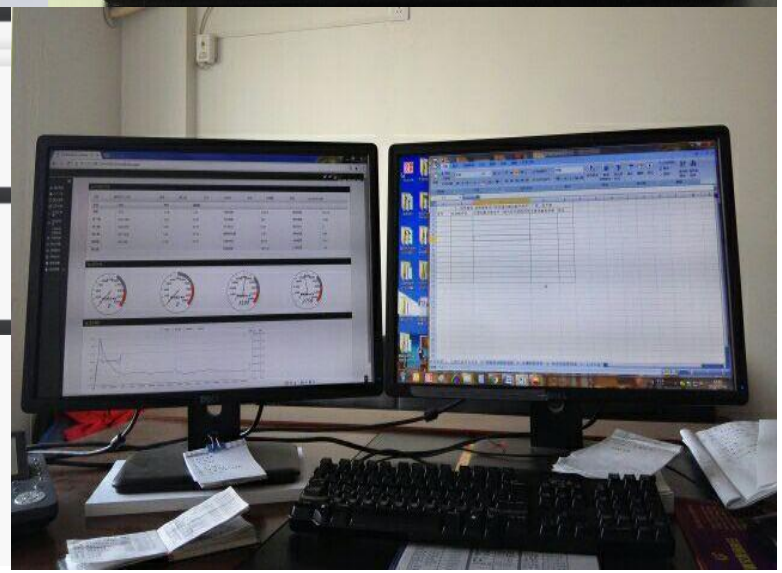


- Perforating Interval
- Pumping Down Visualizing
- Automatic Locating
- Pumping Rate
- Well Trajectory & Previous Wireline Status Curve
- Real time Wireline Status Curves

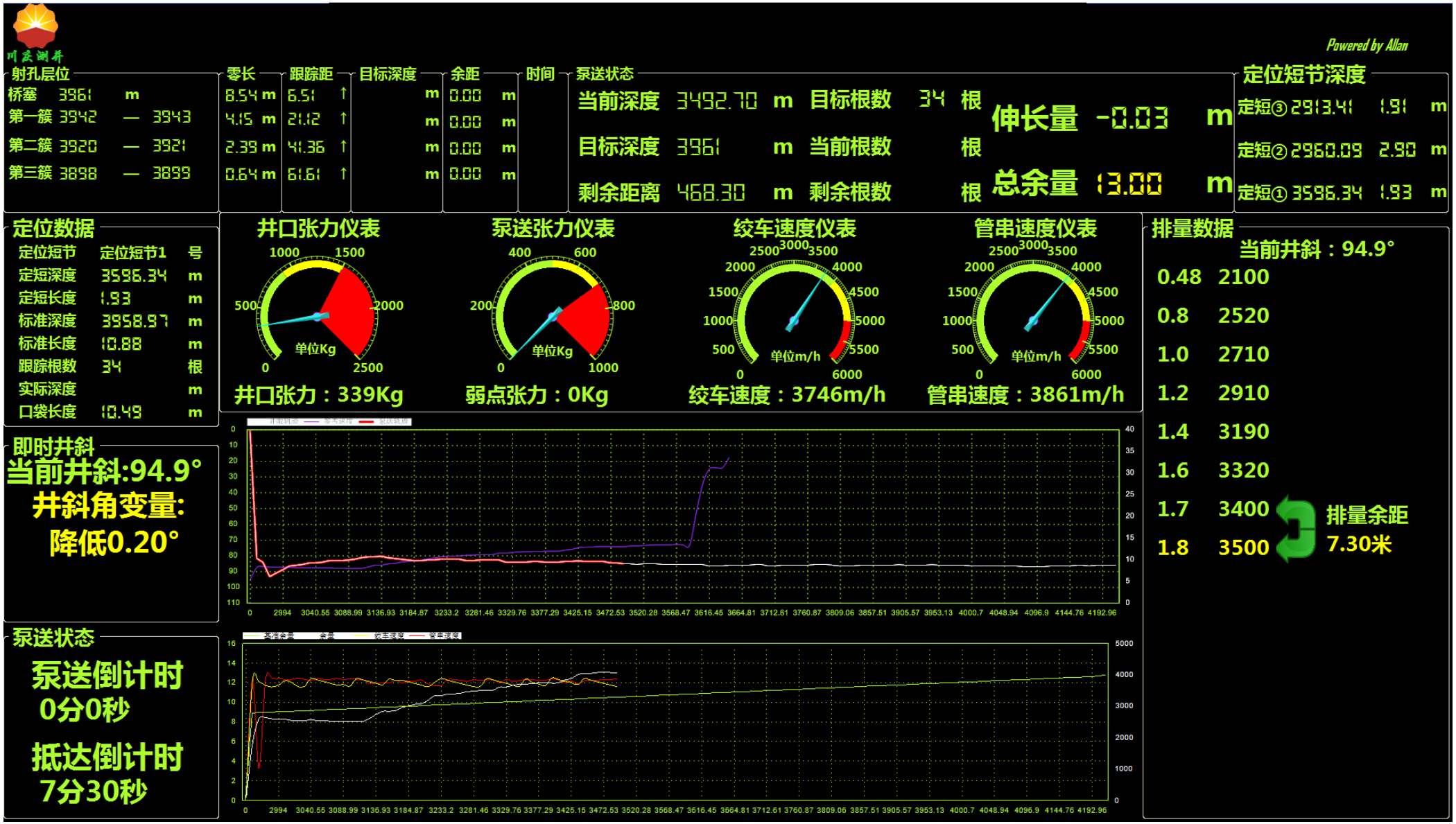
Remote Assisting

- Display Real-Time Remote Data
- Analyze Pumping Down Field Data

Comparative Analysis of Curves



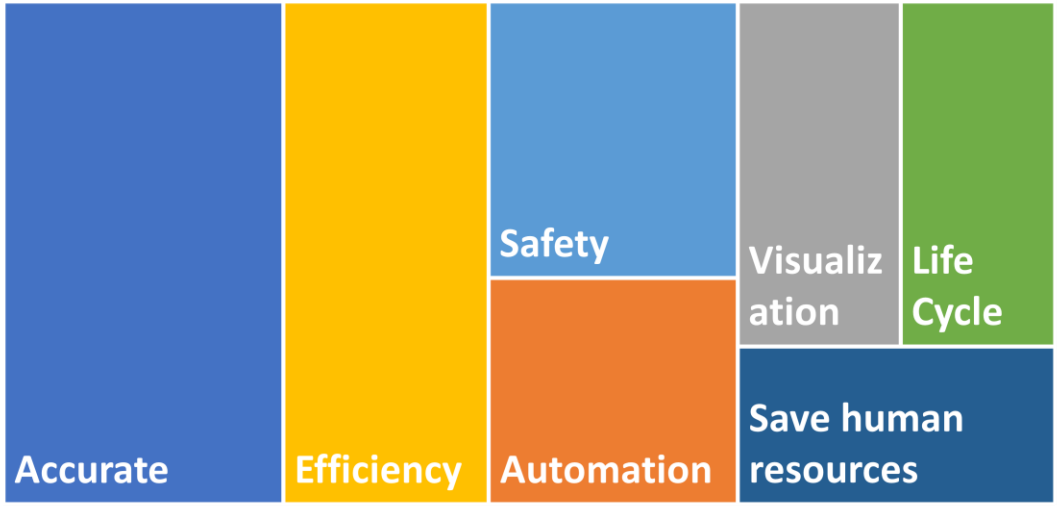
Pumping Down Data Remote Synchronization

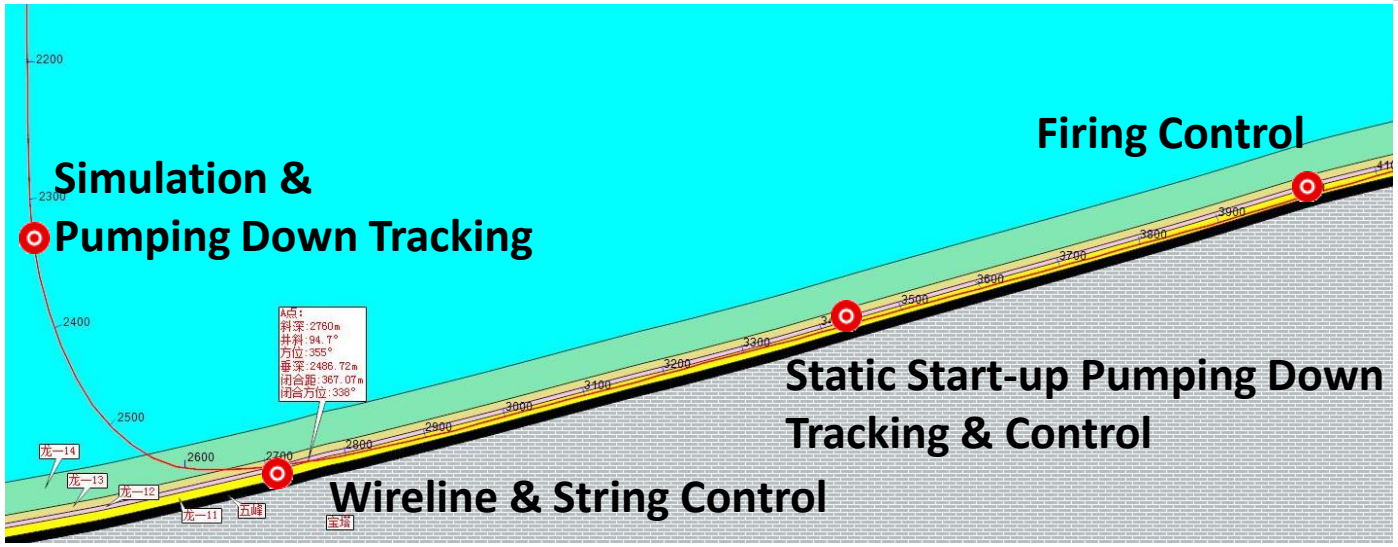

Powered by Allan
射孔层位
桥塞 3961 m
第一簇 3942 — 3943
第二簇 3920 — 3921
第三簇 3898 — 3899
零长
跟踪距
目标深度
余距
时间
泵送状态
当前深度 3492.70 m 目标根数 34 根
目标深度 3961 m 当前根数 根
剩余距离 468.30 m 剩余根数 根
伸长量 -0.03 m
总余量 13.00 m
定位短节深度
定短③ 2913.41 1.91 m
定短② 2960.09 2.90 m
定短① 3596.34 1.93 m
定位数据
定位短节 定位短节1 号
定短深度 3596.34 m
定短长度 1.93 m
标准深度 3958.97 m
标准长度 10.88 m
跟踪根数 34 根
实际深度 m
口袋长度 10.49 m
井口张力仪表
单位Kg
井口张力：339Kg
泵送张力仪表
单位Kg
弱点张力：0Kg
绞车速度仪表
单位m/h
绞车速度：3746m/h
管串速度仪表
单位m/h
管串速度：3861m/h
排量数据
当前井斜：94.9°
0.48 2100
0.8 2520
1.0 2710
1.2 2910
1.4 3190
1.6 3320
1.7 3400
1.8 3500
排量余距
7.30米
即时井斜
当前井斜:94.9°
井斜角变量:
降低0.20°
泵送状态
泵送倒计时
0分0秒
抵达倒计时
7分30秒

VIDEO HERE

W202H1X-9

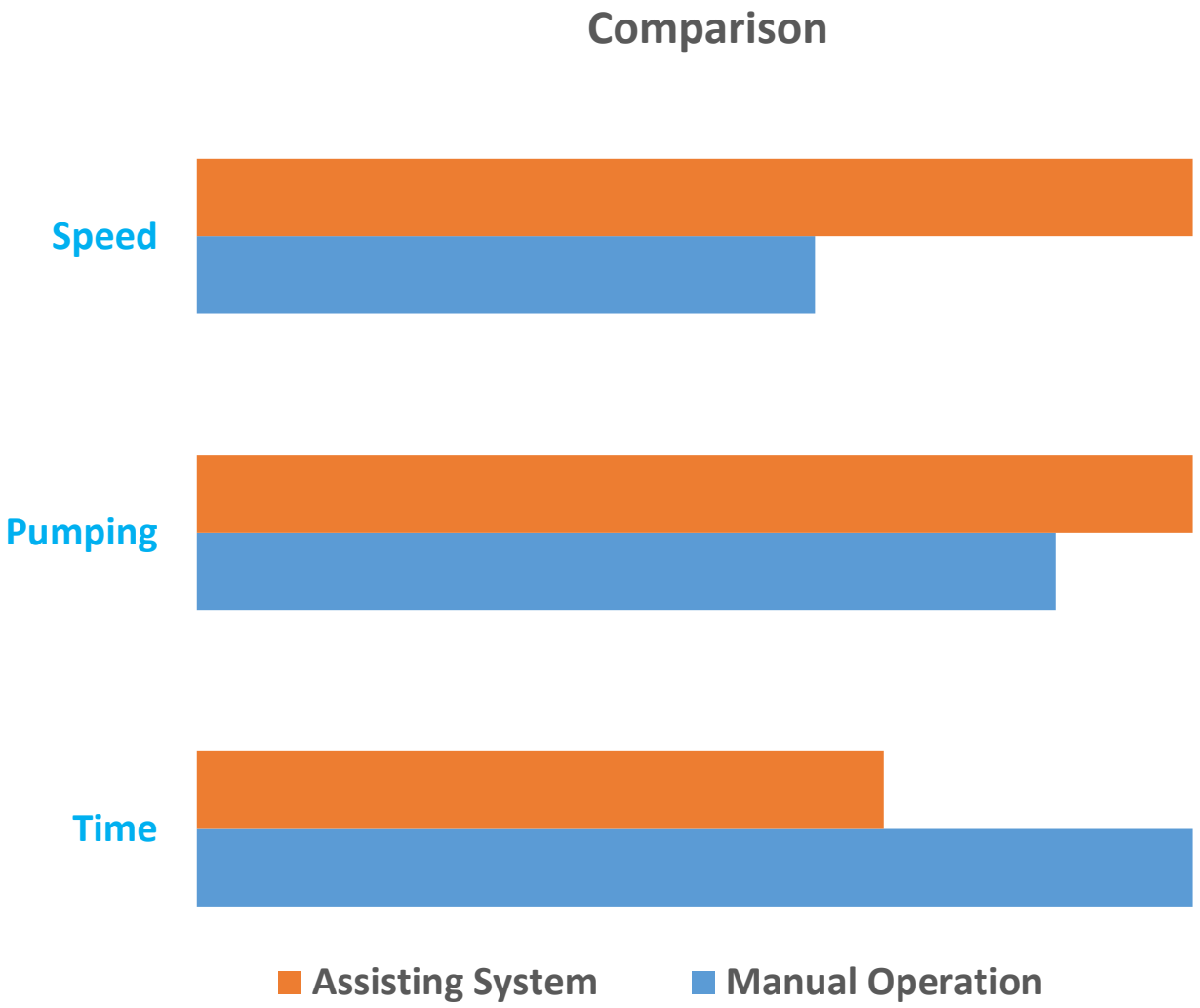
- Total Depth: 5800m
- Horizontal Interval: 1800m
- MAX Inclination angle: 104 °
- All functions of Assisting System





- Crew (per day): 7 person
- Speed (m/h): 1800~4500
- Complex: None

Efficiency



- 3800m/h, string speed increased 700m/h.
- 98%, one time succeeding rate increased 8%.
- 192 min, 37 min is reduced in 1 stage.

Safety

- The accuracy of designed pumping rate reaches 95% plus.
- Crew can get expert's advice real time in complex well condition.
- Since 2013, Plug & Gun system dropping in well accidents has reduced 90%.

Improving Pumping Down Efficiency and Safety with Intelligent Assisting System

- Using Intelligent Assisting System can promote efficiency and ensure downhole string safety.
- Using Remote System can get expert's advice real time in complex operation. Optimizing Pumping Procedure according to the previous stage.
- Replacing manual operation with software in Pump Down Perforating can reduce the number of people in crew.

QUESTIONS?

THANK YOU

PERFORATORS.ORG
INTERNATIONAL PERFORATING FORUM

2019 NAPS

NORTH AMERICA PERFORATING SYMPOSIUM

AND SAFETY FORUM

DALLAS - FORT WORTH. AUGUST 5-6, 2019.

2019-NAPS-XX

AUTHORS: Zhao Xindi, Ma Ziqiang, Zhang Qingbin
China National Petroleum Corporation.