

564-3100

303-882-7715 - David Richardson

320-000-0000



Richardson Operating Navajo Tribal H -13

San Juan, New Mexico
Sec.13,T29N,R14W
Mesaverde

Step Rate Test

May
~~February~~ 22, 2002

Prepared for: Mr. David Richardson
Owner

Richardson Operating
(303) 830-8000-Denver Office

Prepared by: Mike McNeese
AMERICAN ENERGY SERVICES

Service Point: Farmington
Sales Contact: Mike McNeese

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AMERICAN ENERGY SERVICES

GENERAL INFORMATION

Customer : **Richardson Operating**
Well Name : **Navajo Tribal H -13**
County, State : **San Juan, New Mexico**
Note : **Step Rate Test**
Prepared for : **Mr. David Richardson**
Customer Title: **Owner**
Phone No. : **(303) 830-8000-Denver Office**
Prepared by : **Mike McNeese**
Title: **Technical Sales**
Phone No. : **(505) 325-4192**
Service point : ▼
State : **New Mexico**
Sales Contact: **Mike McNeese**
Sales Title: **Account Manager**
Phone No. : **(505) 325-4192**
Sec.,T,R **Sec.13,T29N,R14W**
Field **Blanco Mesaverde**
Formation: **Mesaverde**
Date: **February 22, 2002**
Miles To Loc.: **10**
No. Units: **7**

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 Sec.13,T29N,R14W
 Mesaverde
 San Juan, New Mexico
 Step Rate Test

JOB DATA

Job Type: **Step Rate Test**
 Treating Conductor: **Tubing**
 Est. Pump Rate (bpm): **12.250**
 Est. Pressure (psi): **2,200** **3,000 (max psi)**

Fluid Requirements:
Produced Water **98,438 gallons**

Total Water Required: 98,438 gallons

Proppant/Diverter Requirements:

Total Sand Volume: 0

(lbs sand/foot pay) 0

WELL DATA

Formation: **Mesaverde**
 Top Perforation (ft.): **2,490**
 Bottom Perforation (ft.): **2,520**
 Mid Perforation (ft.): **2,505**
 No. of Perforations: **60** **2 jspf**
 Perforation Diameter (inches): **0.41**
 Frac Height (ft.): **n/a**
 Net Pay (ft.): **30**
 Fracture Gradient (psi/ft): **0.7500**
 Bottomhole Pressure (psi): **n/a**
 Bottom Hole Temp (deg. F): **120**
 Porosity (%): **n/a**
 Permeability (md): **n/a**
 Tubing Size: **2 7/8", 6.5#, 0'-2390'**
 Casing Size: **4 1/2", 10.5#, 0'-3220' (PBSD)**
 Liner Size: **n/a**
 Well/Production type: **Salt Water Disposal**

Additional Information: Produced water will be supplied by the customer.

2347.84' - packer

Frac Calculations

Tool Set @ 2500'

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<u>INPUT</u>		
Top Perforation (ft.):	2,490	
Bottom Perforation (ft):	2,520	
Mid Perforation (ft):	2,505	
Fracture Gradient (psi/ft):	0.75	
Pipe Friction (psi/ft):	560	
No. of Perforations:	60	
Perforation Diameter (inches):	0.41	
Fluid S.G.	1.000	
Tubing Size:	2 7/8", 6.5#, 0'-2390'	
Casing Size:	4 1/2", 10.5#, 0'-3220' (PBD)	
Liner Size:	n/a	
Est. Pump Rate (bpm):	12.25	
Csg./Tbg Capacity (bbl/ft):	0.00579	0.0238
Flush Volume (gal):	1,561	

Definitions:

BHFP = Bottomhole Frac Pressure (psi)

HH = Hydrostatic Head (psi)

PF = Friction Pressure Loss (psi)

PPF = Perforation Friction Pressure (psi)
= $2.93 * (\text{rate} / \#\text{perfs})^2 / (\text{perf diameter})^4$
* specific gravity

ISDP = Instantaneous Shut Down Pressure
= BHFP - HH

STP = Surface Treating Pressure (psi)
= BHFP - HH + PF + PPF

HHP = Hydraulic horsepower (hhp)
= STP * Rate / 40.8

Calculations:

BHFP =	1,879	psi
HH =	1,086	psi
PF =	1,403	psi
PPF =	4	psi
ISDP =	792	psi
STP =	2,200	psi
HHP =	660	



Procedure For Step Rate Test:

- 1. Pump produced water at 0.25 bpm for exactly 15 minutes and record all of the rates and pressure. Use a adjustable choke to pinch back the rate and adjust to the desired rate.***
- 2. Pump produced water at 0.75 bpm for exactly 15 minutes and record all of the rates and pressure. Use a adjustable choke to pinch back the rate and adjust to the desired rate.***
- 3. Pump produced water at 1.25 bpm for exactly 15 minutes and record all of the rates and pressure. Use a adjustable choke to pinch back the rate and adjust to the desired rate.***
- 4. Pump produced water at 1.75 bpm for exactly 15 minutes and record all of the rates and pressure. Use a adjustable choke to pinch back the rate and adjust to the desired rate.***
- 5. Pump produced water at 2.25 bpm for exactly 15 minutes and record all of the rates and pressure. Use a adjustable choke to pinch back the rate and adjust to the desired rate.***
- 6. Pump produced water at 2.75 bpm for exactly 15 minutes and record all of the rates and pressure. Use a adjustable choke to pinch back the rate and adjust to the desired rate.***
- 7. Pump produced water at 3.25 bpm for exactly 15 minutes and record all of the rates and pressure. Use a adjustable choke to pinch back the rate and adjust to the desired rate.***
- 8. Pump produced water at 3.75 bpm for exactly 15 minutes and record all of the rates and pressure. Use a adjustable choke to pinch back the rate and adjust to the desired rate.***
- 9. Pump produced water at 4.25 bpm for exactly 15 minutes and record all of the rates and pressure. Use a adjustable choke to pinch back the rate and adjust to the desired rate.***
- 10. Pump produced water at 4.75 bpm for exactly 15 minutes and record all of the rates and pressure. Use a adjustable choke to pinch back the rate and adjust to the desired rate.***
- 11. Pump produced water at 5.25 bpm for exactly 15 minutes and record all of the rates and pressure.***

12. Pump produced water at 5.75 bpm for exactly 15 minutes and record all of the rates and pressure.
13. Pump produced water at 6.25 bpm for exactly 15 minutes and record all of the rates and pressure.
14. Pump produced water at 6.75 bpm for exactly 15 minutes and record all of the rates and pressure.
15. Pump produced water at 7.25 bpm for exactly 15 minutes and record all of the rates and pressure.
16. Pump produced water at 7.75 bpm for exactly 15 minutes and record all of the rates and pressure.
17. Pump produced water at 8.25 bpm for exactly 15 minutes and record all of the rates and pressure.
18. Pump produced water at 8.75 bpm for exactly 15 minutes and record all of the rates and pressure.
19. Pump produced water at 9.25 bpm for exactly 15 minutes and record all of the rates and pressure.
20. Pump produced water at 9.75 bpm for exactly 15 minutes and record all of the rates and pressure.
21. Pump produced water at 10.25 bpm for exactly 15 minutes and record all of the rates and pressure.
22. Pump produced water at 10.75 bpm for exactly 15 minutes and record all of the rates and pressure.
23. Pump produced water at 11.25 bpm for exactly 15 minutes and record all of the rates and pressure.
24. Pump produced water at 11.75 bpm for exactly 15 minutes and record all of the rates and pressure.
25. Pump produced water at 12.25 bpm for exactly 15 minutes and record all of the rates and pressure.

STP required to fracture the formation =	1,879	psi	
(based on ISIP from pump-in) ISDP =	909	psi	
Frac Gradient From ISDP =	0.7500	psi/ft	ESTIMATED FROM OFFSET

Pump Schedule

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Number of tanks Using 360 Usable BBL/Tank:

6.51

Fluid & Proppant Pumping Schedule

Fluid Type	Fluid Volume (gals)	Conc. (lb/gal)	Totals (lbs)	Proppant Mesh Size	Clean Fluid (bbbls)	Volume Cum Clean (bbbls)	Slurry Fluid (bbbls)	Cum Slurry (bbbls)
Produced Water	158	0.00	0	Pad	4	4	4	4
Produced Water	473	0.00	0	0.00	11	15	11	15
Produced Water	788	0.00	0	0.00	19	34	19	34
Produced Water	1103	0.00	0	0.00	26	60	26	60
Produced Water	1418	0.00	0	0.00	34	94	34	94
Produced Water	1733	0.00	0	0.00	41	135	41	135
Produced Water	2048	0.00	0	0.00	49	184	49	184
Produced Water	2363	0.00	0	0.00	56	240	56	240
Produced Water	2678	0.00	0	0.00	64	304	64	304
Produced Water	2993	0.00	0	0.00	71	375	71	375
Produced Water	3308	0.00	0	0.00	79	454	79	454
Produced Water	3623	0.00	0	0.00	86	540	86	540
Produced Water	3938	0.00	0	0.00	94	634	94	634
Produced Water	4253	0.00	0	0.00	101	735	101	735
Produced Water	4568	0.00	0	0.00	109	844	109	844
Produced Water	4883	0.00	0	0.00	116	960	116	960
Produced Water	5198	0.00	0	0.00	124	1084	124	1084
Produced Water	5513	0.00	0	0.00	131	1215	131	1215
Produced Water	5828	0.00	0	0.00	139	1354	139	1354
Produced Water	6143	0.00	0	0.00	146	1500	146	1500
Produced Water	6458	0.00	0	0.00	154	1654	154	1654
Produced Water	6773	0.00	0	0.00	161	1815	161	1815
Produced Water	7088	0.00	0	0.00	169	1984	169	1984
Produced Water	7403	0.00	0	0.00	176	2160	176	2160
Produced Water	7718	0.00	0	0.00	184	2344	184	2344
Totals	98438		0		2344		2344	

Rate Schedule

Fluid Type	Fluid Volume (gals)	Proppant Conc. (lb/gal)	Slurry Rate (bpm)	Clean Fluid Rate (bpm)	Proppant Rate (lbs/min)	Slurry Volume (bbbls)	Cum Slurry (bbbls)	Pump Time (min)
Produced Water	158	0.00	0.25	0.3	0	4	4	15.00
Produced Water	473	0.00	0.75	0.8	0	11	15	15.00
Produced Water	788	0.00	1.25	1.3	0	19	34	15.00
Produced Water	1103	0.00	1.75	1.8	0	26	60	15.00
Produced Water	1418	0.00	2.25	2.3	0	34	94	15.00
Produced Water	1733	0.00	2.75	2.8	0	41	135	15.00
Produced Water	2048	0.00	3.25	3.3	0	49	184	15.00
Produced Water	2363	0.00	3.75	3.8	0	56	240	15.00
Produced Water	2678	0.00	4.25	4.3	0	64	304	15.00
Produced Water	2993	0.00	4.75	4.8	0	71	375	15.00
Produced Water	3308	0.00	5.25	5.3	0	79	454	15.00
Produced Water	3623	0.00	5.75	5.8	0	86	540	15.00
Produced Water	3938	0.00	6.25	6.3	0	94	634	15.00
Produced Water	4253	0.00	6.75	6.8	0	101	735	15.00
Produced Water	4568	0.00	7.25	7.3	0	109	844	15.00
Produced Water	4883	0.00	7.75	7.8	0	116	960	15.00
Produced Water	5198	0.00	8.25	8.3	0	124	1084	15.00
Produced Water	5513	0.00	8.75	8.8	0	131	1215	15.00
Produced Water	5828	0.00	9.25	9.3	0	139	1354	15.00
Produced Water	6143	0.00	9.75	9.8	0	146	1500	15.00
Produced Water	6458	0.00	10.25	10.3	0	154	1654	15.00
Produced Water	6773	0.00	10.75	10.8	0	161	1815	15.00
Produced Water	7088	0.00	11.25	11.3	0	169	1984	15.00
Produced Water	7403	0.00	11.75	11.8	0	176	2160	15.00
Produced Water	7718	0.00	12.25	12.3	0	184	2344	15.00
Total Pump Time (min)								375
Total Pump Time (hrs.)								6.25

Rex Denny

10.75 sbl / min - Ran out of H₂O @ 1:56 pm 6/3/16

920 - ISIP

490 - 5 min

440 - 10 min

420 - 15 min