

west virginia department of environmental protection

Office of Oil and Gas 601 57th Street, S.E. Charleston, WV 25304 (304) 926-0450 fax: (304) 926-0452

Austin Caperton, Cabinet Secretary www.dep.wv.gov

Monday, April 1, 2019
PERMIT MODIFICATION APPROVAL
Horizontal 6A / New Drill

HG ENERGY II APPALACHIA, LLC 5260 DUPONT ROAD PARKERSBURG, WV 26101

Re: Permit Modification Approval for NAYS 1209 N-4H

47-033-05937-00-00

Extend intermediate string, 17.5", by 150' through storage field.

HG ENERGY II APPALACHIA, LLC

The Office of Oil and Gas has reviewed the attached permit modification for the above referenced permit. The attached modification has been approved and well work may begin. Please be reminded that the oil and gas inspector is to be notified twenty-four (24) hours before permitted well work is commenced.

If there are any questions, please feel free to contact me at (304) 926-0450.

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Chief

James A. Martin

Operator's Well Number: NAYS 1209 N-4H

Farm Name: HG ENERY II APPALACHIA, LLC

U.S. WELL NUMBER: 47-033-05937-00-00

Horizontal 6A New Drill
Date Modification Issued: 04/01/2019

Promoting a healthy environment.

API NO. 47- 033 65937

OPERATOR WELL NO. Nays 1209 N-4H
Well Pad Name: Nays 1209

STATE OF WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION, OFFICE OF OIL AND GAS WELL WORK PERMIT APPLICATION

	tor: HG Ene	ergy II Appa	alachia,	494519932	Harrison	Union	West Milford 7.5
				Operator ID	County	District	Quadrangle
2) Operator's V	Well Number:	Nays 120	9 N-4H	Well P	ad Name: Nay	s 1209	
3) Farm Name	/Surface Own	er: Nays/HG	Energy II A	ppalachia Public Ro	oad Access: Ki	ncheloe Ru	n Rd/SLS 35
4) Elevation, c	urrent ground	: 1002'	E	levation, propose	d post-construc	tion: 1007'	
5) Well Type	(a) Gas x	(_ Oil _	Un	derground Stor	age	
	(b)If Gas	Shallow	x	Deep	-		02
		Horizontal	X				500
6) Existing Pad	l: Yes or No	No			_		50 W 2/7/2019
				cipated Thickness		Pressure(s):	
3) Proposed To	otal Vertical D	epth: 690	0'				
) Formation at	t Total Vertica	al Depth:	Marcellu	s			
0) Proposed T	otal Measured	d Depth:	23,646'				
1) Proposed H	Iorizontal Leg	Length:	16,306'				
2) Approxima	ite Fresh Wate	er Strata De	pths:	135', 500'			
	Determine Fre	esh Water D	epths:	Nearest offset we	ell data		
3) Method to				Average Burn Burn Burn			
		epths: No	ne noted	in offsets			
4) Approxima	ite Saltwater D		To the of				
4) Approxima5) Approxima	ite Saltwater D	Depths: 6	60' to 66		None		
4) Approxima5) Approxima	ate Saltwater Date Coal Seam ate Depth to Poosed well locat	Depths: 60	60' to 66 d (coal m	5' ine, karst, other):		o X	
4) Approxima5) Approxima6) Approxima7) Does Propolirectly overlyi	ate Saltwater Date Coal Seam ate Depth to Poosed well locating or adjacent	Depths: 60 ossible Voice tion contain t to an activ	60' to 66 d (coal m coal sea e mine?	5' ine, karst, other): ms		o X	
4) Approxima5) Approxima6) Approxima7) Does Propoirectly overlyi	ate Saltwater Date Coal Seam ate Depth to Poosed well locating or adjacent	Depths: 60 ossible Voice tion contain t to an activ	60' to 66 d (coal m coal sea e mine?	5' ine, karst, other): ms		o X	
4) Approxima5) Approxima6) Approxima7) Does Propo	ate Saltwater Date Coal Seam ate Depth to Poosed well locating or adjacent	Depths: 60 pessible Voice tion contains to an active fo: Name:	60' to 66 d (coal m coal sea e mine?	5' ine, karst, other): ms		o <u>X</u>	

FEB 1 2 2019

WV Department of Environmental Protection WW-6B (04/15)

API NO. 47	
OPERATOR WELL NO.	Nays 1209 N-4H
Well Pad Name: Nays	1209

18)

CASING AND TUBING PROGRAM

TYPE	Size (in)	New or Used	Grade	Weight per ft. (lb/ft)	FOOTAGE: For Drilling (ft)	INTERVALS: Left in Well (ft)	CEMENT: Fill-up (Cu. Ft.)/CTS
Conductor	30"	New	LS	157.5	100'	100'	Drilled In
Fresh Water	20"	NEW	J-55	94	600'	600'	40% excess, yield =1.20, CTS
Coal	13 3/8"	NEW	J-55	68	1735'	1735' /	40% excess yield = 1.20,CTS
Intermediate	9 5/8"	NEW	J-55	40	2500'	2500'	40% excess yield Lead/ 0% Excess Talk
Production	5 1/2"	NEW	P-110	23	23646'	23646'	20% excess yield = 1.19, tall yield = 1.04
Tubing							1
Liners						7	

50w 2/7/2019

TYPE	Size (in)	Wellbore Diameter (in)	Wall Thickness (in)	Burst Pressure (psi)	Anticipated Max. Internal Pressure (psi)	Cement Type	Cement Yield (cu. ft./k)
Conductor	30"	30"	.500				CTS
Fresh Water	20"	24"	.438	2110	1200	Type 1, Class A	30 % excess yield = 1.20, CTS
Coal	13 3/8"	17 1/2" /	.480 /	3450 /		Type 1/Class A	40% excess yield = 1.20, CTS
Intermediate	9 5/8"	12 1/4"	.395	3950		Type 1/Class A	40% arcess yield = 0% Excess Load 40
Production	5 1/2"	8 1/2"	.415	14520	12500	Type 1/ClassA	20% ercess yield = 1.19, tall yield 1,940
Tubing							
Liners							

PACKERS

Kind:	
Sizes:	
Depths Set:	

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WV Department of Environmental Protection

Page 2 of 3

Well Pad Name: Nays 1209

19) Describe proposed well work, including the drilling and plugging back of any pilot hole:

Drill the vertical depth to the Marcellus at an estimated total vertical depth of approximately 6900 feet. Drill horizontal leg to estimated 16306 TMD, stimulate and be capable of producing from the Marcellus Formation. Should we encounter an unanticipated void in the coal, we will install a minimum of 20' of casing below the void but not more than 100' below the void, set a basket and grout to surface.

20) Describe fracturing/stimulating methods in detail, including anticipated max pressure and max rate:

The stimulation will be completed with multiple stages divided over the lateral length of the well. Stage spacing is dependent upon engineering design. Slickwater fracturing technique will be utilized on each stage using sand, water, and chemicals. See attached list. Maximum pressure not to exceed 12,500 psi.

- 21) Total Area to be disturbed, including roads, stockpile area, pits, etc., (acres): 16.148 acres
- 22) Area to be disturbed for well pad only, less access road (acres): 10.834 acres

23) Describe centralizer placement for each casing string:

No centralizers will be used with conductor casing.
Freshwaiter - centralized every 3 joints to surface.
Coal - Bow Spring on every joint a surface.
Coal - Bow Spring on every joint.
Intermediate - Bow Spring on first 2 joints then every third joint to 100' from surface.
Production - Run 1 spiral centralizer every 5 joints from the top of the curve to surface. Run 1 spiral centralizer every 3 joints from the 1st 5.5° long joint to the top of the curve to

24) Describe all cement additives associated with each cement type:

Conductor HML, Costing to the defilled in will find the Figure Fig. 1.20, CTS
Fresh Water 1.50 ppg PNE-1 + W. New Co CGI. 4.4% Excess Yield = 1.20, CTS
Fresh Water 1.50 ppg PNE-1 + 2.5% bened CGI. 4.4% Excess Yield 1.50 ppg PNE-1 + 2.5% bened CGI. 4.5% Excess Yield 1.50 ppg PNE-1 + 2.5% bened CGI. 4.5% Excess Yield 1.50 ppg PNE-1 + 2.5% bened CGI. 4.5% Excess Yield 1.50 ppg PNE-1 + 2.5% bened CGI. 4.5% Excess Yield 1.50 ppg PNE-1 + 2.5% bened CGI. 4.5% Excess Yield 1.50 ppg PNE-1 + 2.5% bened CGI. 4.5% Excess Yield 1.50 ppg PNE-1 + 2.5% bened CGI. 4.5% Excess Yield 1.50 ppg PNE-1 + 2.5% bened CGI. 4.5% Excess Yield 1.50 ppg PNE-1 + 2.5% bened CGI. 4.5% Excess Yield 1.50 ppg PNE-1 + 2.5% bened CGI. 4.5% Excess Yield 1.50 ppg PNE-1 + 2.5% bened CGI. 4.5% Excess Yield 1.50 ppg PNE-1 + 0.35% bened RS + 0.75 gal/sk FP13L + 50% bened ASCA1 + 0.5% bened ASCA1 + 0

25) Proposed borehole conditioning procedures:

Conductor - Ensure the hole is clean at TD. Fresh Water prior to pumping cement. Fresh Water - Once casing is at setting depth, Circulate a minimum of one hole volume with Fresh Water prior to pumping cement. Coal - Once casing is at setting depth, Circulate and condition at TD. Circulate a minimum of one hole volume prior to pumping cement. Intermediate - Once casing is at setting depth, Circulate and condition multi at TD. Circulate a minimum of one hole volume prior to pumping cement. Production - Once on bettom/TD With casing, directable at internal solvance in time safe volume prior at low at least 22 bottoms up, or until returns and pump pressures indicate the hole is clean. Circulate a minimum of one hole volume prior to pumping cement.

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FEB 1 2 2019

WV Department of Environmental Protection

*Note: Attach additional sheets as needed.

Diane White

From: James H Moore Iii < James.H.Moore.Iii@dominionenergy.com>

Sent: Wednesday, February 06, 2019 11:55 AM

To: Diane White; Ronald L. Walden

Cc: Josh Hinton

Subject: RE: Revisions to the Nays 1209 N Lateral Permits for the Dominion Energy Natural Gas

Storage Field

Diane,

DETI agrees/approves of HG Energy setting the 13-3/8" casing shoe 150' below the base of the Gantz Sand (Storage Zone) for the NAYS 1209 wells 1H,2H,3H,4H,5H,6H.

Thanks,

Jamie.

Jamie Moore Geologist II **Gas Storage Department** Dominion Energy Transmission, Inc. 925 White Oaks Boulevard Bridgeport, WV 26330 Office-681-842-3372 Work Cell-304-859-1561 Personal Cell 540-641-4044



From: Diane White [mailto:dwhite@hgenergyllc.com]

Sent: Tuesday, February 05, 2019 4:32 PM

To: James H Moore Iii (GasInfrastructure - 2); Ronald L. Walden (GasInfrastructure - 2)

Cc: Josh Hinton

Subject: [External] Revisions to the Nays 1209 N Lateral Permits for the Dominion Energy Natural Gas Storage Field

Jamie and Ron,

Attached are the well schematics for the Nays 1209 N laterals. The revisions which will be requested are to allow for the RECEIVED Office of Oil and Gas 150 feet additional casing through the storage field as per your conversations with Josh Hinton. If you can send back approval via email I'll include that with my request to the DEP for the permit revisions. FEB 1 2 2019

Thank You,

Diane



1209 N-4H Marcellus Shale Horizontal Harrison County, WV

							Harrison County, WV					
						1209 N	I-4H SH	L	2	37424.74N 173237	0.84E	
Ground Elevation	T		1007			1209	N-4H LF		2	37900.25N 173248	6.21E	
Azm	1		342.65	5°		1209 N	I-4H BH	Ĺ,	253463.68N 1727623.91E			
WELLBORE DIAGRAM		HOLE	CASING	GEOLOGY	TOP	BASE	MUD	CEMENT	CENTRALIZERS	CONDITIONING	COMMENTS	
		30"	30" 157.5# LS	Conductor	0	100	AIR	N/A, Casing to be drilled in w/ Dual Rotary Rig	N/A	Ensure the hole is clean at TD.	Conductor casing = 0.5" w thickness	
		24"	20 st	Fresh Water	0	135	AIR	15.6 ppg PNE-1 + 3% bwoc CaCl	Centralized every 3	Once casing is at setting depth, circulate a minimum of one hole volume with	Surface casing = 0.438" v	
		24	94# J-55	Fresh Water				40% Excess Yield=1.20 / CTS	joints to surface	Fresh Water prior to	Burst=2110 psi	
x x				Fresh Water	0	600				pumping cement.		
		-		Kittaning Coal	660	665		Lead: 15.4 ppg PNE-1 + 2.5% bwoc CaCl	Bow Spring on every	Once casing is at setting depth, Circulate and		
			13-3/8" 68#	Little/Big Lime	1126 / 1167	1151 / 1243	AIR / KCL	40% Excess / Tail: 15.9	joint 'will also be running	condition at TD. Circulate a	Intermediate casing = 0.480" wall thickness	
x		17.5"	J-55 BTC	Injun / Gantz (Storage)	1243 / 1535	1349 / 1585	Salt Polymer	ppg PNE-1 + 2.5% bwoc CaCl	ECP for isolating		Burst=3450 psi	
				Intermediate 1	0	1735		zero% Excess. CTS	storage zone*	cement.		
x x	1			Fifty / Thirty Foot	1650 / 1730	1697 / 1742		Lead: 15.4 ppg PNE-1+		Once casing is at setting		
	- 1			Gordon Stray / Gordon	1785 / 1850	1850 / 1940	AIR / KCL	2.5% bwoc CaCl	Bow Spring on first 2	depth, Circulate and	Intermediate casing = 0.395" wall thickness Burst=3950 psl	
	- 1	12.25"	9-5/8" 40# J-55 BTC	5th Sand	2035	2070	Salt	40% Excess / Tail: 15.9 ppg PNE-1 + 2.5% bwoc	joints then every third joint to 100' form			
x x	- 1		0-55 010	Bayard Sand	2125	2160	Polymer	CaCl	surface			
				Intermediate 2	0	2500		zero% Excess. CTS				
x x	- 1	1		Speechley	2745	2763			Run 1 spiral centralizer			
		0.001(4.4(4.4)		Balltown	2965	3005	9.0ppg		every 5 joints from the			
		8.5" Vertical		Benson	4050	4083	SOBM	<u>Lead</u> : 14.5 ppg POZ:PNE-1 + 0.3%	top of the curve to surface.			
				West Falls	4620	5865		bwoc R3 + 1% bwoc	Sulface.			
				Rhinestreet	5865	6140		EC1 + 0.75 gal/sk FP13L + 0.3% bwoc		Once on bottom/TD with casing, circulate at max		
				Cashaqua	6140	6341		MPA170		allowable pump rate for at	Production casing = 0.41	
x x	ч		5-1/2" 23#	Middlesex	6341	6421	11.5ppg-	Tail: 14.8 ppg PNE-1 + 0.35% bwoc R3 + 0.75		least 2x bottoms up, or until returns and pump	wall thickness Burst=14520 psi	
9 9		8.5" Curve	P-110 HC	West River	6421	6514	12.5ppg	gal/sk FP13L + 50%		pressures indicate the hole	Note:Actual centralizer	
F R	9	Office F	CDC HTQ	Burkett	6514	6540	SOBM	bwoc ASCA1 + 0.5% bwoc MPA170	Run 1 spiral centralizer every 3 joints from the	is clean. Circulate a minimum of one hole	schedules may be chang due to hole conditions	
FEB	9	뀨		Tully Limestone	6540	6644		20% Excess	1st 5.5" long joint to the	volume prior to pumping		
par enta	3	C C		Hamilton	6644	6863		Lead Yield=1.19 Tail Yield=1.94	top of the curve. cen	cement		
2 2 al Pr	10	RECEIVED		Marcellus	6863	6914	11.5ppg-	CTS				
FEB 1 2 2019 WW Department of Environmental Protection	0	8.5" Lateral		TMD / TVD (Production)	23646	6900	12.5ppg SOBM					
x 9 x	10		X	Onondaga	6914 X		N SOBW	X	X	X		

Previous Permit

WW-6B (04/15) API NO. 47- 4 7 0 3 3 94505/30719

OPERATOR WELL NO. Nays 1209 N-4H
Well Pad Name: Nays 1209

DEPARTMENT OF ENVIRONMENT

NIA ON, OFFICE OF OIL AND GAS

WELL WORK PERMIT APPLICATION

1) Well Operator: HG Ene	ergy II Appala	achia, 🛔 494	4519932	Harrison	Union	West Milford 7.5'
***************************************		Op	perator ID	County	District	Quadrangle
2) Operator's Well Number	: Nays 1209	N-4H	Well Pa	d Name: Nay	s 1209	
3) Farm Name/Surface Own	ner: Nays/HG E	nergy II Appalachi	Public Ro	ad Access: Ki	ncheloe Ru	n Rd/SLS 35
4) Elevation, current ground	d: 1002'	Elevati	on, proposed	l post-construc	tion: 1007'	
5) Well Type (a) Gas Other	x	Oil	Und	lerground Stor	age	
(b)If Gas		x x	Deep	_		SOW
6) Existing Pad: Yes or No	No					10/22/2018
7) Proposed Target Formation Marcellus at 6863'/6914' a					Pressure(s):	
8) Proposed Total Vertical I	Depth: 6900'					
9) Formation at Total Vertice	cal Depth: M	arcellus			Offic	RECEIVED e of Oil and Gas
10) Proposed Total Measure	ed Depth: 23	3,646'			NO	V 1 4 2018
11) Proposed Horizontal Le	g Length: 16	3,306'				/ Department of
12) Approximate Fresh Wat	ter Strata Dept	hs: 135	5', 500'		Enviro	nmental Protection
13) Method to Determine Fr	resh Water De	pths: Near	est offset w	ell data		
14) Approximate Saltwater	Depths: Non	e noted in of	fsets			
15) Approximate Coal Sean	n Depths: 660	D' to 665'				
16) Approximate Depth to I	Possible Void	(coal mine, k	carst, other):	None		
17) Does Proposed well loc directly overlying or adjace			Yes	N	o X	
(a) If Yes, provide Mine In	nfo: Name:					
	Depth:					
	Seam:	1				
	Owner:					

WW-6B (04/15) API NO. 47-_____
OPERATOR WELL NO. Nays 1209 N-4H
Well Pad Name: Nays 1209

18)

CASING AND TUBING PROGRAM

TYPE	Size (in)	New or Used	Grade	Weight per ft. (lb/ft)	FOOTAGE: For Drilling (ft)	INTERVALS: Left in Well (ft)	CEMENT: Fill-up (Cu. Ft.)/CTS
Conductor	30"	New	LS	157.5	100'	100'	Drilled In
Fresh Water	20"	NEW	J-55	94	600'	600'	40% excess, yield =1.20, CTS
Coal	13 3/8"	NEW	J-55	54.5	1635'	1635'	40% excess yield = 1.20,CTS
Intermediate	9 5/8"	NEW	J-55	40	2500'	2500'	40% excess winted Leady 0% Excess Tall
Production	5 1/2"	NEW	P-110	23	23646'		20% access yield = 1.19, inil yield = 1
Tubing		-					
Liners							-

5pw 10/22/2018

TYPE	Size (in)	Wellbore Diameter (in)	<u>Wall</u> <u>Thickness</u> <u>(in)</u>	Burst Pressure (psi)	Anticipated Max. Internal Pressure (psi)	Cement Type	Cement Yield (cu. ft./k)
Conductor	30"	30"	.500				CTS
Fresh Water	20"	24"	.438	2110	1200	Type 1, Class A	30 % excess yield = 1.20, CTS
Coal	13 3/8"	17 1/2"	.380	2730		Type 1/Class A	40% excess yield = 1.20, CTS
Intermediate	9 5/8"	12 1/4"	.395	3950		Type 1/Class A	40% excess yield = 0% Excess Lead_40
Production	5 1/2"	8 1/2"	.415	14520	12500	Type 1/ClassA	20% excess yield = 1.18, ts8 yield 1.94.0
Tubing	-						
Liners						of	RECEIVED

NOV 1 4 2018

WV Department of Environmental Protection

PACKERS

Kind:		
Sizes:		
Depths Set:		

API NO. 47	-	Ĭ
OPERATOR '	WELL NO. Nays 1209 N-4H	
Well Pad No	ame: Nevs 1209	

19	Describe 1	proposed	well work	. includin	g the drilling	g and plugging	back of any	v nilot hole:
,	,	P-0P004#	1. 411 1. 411	· · · · · · · · · · · · · · · · · · ·	P	D mrs hraddrin	a coort or all	, biice iicie.

Drill the vertical depth to the Marcellus at an estimated total vertical depth of approximately 6900 feet. Drill horizontal leg to estimated 16306 TMD, stimulate and be capable of producing from the Marcellus Formation. Should we encounter an unanticipated void in the coal, we will install a minimum of 20' of casing below the void but not more than 100' below the void, set a basket and grout to surface.

20) Describe fracturing/stimulating methods in detail, including anticipated max pressure and max rate:

The stimulation will be completed with multiple stages divided over the lateral length of the well. Stage spacing is dependent upon engineering design. Slickwater fracturing technique will be utilized on each stage using sand, water, and chemicals. See attached list. Maximum pressure not to exceed 12,500 psi.

- 21) Total Area to be disturbed, including roads, stockpile area, pits, etc., (acres): 16.148 acres
- 22) Area to be disturbed for well pad only, less access road (acres): 10.834 acres

23) Describe centralizer placement for each casing string:

No outsidizers will be used with conductor casing.
Frankmeter - controlled every 3 ploins to surface.

Coal - Bow Spring on every joint.

Coal - Bow Spring on every joint.
Intermediater - Sow Opting on the 2 joints then every third joint to 100° from surface.
Intermediater - Sow Opting on first 2 joints then every third joint to 100° from surface.

Production - Run 1 spring controlled every 6 joints from the top of the curve to surface. Run 1 spring centrolizer every 3 joints from the 1st 5.5° long joint to the top of the curve

24) Describe, all cement additives associated with each cement type:

Office of Oil and Gas

Conductor -NA, Cealing to be deliged in will blust Rotory Rig.
Frosh Nation - 18.0 pag PNE-1 - 25% howc CaCl, 40% Excess Visid = 120, CT3

Conductor -NA, Cealing to be deliged in will blust Rotory Rig.
Frosh Nation - 18.0 pag PNE-1 - 25% howc CaCl, 40% Excess Visid = 120, CT3

AND V 1 4 2018

NOV 1 4 2018

Production - Lead: 16.4 pag PNE-1 + 2.5% howc CaCl, 40% Excess, Tel: 16.9 pag, PNE-1 + 2.5% howc CaCl, atom & Excess, CT3

NOV 1 4 2018

Production - Lead: 14.5 pag POZ-PNE-1 + 0.3% howc CaCl, 40% Excess, Tel: 16.9 pag, PNE-1 + 0.25% howc CaCl, atom & Excess, CT3

Production - Lead: 14.5 pag POZ-PNE-1 + 0.3% howc R3 + 1% howc EC1 + 0.75 galds PP13L + 0.3% howc R3 + 0.75 galds PP13L + 50% howc ASCA1 + 0.5% howc NPA17020% ExcessLead Visid=1.18Tell Yeald=1.94, CT3

WV Department of Environmental Protection

25) Proposed borehole conditioning procedures:

Constitution—Enhance the holds is detent at TD.
Frost Wester - One casting lest estimated goods, chrustes a retorium of one hole volume with Frash Water poor to pumping coment.
Codi - Once casting is at esting depth, Chrustes and condition and ITD. Circulais a printers of one hole volume prior to pumping coment.
Intermediate - Deno casting lest estimate glock, Circulais and condition must of TD. Circulais a minimum of an inhibition of one hole volume prior to pumping coment.
Intermediate - Deno casting lest estimate glock, Circulais and condition must of TD. Circulais a minimum of an inhibition of one hole volume prior to pumping coment.
Production - Deno on bottom/TD with casting, circulais at man solowable pump rate for all besst 2 bottoms up, or until returns and pump pressures buddels the hole is clean. Circulais a minimum of one hole volume prior to pumping comes

*Note: Attach additional sheets as needed.



ntment of al Protection EIVED Jil and Gas 4 2018

1209 N-4H

					NOV 1 4 WW Depart			237424.74N 1732370.84E				
Ground Elevation 1007'			1209 N-4H LP				237900.25N 1732486.21E					
Ázı	Azm WELLBORE DIAGRAM		342.65°			1209 N-4H BHL				253463.68N 1727623.91E		
WELLBORE			CASING	GEOLOGY	ТОР	BASE	MUD	CEMENT	CENTRALIZERS	CONDITIONING	COMMENTS	
	Reflective acceptance											
X	X X X X X X X X X X X X X X X X X X X	30*	30" 157.5# LS	Conductor	0	100 /	AIR	N/A, Casing to be drilled in w/ Dual Rotary Rig	N/A	Ensure the hole is clean at TD.	Conductor casing = 0.5" wa thickness	
		24°	20* 94# J-55				v AIR		Centralized every 3	Once casing is at setting depth, circulate a minimum of one hole volume with Fresh Water prior to pumping cement.	Surface casing = 0.438" wa thickness Burst=2110 psi	
				Fresh Water Fresh Water	0	135, 500√ 600 √			joints to surface			
				Kittaning Coal	660	665 √		Lead: 15,4 ppg PNE-1 +	 	Once casing is at setting depth, Circulate and condition at TD. 'Circulate a minimum of one hole volume prior to pumping cerrent.	Intermediate casing = 0.480 wall thickness Burst=3450 psi	
		17.5"	13-3/8" 68# J-55 BTC	Little/Big Lime	1126 / 1167		Polymer	2.5% bwoc CaCl	Bow Spring on every joint			
X I				Injun / Garitz (Storage)	1243 / 1535	1349 / 1585						
				Intermediate 1 (Shoe 50' below storage)	0	1635√						
X		12.25"	9-5/8" 40# J-55 BTC	Fifty / Thirty Foot	1650 / 1730	1697 / 1742	940 AIR / KCL Salt Polymer	Lead: 15.4 ppg PNE-1 + 2.5% bwoc CaCl 40% Excess / Tail: 15.9 ppg PNE-1 + 2.5% bwoc CaCl zero% Excess. CTS		Once casing is at setting depth, Circulate and condition mud at TD: Circulate a minimum of one hole volume prior to pumping cement.	Intermediate casing = 0.399 Wall thickness Burst=3950 psi	
X				Gerdon Stray / Gordon	1785 / 1850	1850 / 1940						
				5th Sand	2035	2070						
X				Bayard Sand	2125	2160						
				Intermediate 2	0	2500 √						
×		8.5" Vertical	5-1/2* 23# P-110 HC CDC HTQ	Speechtey	2745	2763	-	Lead: 14.5 ppg POZ:PNE-1 + 0.3% bwoc R3 + 1% bwoc EC1 + 0.75 gal/sk FP13L + 0.3% bwoc MPA170 Tail: 14.8 ppg PNE-1 + 0.35% bwoc R3 + 0.75 gal/sk FP13L + 50% bwoc ASCA1 + 0.5% bwoc MPA170 20% Excess Lead Yield=1.94 CTS	Run 1 spiral centralizer every 5 joints from the top of the curve to surface.	Once on bottom/TD with casing, circulate at max allowable pump rate for at least 2x bottoms up, or until returns and pump pressures indicate the hole is clean. Circulate a minimum of one hole	Production casing = 0.415 wall thickness Burst=14520 psi Note:Actual centralizer schedules may be change due to hole conditions	
				Balltown	2965	3005						
				Benson	4050	4083						
				West Falls	4620	5865						
200		8.5" Curve		Rhinestreet	5865	6140	1 11.5ppg- 4 12.5ppg 0 SOBM		Run 1 spiral centralizer every 3 joints from the 1st 5.5" long joint to the top of the curve.			
				Cashaqua	6140	6341						
X				Middlesex	5341	6421						
				West River	6421	6514						
				Burkett	6514	6540						
				Tully Limestone	6540	6644						
100				Hamilton	6644	6863						
×		8.5" Lateral		Marcellus TMD / TVD	6863 23646 ✓	6914 6900	11.5ppg- 12.5ppg SOBM					
				(Production) Onondaga	6914							
			GP S VERBINGEN	-	A		A mansin	I Christian Se X aleman e i	Maganaran asabasa		l Person a persona de la compansión de la comp	