



CIL & GAS DIVISION C. CT Na Robey

DEPARTMENT OF MINES OIL AND GAS DIVISION &

Spudder Cable Tools

Oll or Gas Welf

Storage

Gas

Perf. bottom.....

Perf. bottom..

Quadrangle Holden

MINGO-813 Permit No.

WELL RECORD

				(KIND)
Company Columbia Gas Transmission Corporation Address Charleston, West Virginia	Casing and Tubing	Used in Drilling	Left in Well	Packers
Farm Cotiga Development Company Acres 11,151,3				
	3TL 2011	201	201	Kind of Packer
Well No. 9675 Elev. 715.96	13=3/89	931	938	
District Harvey County Mingo	20. 9-5/8"	20751	20121	Size of
The surface of tract is owned in fee by Cotiga Development Co.	» 8¼		*********	
Paoli, Pa. Address.	63/6			Depth set
Mineral rights are owned by Cotiga Developemnt Company	5 3/16			·····································
Address Paoli, Pa	41/2		************************	· · · · · · · · · · · · · · · · · · ·
Drilling commenced September 14, 1972	3		*******	Perf. top

Drilling completed October 10. Date Shot 10-12-72 From 2900 With 18,700# of DuPont Gelatin Attach copy of cementing record. 6 /10ths Water in 2 Inch CASING CEMENTED 9-18-72 Date /10ths Merc in:Inch 103,000 ///67 Amount of cement used (bags)......

Name of Service Co. Dowell

COAL WAS ENCOUNTERED AT. FEET INCHES.

WELL FRACTURED (DETAILS)...

RESULT AFTER TREATMENT (Initial open Flow or bbls.)..... ROCK PRESSURE AFTER TREATMENT.

..... HOURS.... 10 9

Not Acidized

Formation Color	Hard or Soft	Тор	Bottom	Oil, Gas or Water	Depth	Remarks
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		175	225			
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		318	380			
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i & Shale		440	500			-
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		735	1000			
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		2050	1535	Bottom of Sa	1t. Sand	
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le Lime		1773	1807			
11 Cave Shale		1807	1813			
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		2315	2788			
		2788	2892	* *		1,
Shale		2892	3740	Show of Gas	3346° to	3600°
& Brown Spale		3740	3880			
wn Shale		3880	4172			şi-kı

Formation	Color	Hard or Soft	Top 8	Bottom	Oil, Gas or Water	Depth Found	Remarks
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STATE OF WEST VIRGINIA DEPARTMENT OF MINES



OIL & GAS DIVISION DEFT. OF MINES

Oil and Gas Division

OIL AND GAS WELL PERMIT APPLICATION

Charleston, W. Va.	DATE	August 25, 1972	anthronia spirito indicato de companyo
Surface Owner Susie Thompson	Company Co	lumbia Gas Trans	mission Corp.
Address	Address P.O	. Box 1273 Char	leston, W.Va. 253
Mineral Owner Cotiga Development Co.	Farm Cotig	a Development Co	. Acres 11,151.31
Address 25 Darby Road Paoli, Pa. 19301	Location (wat	ers) Laurel Fork	of Pigeon Creek
Coal Owner Cotiga Development Co.	`	,	Elevation 715.96 1
Address		Harvey	
Coal Operator Not Operated	Quadrangle	Holden	
Address			
provisions being in accordance with Chapter 22, the W. Va. Code, the location is hereby approved drilling. This permit shall expire if rations have not communed by 12-18-72			
aty Director - Oi? & Gas Division			Kenneth
dity bilected of a dab billion	HVSPECT	OR TO BE NOTIFIED	Distant
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The undersigned well operator is entitled to drill upon the state thereto, (or as the case may be) under grant or lease da Company made to Woods 011 & Gas Co.	above named far ted December and recor	om or tract of land for er 5, 1929 ded on the 18th	oil and gas, having fee
The undersigned well operator is entitled to drill upon the site thereto, (or as the case may be) under grant or lease da Company made to Woods 0:1 & Gas Co. 929, in Mingo County, Book 24 X NEW WELL DRILL DEEPER	above named far ted December and recor Page 339	m or tract of land for er 5, 19 29 ded on the 18th	oil and gas, having fee by Cotiga Develop day of December
The undersigned well operator is entitled to drill upon the sittle thereto, (or as the case may be) under grant or lease date to the company made to Woods 011 & Gas Co. 929, in Mingo County, Book 24	above named far ted December and recor Page 339	m or tract of land for er 5, 19 29 ded on the 18th	oil and gas, having fee by Cotiga Develop day of December
The undersigned well operator is entitled to drill upon the sitle thereto, (or as the case may be) under grant or lease da Gompany made to Woods 0:1 & Gas Co. 929, in Mingo County, Book 24 X NEW WELL DRILL DEEPER OIL AND GAS WELL ORIGINALLY DRILLED The enclosed plat was prepared by a registered engineer or ave been notified as of the above date. The above named coal owners and/or operator are hereby no make by Section 3 of the Code, must be received by, or file Copies of this notice and the enclosed plat were mailed by recoal owners at their above shown respective address	above named far ted and recor and recor Page 33 REDRILL BEFORE JUNE licensed land su obtified that any od with the Depa	m or tract of land for ar 5, 19 29 ded on the 18th 9 FRACTU 5, 1969. Inveyor and all coal or objection they wish to artment of Mines withing delivered to the above the clay of the coal or the clay of the clay	oil and gas, having fee by Cotiga Develop day of December TRE OR STIMULATE where and/or operators make, or are required n ten (10) days. * e named coal operators before or on the
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The undersigned well operator is entitled to drill upon the state thereto, (or as the case may be) under grant or lease data to the company made to Woods Oil & Gas Co. 929, in Mingo County, Book 24 X NEW WELL DRILL DEEPER OIL AND GAS WELL ORIGINALLY DRILLED The enclosed plat was prepared by a registered engineer or ave been notified as of the above date. The above named coal owners and/or operator are hereby not make by Section 3 of the Code, must be received by, or file Copies of this notice and the enclosed plat were mailed by recoal owners at their above shown respective address made day with the mailing or delivery of this copy to the Depa Address of	above named farted December and recor and recor Page 339 REDRILL BEFORE JUNE licensed land substituted that any ed with the Depage egistered mail, our or ment of Mines ery truly yours, Sign Name P. Character Character and Character Cha	m or tract of land for ar 5, 19 29 ded on the 18th FRACTU 5, 1969. arveyor and all coal or objection they wish to artment of Mines withing delivered to the above at Charleston, West V COLUMBIA GAS TRACTU Oupt., West Operator (1998) Pox 1273 Street	oil and gas, having fee by Cotiga Develop day of December ORE OR STIMULATE where and/or operators make, or are required n ten (10) days. * e named coal operators before, or on the includa. ANSMESSION CORP. Civil Eng. Dept.

*SECTION 3.... If no objections are filed or found by the Department of mines, within said period of ten days from the receipt of notice and plat by the department of mines, to said proposed location, the department shall forthwith issue to the well operator a permit reciting the filing of such plat, that no objections have been made by the coal operators or found thereto by the department and that the same is approved and the well operator authorized to proceed.

BLANKET BOND

MINGO-813 PERMIT NUMBER

THE IS AN ESTIMATE ONLY ACTUAL INFORMATION WILL BE SUBMITTED ON OG-10 UPON COMPLETION

PROPOSED WORK ORDER TO_	X DRILL	DFEPEN	FRACTURE-STIMULATE
DRILLING CONTRACTOR: (If K	nown)	RESPONSIBLE AGEN	T : 55% (4)
Name		N. ME <u>E. G. F</u> o	oster 44
ADDRESS		AD ORESS P. O. E	Box 528 Hamlin, d. a. 2552
PELEPHONE		TELETHONE	324-7245
ESTIMATED DEPTH OF COMPLE	FED WELL: 4710	ROTARY X	CABLE TOOLS
PROPOSED GEOLOGICAL FORMA	ATION: Brown Shale		
TYPE OF WELL: OIL	GAS X	COMB. · STORAC	GE DISPOSAL
			LOOD OTHER
		TILLIII I	
ENTATIVE CASING PROGRAM:			
CASING AND TUBING	USED FOR	LEFT IN	CEMENT FILL UP
SIZE	DRILLING	WELL	OR SACKS - CUBIC FT.
0 - 16			
3 - 10	90'	90′	
- 5/8	1980'	1980'	
- 5/8			
1/2	8 mm at 2 h		
1/2	4710°	4710'	
			Perf. Top
			Perf. Bottom
ners		*	Perf. Top
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OF PLAT. D DRILL DEEPER OR REDRILL: SUBMIT FIVE (5) COPIES OF WELLS DRILLED PRIOR TO MUST ALSO BE SUBMITTED.	OG - 1, SHOWING ORIG 1929, A PERMANENT	GINAL PERMIT NUMBER A COPY OF THE PLAT AND	ND PERFORMANCE BOND. ON THE ORIGINAL WELL RECORD
FRACTURE - STIMULATE:			
OIL AND/OR GAS WELL ORIGINATION OF PERMANENT PLAT A	GINALLY DRILLED BEF ND ORIGINAL WELL RI	ORE JUNE 5, 1929, FIVE (5) ECORD.	COPIES OG - 1, PERFORMANCE
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Required forms must be filed v four (24) hours in advance.	within ninety (90) days of	completion for bond release	. Inspector to be notified twenty-
		The second secon	
The following waiver must be reof.	completed by the coal or	perator if the permit is to be	issued within ten days of receipt
	£ nu		
AIVER: I the undersigned, Agent this lease have examined		Coal Company, Owns naps this proposed well loca	
We the	Coal Company	have no objections to said	well being drilled at this location,
providing operator has con Code.	nplied with all rules and re	gulations in Articles 4, 5, and	7, Chapter 22 of the West Virginia
			, 1986 - 1
		reternation con introduction contains a containment of the containment	For Coal Company
			For Coal Company

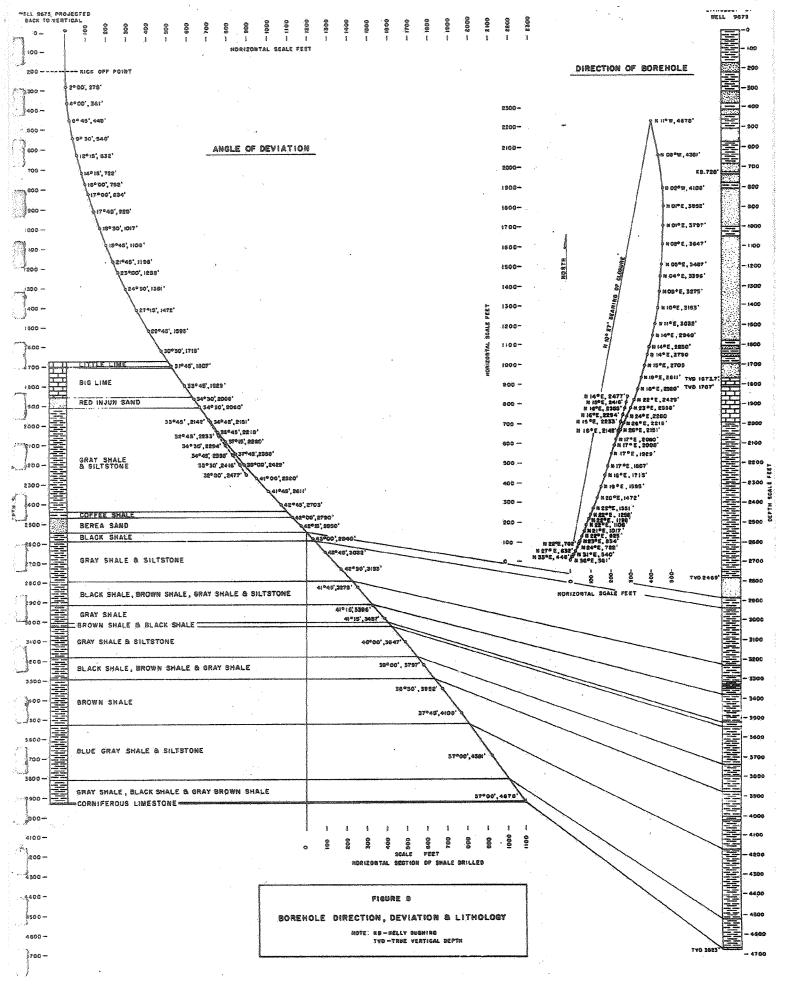
Official Title

however, the borehole cut the predicted failure envelope at an angle of approximately 80° ; at T.D. we still had 70° between the borehole and the failure envelope.

The stratigraphy of this well was normal in relation to the surrounding wells. True vertical thickness of the shale section from the base of the Berea to the top of the Corniferous was 1,378° and the actual Brown Shale interval, the kerogen bearing zone and source rock, had a true vertical thickness of about 345°. In well 9675, however, the actual shale thickness drilled was 1,781° for a net increase in the Brown Shale section of 29.2%. The thickness of the good brown shale interval within the shale section (3740° - 4174° kerogen zone) was increased from 345 feet to 434 feet for a net increase of 25.8% for this interval (Figure 8).

From a study of driller's logs, electric logs and sand samples available, it is obvious that production in the Brown Shale is not restricted to any one interval within the shale section, therefore, the entire 1,781 feet that was drilled could theoretically be a fractured reservoir. Since the stratigraphy of this well does not appear to be significantly different than other wells within the area, the difference in results must be due to the fractures encountered while drilling the well.

The structure in the area is relatively simple. The Berea generally has an east-west strike with gentle southward dip and the Corniferous has a north-south strike with an eastward dip. The main structural complication in this area is the east-west trending Warfield Fault (Figure 1). It is this fault and the associated fracture system that accounts for the major amount of production in the study area



Ryan, Griffith + Foster

TABLE I WELL NO. 9675 MINGO COUNTY, W. VA. Open Flow After Fracturing 103 Mcfd; R. P. 552 psi

PRODUCTION

Month	Days on Line	Production/Mcf	Line Pressure	<u> </u>
April	30	893	94#	
May	31	482	86#	
June	30	426	7 4 #	

entered into UVGES OGDB 7/17/2007

GEOLOGICAL AND ENGINEERING

Report on

DEVIATED SHALE WELL #9675,

HARVEY DISTRICT, MINGO COUNTY, WEST VIRGINIA

by

William M. Ryan, Geologist
Paul R. Griffith, Assistant Superintendent, Hamlin Division
John M. Foster, Project Engineer-Wells

COLUMBIA GAS TRANSMISSION CORPORATION EXPLORATION AND DEVELOPMENT DEPARTMENT

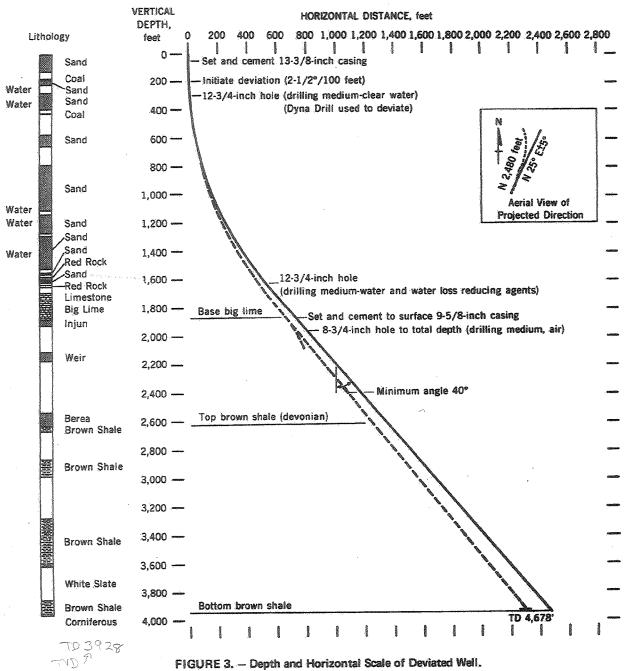


FIGURE 3. - Depth and Horizontal Scale of Deviated Well.

DRILLING A DIRECTIONALLY DEVIATED WELL TO STIMULATE GAS PRODUCTION FROM A MARGINAL RESERVOIR IN SOUTHERN WEST VIRGINIA

BY

W. K. Overbey, Jr. and W. M. Ryan

Technical Progress Report

U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

Morgantown Energy Research Center Morgantown, West Virginia