DOE/MC/26026-94/C0298

Multistrata Exploration and Production Study

Authors:
  L.K. Hawkins
  R.G. Brunk
  T. Walter
  J. Morgan
  F.T. Al-Saadoon

Contractor:
The College of West Virginia
  (formerly Beckley College)
P.O. Box AG
  Beckley, WV 25802-2830

Contract Number:
  DE-AC21-89MC26026

Conference Title:
  Fuels Technology Contractors Review Meeting

Conference Location:
  Morgantown, West Virginia

Conference Dates:
  November 16-18, 1993

Conference Sponsor:
  U.S. Department of Energy, Morgantown Energy Technology Center
DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This report has been reproduced directly from the best available copy.

Available to DOE and DOE contractors from the Office of Scientific and Technical Information, 175 Oak Ridge Turnpike, Oak Ridge, TN 37831; prices available at (615) 576-8401.

Available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161; phone orders accepted at (703) 487-4650.
Multistrata Exploration and Production Study

**CONTRACT INFORMATION**

**Contract Number**  
DE-AC21-89MC26026

**Contractor**  
The College of West Virginia  
(formerly Beckley College)  
P.O. Box AG  
Beckley, WV 25802-2830

**Subcontractor**  
American Pump Company  
P. O. Box 2797  
Monroe, LA 71294

**Contract Project Manager**  
Linda K. Hawkins

**Principal Investigators**  
Ronald G. Brunk  
Tom Walter  
John Morgan  
Felah T. Al-Saadoon

**METC Project Manager**  
Charles W. Byrer

**Period of Performance**  
October 1, 1989 to November 24, 1993

**Schedule of Milestones**

<table>
<thead>
<tr>
<th>FY 93 Program Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Select New Subcontractor</strong></td>
</tr>
<tr>
<td><strong>Automate TW1 &amp; TW3</strong></td>
</tr>
<tr>
<td><strong>Develop New Field Plan</strong></td>
</tr>
<tr>
<td><strong>Conduct Workover on TW1</strong></td>
</tr>
<tr>
<td><strong>Conduct Workover on TW3</strong></td>
</tr>
<tr>
<td><strong>Final Report</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S</th>
<th>O</th>
<th>N</th>
<th>D</th>
<th>J</th>
<th>F</th>
<th>M</th>
<th>A</th>
<th>M</th>
<th>J</th>
<th>J</th>
<th>A</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OBJECTIVES

The objective of this project was to develop and verify a geotechnical/geostatistical approach to find natural gas resources and to verify the process by drilling, completing, testing, and producing wells located by the process.

BACKGROUND INFORMATION

Research conducted on the Eccles 7.5' quadrangle in Raleigh County, WV, in 1990, pinpointed several target areas. Immediate landowners, gas companies, and mineral rights owners were contacted to determine their willingness to assist the College in conducting the research. Extensive talks were held and as a result, agreements were drawn up between the College and the owners and Test Well 1 was completed in May 1991 and Test Wells 2 and 3 in November, 1991. The wells were shut in for one year thereafter while the parties involved negotiated agreements. The wells were placed on line at the close of fiscal year 1992. The following section summarizes the activities conducted in fiscal year 1993.

PROJECT DESCRIPTION

Activities for the Multistrata Project began in Fiscal Year 1993 with the placement of the three Test Wells into production full force. By turning all three wells in line October 1, 1992, gas began flowing as designed by the agreements negotiated in Fiscal Year 1992. All the parties involved began to see tangible results as the gas moved from the College’s gathering lines into the systems of Ramco, Columbia, and Mountaineer Gas Companies.

The College of West Virginia began work as specified in the Field Test Plan for Phase II, Task 12. A new consulting agreement, based on the Task 12 Outline, was drafted and forwarded to potential new subcontractors. American Pump Company, headquartered in Monroe, LA, was selected as the College’s subcontractor.

One of the first activities undertaken was to study possible results of installing a compressor in the College’s system. This included assessment of such issues as: impact on the parties involved, effects on the wells’ production and the system’s overall performance, and sizing and pricing the compressor. This task has been addressed on an ongoing basis over the past ten months. No final decisions have been made due to constraints placed on us by gas companies involved and cost considerations.

The Test Well 1 and Test Well 3 sites were successfully automated. The College coordinated the automation activities which included selecting and installing electric motors and controls for each site. It also required electricians and Appalachian Power Company to set several poles, hang 5000 feet of line, and install two transformers.

Prior to running electricity to these sites, the pumps used to dewater the coal seams were operated on a manual basis. By running them 12 hours a day, three days per week, coal gas production increased an average 6 mcfd. Following automation, production from the coals increased another 4 mcfd on average. A number of pump rates and schedules were attempted in order to achieve maximum dewatering. None of the results, however, met our expectations.

Well data and histories were extensively analyzed to determine accurate tubing tallies and depth placement of the pumps on TW1 and TW3.
Evidence seemed to indicate that the pump on TW3 should be lowered approximately 60 feet. It also appeared that gas locking was a persistent problem on TW1. A decision was made, as a result of these problems, to develop a workover plan and to schedule workover rigs to move on site.

Rigs were contracted and moved on site July 19, 1993, and workover continued through July 30. Rigs were also on site for 13 days in August.

On TW1, the 2 and 3/8" and 1 and 1/2" strings were pulled, tallied, inspected, and repaired. The pump jack was replaced with a progressive cavity pump and a drip tube was added for better water/gas separation. All zones were swabbed independently with poor water recovery on each run. Each zone was producing less than three barrels of water per day.

TW1 was also flow tested extensively at atmosphere with good results. The coals averaged 30 mcf/d, the Ravencliff Sandstone 60 mcf/d, and the Big Lime 40 mcf/d.

A small acid job utilizing 800 gallons of 15% HCL was attempted on the Big Lime formation. We felt that the acid might clean out the perforations and the fractures from the original frac job. The zone went on vacuum for a few days and then slowly began to recover. Production tailed off but returned to previous levels after four weeks.

Workover on Test Well 3 included pulling, tallying, and repairing the tubing strings, pump assembly, rods, and all parts downhole. A drip tube was also placed on this well below the pump for better water/gas separation. The improper depth placement of the pump on this well was verified. Two joints of 1 and 1/2" were inadvertently left out of the hole during some work about a year earlier. As a result, the pump was landed just above the perfs at the Poca Coal Seam. This was the cause, as suspected, of the continuous gas interference while pumping the coals. The pump has now been placed 60 feet below the Poca Coal and should enable us to adequately dewater the seam.

Attention was focused next on the Ravencliff Sandstone. This formation was found to be uneconomical with a maximum gas production of 2 mcf and 15 bbls of water per day. All necessary paperwork for plugging this zone was completed, but another approach was first attempted. Both strings were pulled out of the hole, and the 4 and 1/2" casing was cut at 1413 feet and removed. This opened the well up completely and allowed the water from the coal seam to simply fall downhole. Calculations indicated that the Ravencliff formation would accept the coal water, thereby solving our water disposal problems. The Ravencliff, however, has not taken the water up to this point.

The coals continue to show good potential, and averaged 35 mcf/d when flowed to atmosphere. Dewatering of the Poca Coal, however, has been hindered by malfunctioning pump off switches and a high number of shut-in periods imposed upon us by Columbia Gas and Ramco Gas. The wells were shut in 6 days in June, 12 days in July, 4 days in August, and 13 in September. These shut-ins affected not only our wells, but all the wells in the area.

Water disposal has also been addressed on a continuing basis over the past few months. Currently, we have permission from the State of West Virginia to apply water from the coal seams directly to the surface since the coal seam water has been analyzed and found to be potable. There are certain guidelines, of course, such as requirements to monitor the disposal, to avoid erosion, etc. Several meetings have been held with the State Oil & Gas Division and the Division of Environmental Protection, and the subject will continue to be discussed. We hope to
eventually obtain permission from them to implement our water disposal plan. Our plan will include a drainage field with perforated pipe for the coal water, and a line and tank at the foot of the hill for the brine from the deep zones.

It should also be noted that water production from the coals is minimal. Water from the coals on TW1 averages about 2.2 bbls per pumping hour, and TW3 coal water is only 1.2 bbls per actual pumping hour. Based on swabbing and echometer tests done during workover, the water influx rate appears to be near 2 bbls per day from the coals on each well.

The gas production overall from the three Project Test Wells has been exceptional. TW1 has proven to be extremely successful with an average production of 52 mcf/d for 1993 (prior to workover activities). This well far surpasses most wells in the region since many wells in southern West Virginia typically produce 8 - 12 mcf/d. This makes TW2 (10 mcf/d), comparatively speaking, an average well for the area. TW3 may be the most interesting of the three since its production (15 mcf/d) is drawn almost entirely from the Poca Coal Seam. Circumstances have thus far prevented us from adequately dewatering and producing this well; but, even so, it still outproduces the average conventional well in the area.

FUTURE WORK

The College has developed plans to tie directly into a main gas transmission line (KA-7), part of the Columbia Gas system, which runs within 1500 feet of TW1. This would eliminate Ramco Gas as a player in our gas transmission and sale arrangement. As a result, we will no longer be forced to operate within the constraints placed upon us by Ramco, nor will we be subject to Ramco compression and gathering charges. This will require, however, installation of a compressor and a new sales meter.

The College expects that, based on the atmospheric flow tests conducted in July and August of this year, gas production should double once a compressor is installed. Initial figures indicate that by pulling line pressure down to the 1-5 psi range, we may see $3500 in additional monthly revenue if our projections are accurate. The compressor will need to be three-phase and in the 100 hp range, and will provide 1 psi suction and 300 psi discharge. Several bids have been obtained and talks are continuing with the bidders and with Columbia Gas, who must approve the plan before it can be implemented.

REFERENCES

ENDDATE 3/11/94 FILED DATE