GEOLOGY OF THE PITCHFORK RANCH FIELD
LEA COUNTY, NEW MEXICO

J. Stewart Martin, James R. Broten and Donald R. Mathews
Presented by Larry K. Hastings
Enron Oil & Gas Co.

LOCATION

The Pitchfork Ranch Field is located in southwestern Lea County, New Mexico, about 17 miles northwest of Jal and about 110 miles northwest of Midland. See Figure I.

PAY ZONES

Figure II is a composite electric type log indicating the various pay zones of the Pitchfork Ranch Field. Figure III shows the areal distribution of the field and its general structure. Figure IV is a net isopach of the Morrow "C" Sand, the main pay zone in the field.

HISTORY AND DEPOSITIONAL ENVIRONMENT

The Pitchfork Ranch Field was discovered by HNG Oil company with the completion of the Madera "32" State Com #1, Sec. 32, 24S-34E in May 1982: IPCAOF 8,485 MCFGPD, perforations 14723-15018. This pay zone is the Morrow "C" Sand. The exploratory well was based on seismic and subsurface geology looking for the Morrow channel sands which are encountered four miles to the north in Sec. 5, 24S-34E in the South Bell Lake Field. This was the exploration model at the time of drilling. Because of an expiring federal lease, HNG drilled a one mile step-out to the east; it was completed in the same Morrow "C" zone for IPF 1,800 MCFGPD, 16/64" ck, FTP 6200#, perforations 14632-14951. At this point in time HNG's concept of the Morrow "C" depositional environment changed from a channel system to a submarine fan as a result of HNG personnel's attending an AAPG Deep Clastics School at Santa Barbara, CA, in May 1982. This submarine fan was fed by channels from the Central Basin Platform which lies 12 miles to the east. There is plenty of source for clastic sediments as there are Permian rocks lying on Granite basement near Eunice, New Mexico. In other words, it became a "pile" of sand instead of a channel "fill" deposit.

An example is the Forties Field in the North Sea which produces from a turbidite sand mound and contains no structure. Its EUR is estimated to be 1-1/2 billion barrels of oil.

Mutti's model (See Figure V) of a submarine fan system fits quite well. His model has been adapted to the Pitchfork Ranch area. The Paduca Field to the west in 25S-31E in eastern Eddy County is also a similar Morrow submarine fan but a lot smaller in areal extent. The Morrow producing zone correlates with the Morrow "C" sand of the Pitchford Ranch Field. The Cinta Roja Field to the northeast in 24S-35E is a channel facies of the "C" sand.

Coming up section, the next Morrow Sand Zone of interest is the "Sinatra Sand" which was named such because it was such "A Stranger in the Night," a song made famous by singer Frank Sinatra. The first well to be completed in this zone was the Chaparral "10" #1, Sec 10, 25S-34E: Flowed 2,700 MCFGPD, FTP 5600#. One other well, the Page "3" #1, has been completed in this zone. In November 1986, the Page "3" #1 was producing 8.2 MM/D to the pipeline and has cumulative production of 2.8 MMMCFG. The Chaparral "10" #1 produced approximately 500 MMCFG before going to water. It is currently being recompleted to the Atoka. The depositional environment of the Sinatra Sand appears to be a combination of a channel and bar facies. There are probably some channel mouth bar deposits immediately to the south of these producers. However, this is very conjectural.

A true channel facies model in the Pitchfork Ranch Field is the "Warren Sand." This sand has not been perforated to date. It was first encountered in the Warren "E" #1. During the drilling operations, a gas kick was encountered with a surface pressure of 1200# with 14.1 lb mud in the hole. It took 14.7 lb mud to hold it.

This change of facies moving up section in the Morrow probably indicates a regression in the Morrow seas from a deep water submarine fan environment to a combination channel and bar facies which is probably a shallower water deposit and finally to possibly even a fluvial facies with true channel fill deposition. Some coals have been noted in the samples associated with the Morrow "A" sand, the upper most sand in the Morrow, indicating even marshy conditions.

Without any core data it is difficult to determine exact water depths at time of deposition. HNG drilling personnel are reluctant to core over-pressured zones for safety reasons. The Wolfcamp, Atoka, and Morrow are all over-pressured.

The Atoka Sand reservoir was discovered by the HNG Pitchfork "34" Federal Com #1, Sec. 34, 24S-34E: IPF Flowed 2,100 MCFGPD, 7/64" CK, FTP 8100# from perforations 13924-13930, LGR 30 BC/MM; it was completed in June 1983. Cum. prod. to 11-1-86 was 4,546 MMCF and 104 MBC. A confirmation well was completed by John L. Cox in his

RESERVES AND RESERVOIR ANALYSIS

The Morrow "C" sand, the most widespread producing reservoir, acts like a common reservoir from BHP/Z data on 14 wells since the initial discovery well was completed. (See Figure VII.) In other words, the Morrow "C" sand common reservoir covers 7-1/2 square miles which is extremely unique for a Morrow sand reservoir in SE New Mexico. Al Klaar of Llano, Inc., describes the typical Morrow reservoir as a box of cigars. The gas-in-place for the Morrow "C" sand alone is estimated to be 110 BCF; Cum. prod. from the "C" sand to 1-1-87 is about 45 BCF. The highest single well Cum. prod. to 11-1-86 is the HNG Madera "28" Federal Com. #1 with 7.4 BCF of production.

The gas-in-place of the other Morrow sands have not been determined as many of the zones are behind pipe and are not producing at this time. The "Sinatra Sand" EUR is not predictable because of the previously-mentioned water production of the Chaparral "10" #1.

The gas-in-place of the Atoka sand reservoir is substantial. The productive limits of the Atoka are currently being defined by drilling.

Considering the potential of the unknown reservoirs and the gas-in-place of the known reservoirs, it is estimated that the gas-in-place of the Pitchfork Ranch Field will be in excess of 200 BCF.

DRILLING AND COMPLETION PRACTICE

The casing program for a typical 15,000 foot Pitchfork Ranch Morrow producer is shown on Figure VIII.
The drilling fluids used in a typical well from surface to approximately 14,200 feet is 9-10 lb. brine, visc. 28, unless an Atoka gas kick is encountered. If no Atoka kick is encountered, the drilling is continued with the brine to TD or until a Morrow gas kick is encountered. If gas kicks are encountered, the brine is displaced with a 13.7-14.5 lb oil base mud (oil 80%, water 20%), visc 60, chlorides 300,000 ppm, from the gas kick to TD.
The logging suite is not unusual. It generally consists of a Resistivity Log, Compensated Neutron-Formation Density Log and, if a velocity survey is run, a BHC Sonic Log. There are typically two logging runs, the first to the Wolfcamp casing point and the second to total depth.

The typical completion practice is to set liner at TD, displace hole with 10 lb brine, spot 1000 gals of acetic acid, weighted to 10.2 lb and inhibited. Run a GR-CLL log from PBTD to approximately 12,600'; run 2-7/8" tubing and set in PBR at top of liner, displace tubing with nitrogen to be underbalanced by

Vaca Ridge "4" Federal Com #2 in Sec. 4, 25S-34E in March 1986: IPF 3,900 MCFGPD, 20/64" ck, FTP 2350#, LGR 24 BC/MM. It went on gas sales on 3-17-86 and is the 26th producer in the field. Nine other wells in the field area have encountered this Atoka sand. It appears to be a very thin but a highly permeable long shore sand deposit associated with an Atoka reef front. The Atoka algal reef produces in the Bell Lake Field and Antelope Ridge Field to the north. Some interesting gas shows have been encountered in the Pitchfork Ranch Field in this algal reef zone. At the present time, there are four wells producing from the Atoka; the two previously mentioned plus the Diamond "5" #2 and the Madera "32" #3. Production from the Atoka, at the present time, is on the order of 16 MMCF/D.

The Wolfcamp oil zone was discovered by the HNG Moore "34" Com. #1, Sec. 34, 24S-34E: IPF 168 BOPD, 462 MCF, 14/64" ck, FTP 1300#, 34°, completed 9-18-84. It has proved to be non-commercial and has not been offset. However, the first exploratory test drilled by HNG in the area in 1980, the Bell Lake "11" Federal #1, Sec. 11, 25S-33E was completed as the discovery well for the Vaca Draw (Wolfcamp) Field: IPCAOF 4,938 MCF, perforations 13684-13693, completed in January 1982. Cum. prod. to 3-1-86: 926,353 MCF and 33,385 BC. These Wolfcamp zones are detritals containing limestone, chert and sand, associated with some time line.

Several other Upper Wolfcamp and Bone Spring zones will ultimately be productive in the Pitchfork Ranch Field Area. It is also predicted that some of these will be good oil producing reservoirs. However, economics will have to be satisfactory.

PRODUCTION HISTORY

Production began in August 1982 when Transwestern Pipeline connected the discovery well to its pipeline system to the California market. The production history is shown on Figure VI. In April 1986 we have had some cutbacks up to 70%. In fact, the entire field was completely shut-in for 30 days from mid-May to mid-June 1984. The current gas market demand fluctuates almost on a daily basis with Transwestern Pipeline. However, this fluctuation does not hurt the reservoirs since there are no serious water problems. Currently the field is producing 75-80 MM/D. For production purposes, the Pitchfork Ranch and Pitchfork Ranch, West Fields are considered one field. The field development was very active in 1983-1984; at one time, HNG had five rigs drilling in the Pitchfork Ranch Field area. Currently, there is only one active rig in the field.

The average price per MCF varies monthly with a certain percentage on the Transwestern Contract and the remainder on the Pacific Atlantic Marketing Inc. Spot Market.

approximately 3,000#, (this is done to reduce any formation damage from drilling), perforate the Morrow "C" sand with about 20 holes in a 50' interal, break down perforations with spot acid, flow to test. If necessary, acidize perforations with 4,000 gals and flow to test. SI-WOPLC. Subsequent to going on gas sales, an absolute open flow four-point potential test is run to the pipeline.

CONCLUSIONS

The Pitchfork Ranch Field is by far the largest and most unique deep gas field discovered and developed in SE New Mexico since the Indian Basin Field was discovered by Ralph Lowe in 1962, twenty years ago. Cum prod for the Indian Basin is in excess of 1.1 trillion CFG.

The exploration philosophy learned from the geology of the Pitchfork Ranch Field is that "if you encounter a channel sand facies in the Upper and Middle Morrow, in the deep Delaware Basin of SE New Mexico, look for a submarine fan basinward and vice versa."

All the large stratigraphic gas fields of the Permian Basin have not been found -- the Pitchfork Ranch Field is a prime example.

The future of the Permian Basin is still bright; many townships in SE New Mexico contain only a few wells which have penetrated the entire Morrow clastic section. HNG Oil Company made a significant gas discovery in Eddy County in 25S-27E last year in our Hay Hollow "25" State #1, the first Morrow production in over 120 square miles. It is located 7 miles SE of the White City Field. The explosion in seismic-stratigraphic exploration technology will have a profound impact on oil and gas exploration in the Permian Basin for decades well into the 21st Century. The computer age truly has revolutionized seismic technology.

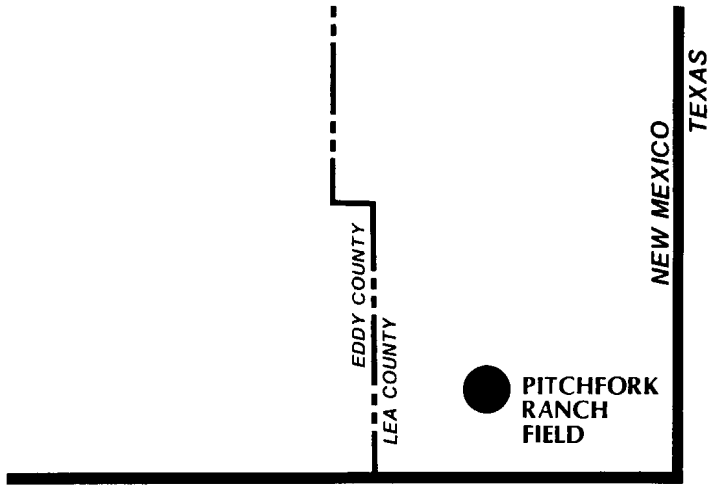


Figure 1(I)—Pitchfork Ranch Field
Lea County, New Mexico

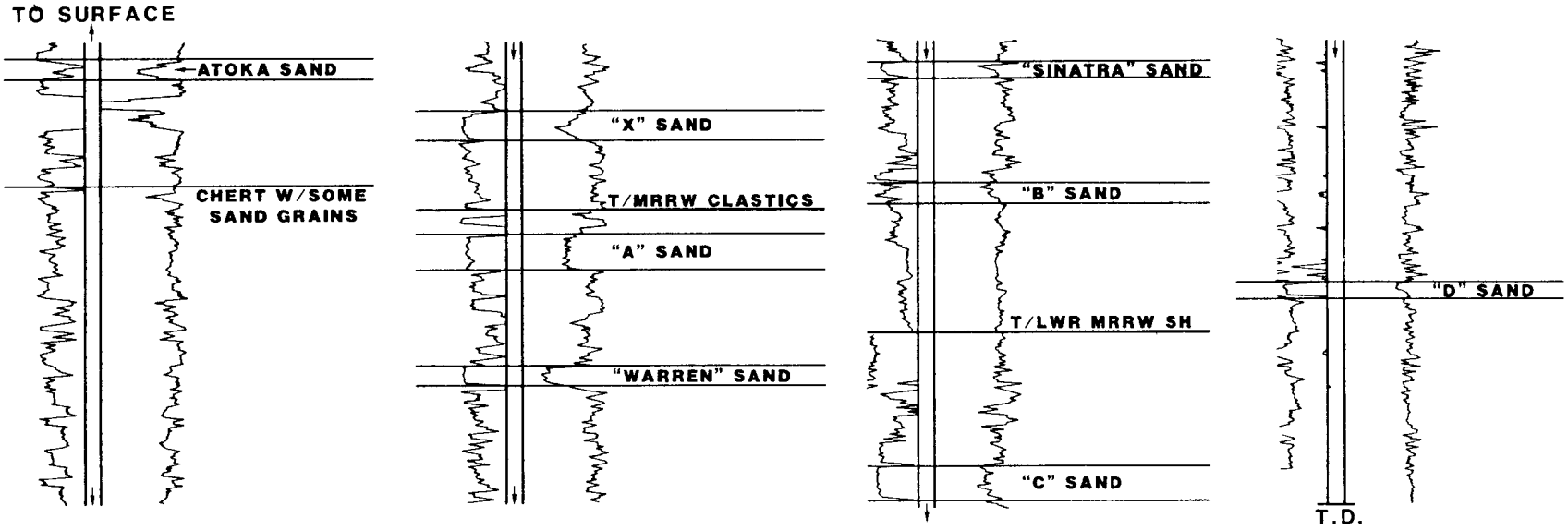
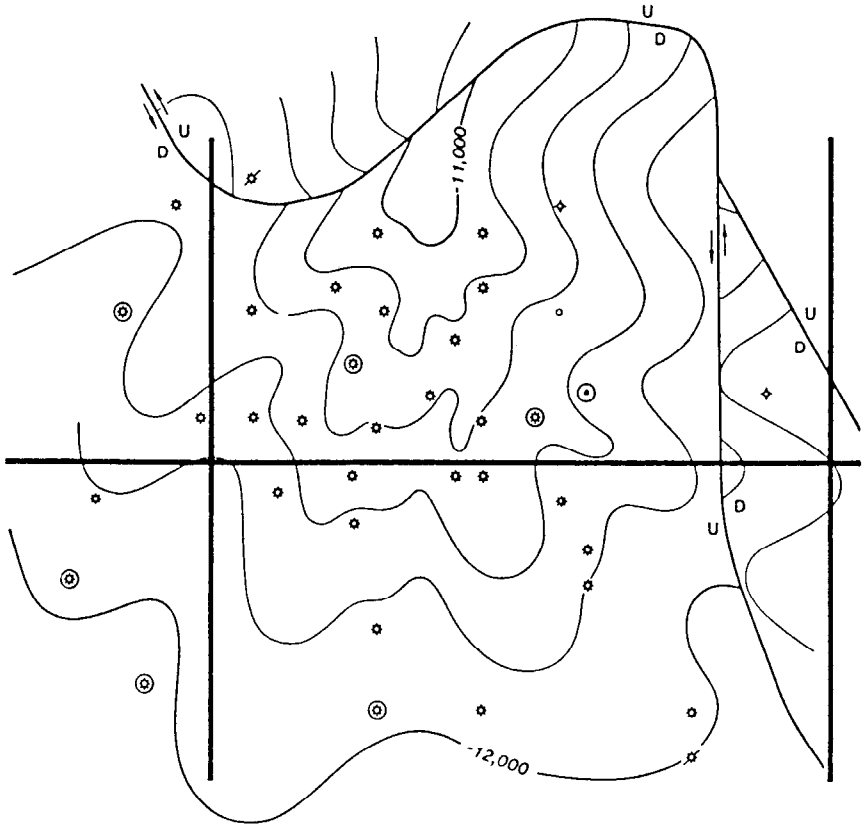
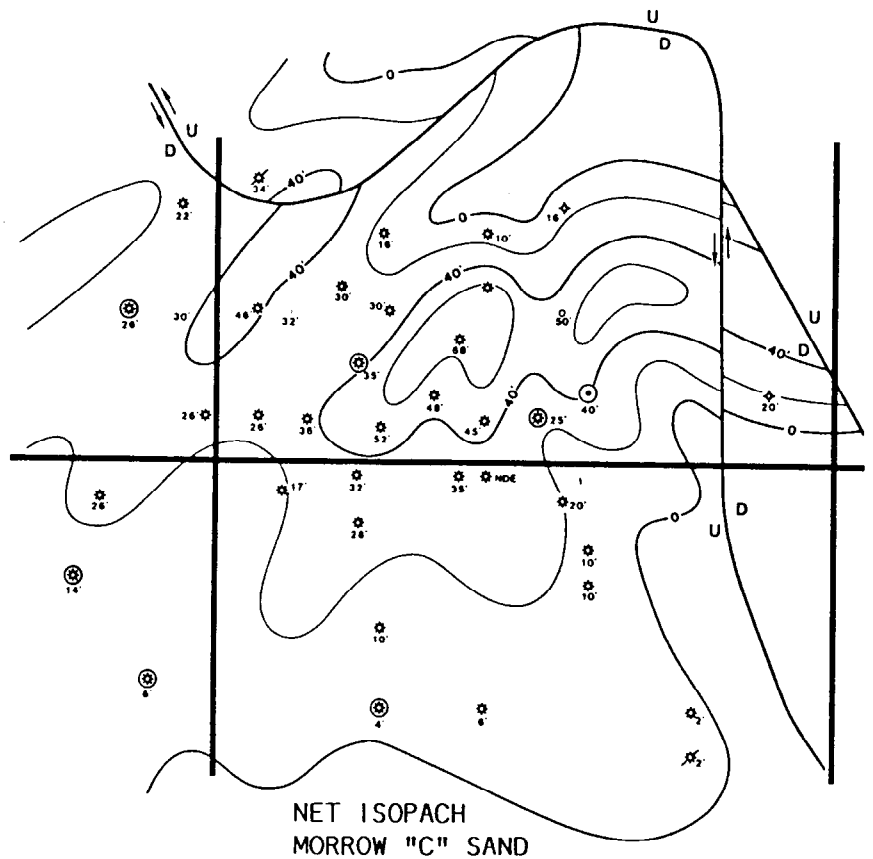


Figure 2(II)—Type log (Pitchfork Ranch Field)



STRUCTURE
TOP/MIDDLE MORROW SHALE
200' CONTOUR INTERVALS
GEOLOGY BY J.R. BROTEN

Figure 3(III)—Pitchfork Ranch Field
Lea County, New Mexico



NET ISOPACH
MORROW "C" SAND
POROSITY ≥ 6%
GAMMA RAY < 50 API UNITS
20' CONTOUR INTERVALS
GEOLOGY BY J.R. BROTEN

Figure 4(IV)—Pitchfork Ranch Field
Lea County, New Mexico

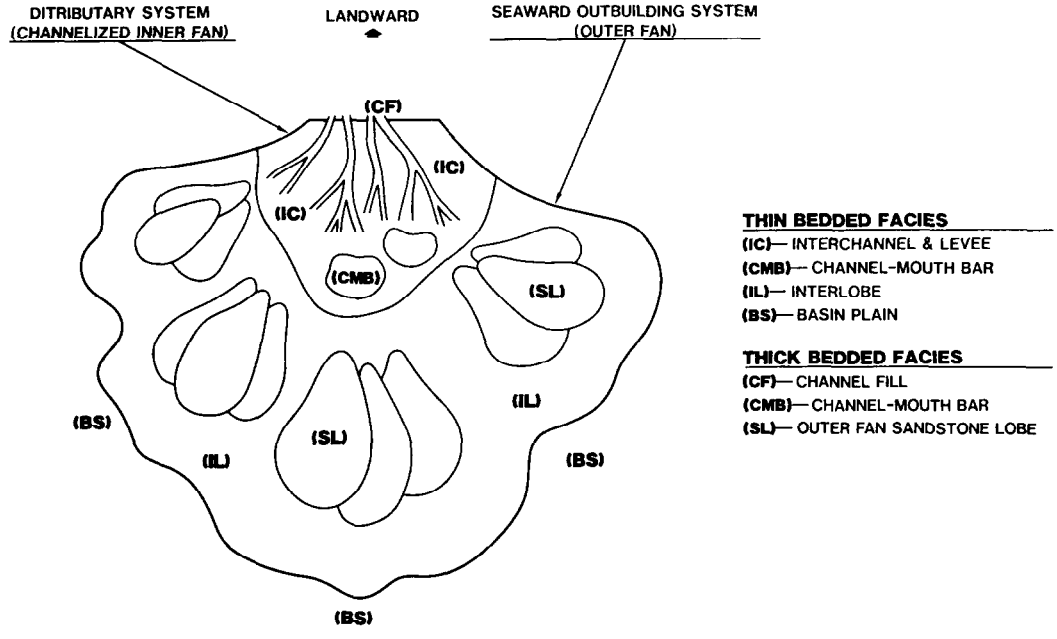


Figure 5(V)—Model of submarine fan system adapted to Pitchfork Ranch area (after Mutti, et al, 1975)

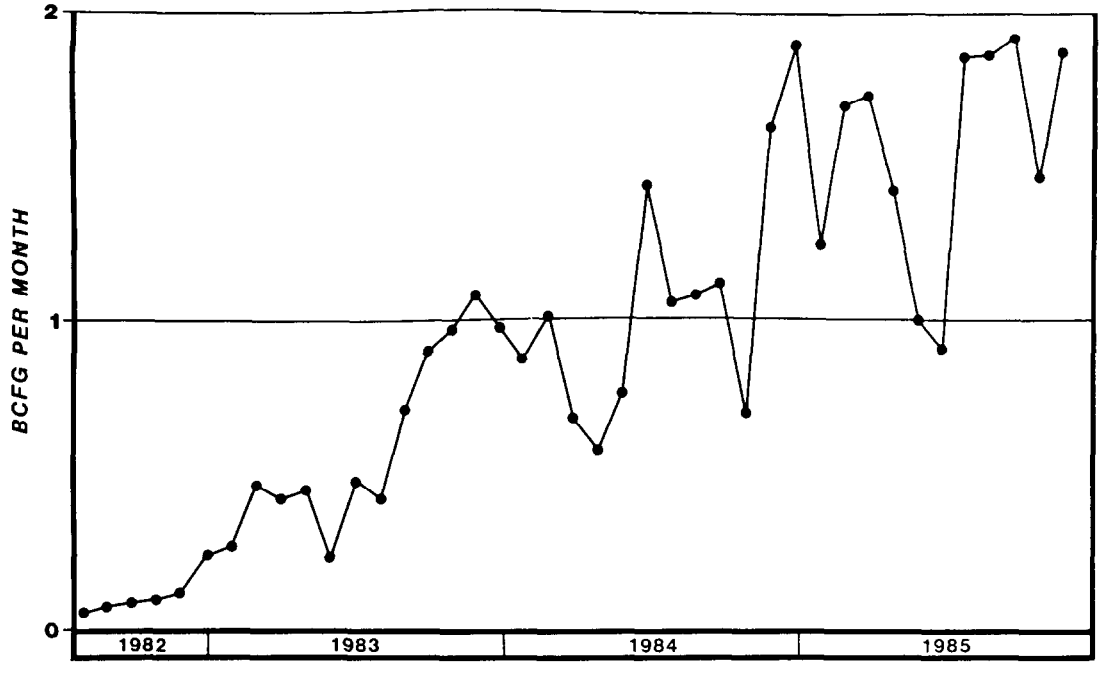


Figure 6(VI)—Monthly gas production (Pitchfork Ranch Field)

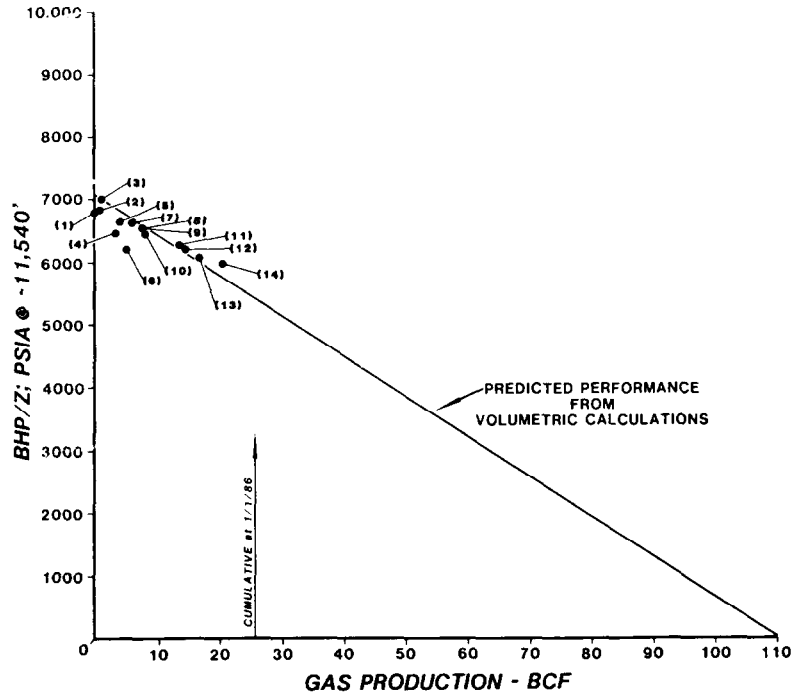


Figure 7(VII)—Initial pressures in development wells for Morrow "C" zone (Pitchfork Ranch Field)

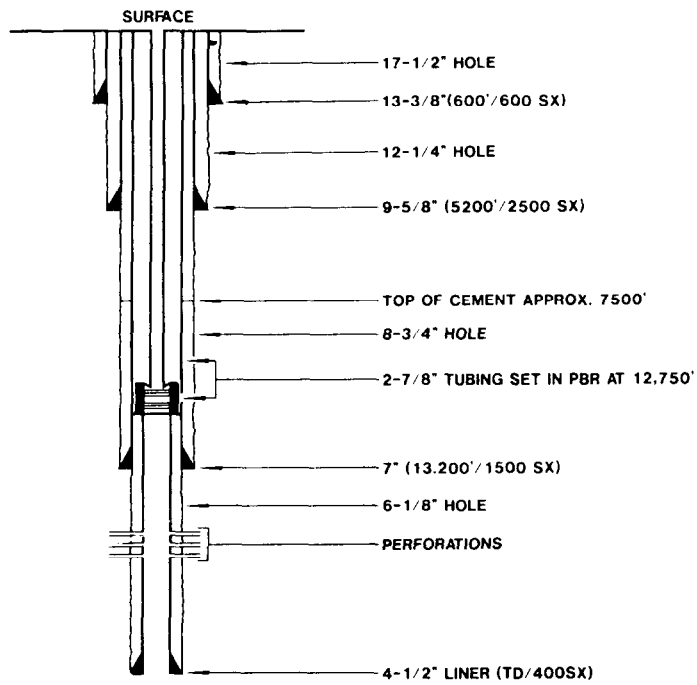


Figure 8(VIII)—Casing program (Pitchfork Ranch Field)