

# Producing Potential of Texas Oil Wells

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## ABSTRACT

The recent Middle East crisis provided an opportunity to observe the U. S. oil industry's ability to respond to a sharp buildup in crude oil demand. The industry was called on to quickly provide oil to replace that no longer available as a result of the Suez Canal blockage during and immediately after the 6-day Arab-Israeli war in June, 1967. This requirement for a rapid boost in production and domestic shipping came after nearly 10 years of heavy proration in Texas, Louisiana, and several of the adjoining states.

Texas prorated wells have been held to less than half of their assigned yardstick allowables or MER since the 1956-57 Suez Canal closure. Oil producers in Texas went through a 6-year period (1960-1965) in which the proration factor was constantly below 30 percent. The necessity for this extended period of heavy proration was beginning to raise questions and concern as to where restrictions and "bottle-necks" may have developed in the State's production and transportation system.

This paper summarizes the 10 years of history prior to the 1967 Middle East crisis and reviews crude oil production performance during the crisis months. An estimate of the crude oil producing capability at 100 percent proration is stated based on observations during the sharp allowable buildup period of 1967. Recent history and current developments give some insight into the future for the Texas oil business, and the author's opinions regarding the next two to eight years are discussed.

## INTRODUCTION

For some time, there has been a need for accurate information on the U.S. oil industry's ability to produce oil during an emergency. As economic and employment conditions stabilized after World War II, crude oil producing capacity in the world and in the U.S. increased rapidly. Market demand proration has been a way of life in Texas since 1948. Not since that year when crude oil production from the State averaged 2.46 million bbl daily have we had a true measure of producing capability.

The National Petroleum Council has taken an

active role in preparing producing capacity estimates. The first NPC report on productive capacity of crude oil was published in May 1961. Their most recent report, "Estimated Productive Capacity of Crude Oil, Natural Gas, and Natural Gas Liquids in the United States", was published in July, 1966. NPC figures represent wellhead capacities unrestricted by downstream lease equipment or gathering and transportation equipment. This work was subdivided geographically by Petroleum Administration for Defense Districts and estimates are not published for Texas. The Railroad Commission has periodically estimated the reserve producing capability of Texas by districts simply by extending its factor and applying increasing incapability corrections to the resulting figure, starting from known historical underproduction bases.

The API presently is gathering crude oil producing capability estimates and plans call for reporting this information in the 1967 "blue book" on reserves that will be published in the summer of 1968. The API capacity figures are designed to reflect U.S. crude oil capability after 90 days under maximum demand conditions. Unlike prior NPC projections, the API capacities will consider wellbore and lease facility restrictions.

The State has been divided into three major supply areas for the purpose of reflecting on the 1967 crisis period in Texas and of reviewing the producing potential of Texas oil wells and the

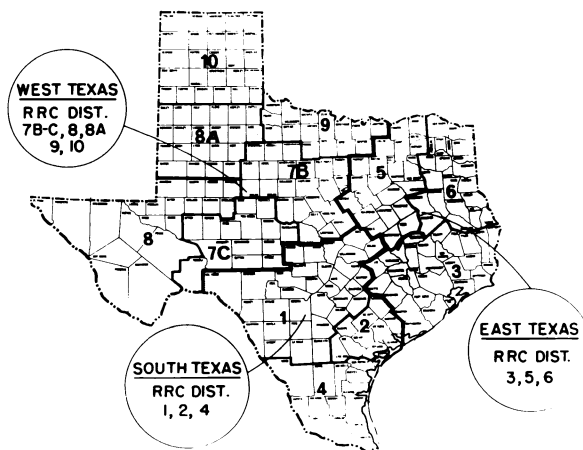


FIG. 1 — TEXAS OIL SUPPLY AREAS.

related factors that affect the producing capacity. Fig. 1 indicates the three areas selected — East Texas, South Texas, and West Texas. The East Texas area includes Railroad Commission Districts 3, 5, and 6, while South Texas encompasses Districts 1, 2, and 4. The larger West Texas area reflects Railroad Commission Districts 7-B, 7-C, 8, 8-A, 9, and 10.

### DRILLING AND ADDITIONAL RECOVERY ACTIVITIES

Fig. 2 shows that total yearly well completions in the State have declined from 21,350 in 1957 to 9,470 in 1967. This 56 percent decline during the period has been reflected throughout the State. West Texas has experienced the greatest decline with a 63 percent reduction, from 14,907 in 1957 to 5,563 in 1967. It is only natural that the number of active rotary rigs in the State has followed the trend, dropping from an average of 915 in 1957 to an average of 340 in 1967.

Despite the steady reduction in drilling, the average number of producing completions increased steadily until 1962-64. After peaking at 194,427 wells in 1964, the active completion count has since declined by about 4,500. On a more encouraging note, secondary recovery and pressure maintenance activities have shown a big increase over the past 10 to 12 years. Fig. 3 shows this growth in projects.

Initiation of new projects has increased from some 130 yearly in the 1956-58 period to approximately 450 each year in 1964-66. Data are not compiled for 1966 and 1967; however, based on the requests handled in Austin during this period, the total should at least equal the prior two years. Water injection continues to be the predominant additional recovery method, constituting some 75 percent of the new projects currently. Thermal recovery activities have increased in the State recently, and based on an *Oil and Gas Journal* article last year, 35 fire-flood or steam-flood projects had been initiated by late 1967.

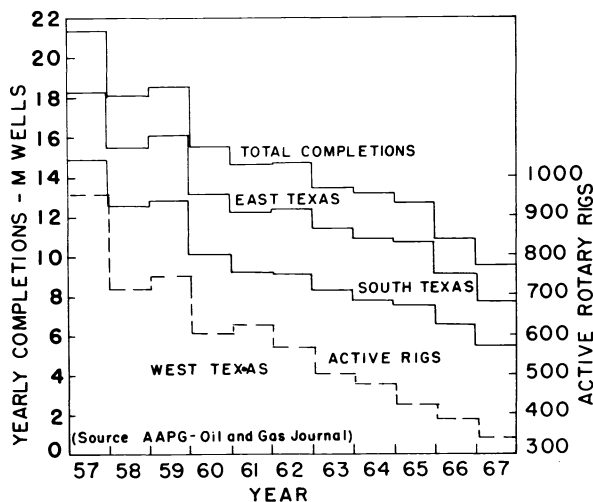


FIG. 2 — TOTAL YEARLY WELL COMPLETIONS IN TEXAS.

Most of the additional recovery activities are associated with the West Texas and South Texas supply areas. Many East Texas area fields are fortunate to have natural water-drive mechanisms, thus reducing the number of projects in this supply area. Some 80 percent of the additional recovery projects are located in the West Texas area and these are principally waterfloods. In South Texas, gas injection nearly equals the water injection programs.

In a 1965 publication, the U.S. Department of the Interior published data indicating that 34 percent of the 1963 crude oil production from Texas was attributable to secondary recovery. This compared with 25 percent in 1957. Based on current trends, additional recovery operations will become increasingly important and by 1980 additional recovery is projected to supply nearly half of the Texas crude.

Despite the buildup in additional recovery projects, the big decline in drilling activities has resulted in a net decline in Texas crude oil reserves of 706 million bbl over the last 10 years. This 5 percent reduction over the period is based on API reserve statistics as of year-end 1966. Reserve additions as compared with crude oil production data for the three supply areas are detailed on Table 1. East Texas and South Texas have accrued net losses of 743 and 365 million bbl respectively,

TABLE 1 — TEXAS CRUDE OIL RESERVE ADDITIONS AND PRODUCTION (MILLIONS OF BARRELS)

YEAR	EAST TEXAS RESERVE		SOUTH TEXAS RESERVE		WEST TEXAS RESERVE		STATE TOTAL RESERVE	
	ADDS.	PROD.	ADDS.	PROD.	ADDS.	PROD.	ADDS.	PROD.
1957	132.6	280.2	105.0	148.1	592.4	629.7	830.0	1058.0
1958	222.9	229.3	79.7	122.0	374.5	558.6	677.1	909.9
1959	179.8	230.3	60.2	123.1	1241.9	591.0	1481.9	944.4
1960	106.2	211.5	28.8	116.9	655.9	563.7	790.9	892.1
1961	204.4	212.9	401.0	118.9	380.5	562.9	985.9	894.7
1962	138.2	213.4	47.2	121.7	507.4	558.9	692.8	894.0
1963	120.3	218.2	43.9	129.5	676.1	567.7	840.3	915.4
1964	99.9	216.4	40.7	133.8	514.7	578.4	655.3	928.6
1965	102.5	210.4	58.1	135.4	775.5	587.0	936.1	932.8
1966	203.2	230.1	68.5	148.4	499.0	618.1	770.7	996.6
Est. 1967		255.7		166.0		651.7		1073.4
'66 Totals	1510.0	2252.7	933.1	1297.8	6217.9	5816.0	8661.0	9366.5
Decrease in reserves over last 10 yrs.	742.7		364.7		+401.9		705.5	

Source: API Reserves as of 12-31-66

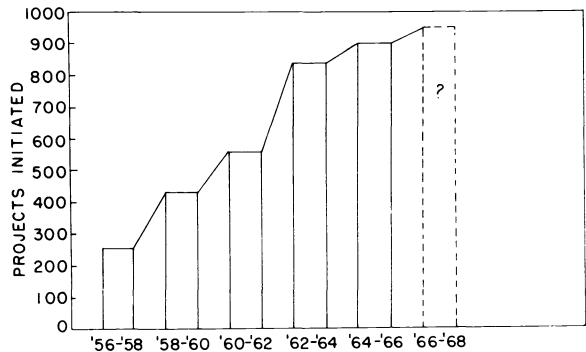


FIG. 3 — TEXAS SECONDARY RECOVERY AND PRESSURE MAINTENANCE. PROJECTS INITIATED DURING 2-YEAR PERIOD.

while West Texas has shown a net gain of 402 million bbl. We must recognize that this net loss in reserves came during a period of limited demand for Texas oil. A continued environment of declining reserve additions, coupled with the current and expected future trend of increasing production would result in rapid reduction in the State's oil reserve life. Crude oil production averaged 2.94 million bbl daily in 1967, resulting in a reserve-to-production ratio of 13:1.

### PRORATION AND ALLOWABLE TRENDS

Fig. 4 summarizes the monthly proration factor history for Texas over the last 11 years. This period begins with the waning months of the earlier Suez crisis. After the Suez Canal was reopened in early 1957, the Texas factor steadily dropped from 18 days (58.1 percent) to 8 days (25.8 percent) over a 15-month period. Prior to that, Aug., 1939, and April, 1942 (when the factor was 12 days or 39 percent), were the only two months in which the Texas proration factor dropped substantially below 50 percent. After a brief rally in 1958-59, demand for Texas crude went into the 6-year drought period due to the moderate growth in crude oil demand coupled with large increases in U.S. and worldwide crude oil producing capacity. Note the steady growth

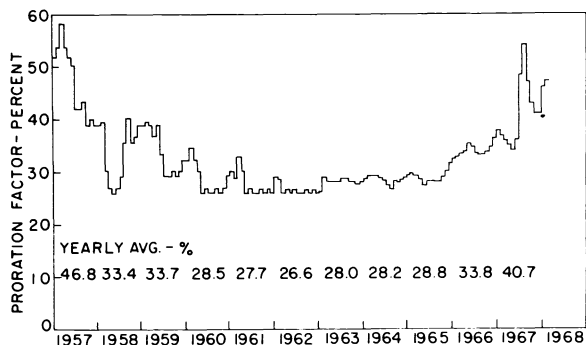


FIG. 4 — TEXAS MARKET DEMAND PRORATION FACTOR.

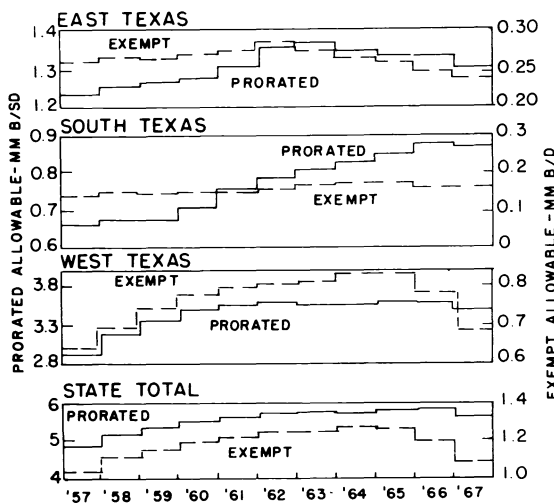


FIG. 5 — TRENDS IN TEXAS PRORATED AND EXEMPT ALLOWABLE.

in proration factors starting in 1966 and continuing to the 1967 crisis.

Prorated and exempt allowables generally were increasing throughout the State in the late 1950's and early 1960's. East Texas allowable growth peaked in 1962-63. (Fig. 5); since that time both exempt and prorated allowables have shown a slight, steady decline. Allowables in West Texas and South Texas grew significantly in the early years shown. West Texas growth resulted principally from drilling; however, additional recovery has become increasingly important, particularly in the last five years. South Texas, which has grown steadily for the last ten years, increased as a result of drilling and additional recovery. Allowables in West Texas have shown a downward trend in recent years due to the big reduction in development well drilling.

### TEXAS OIL INDUSTRY PERFORMANCE DURING 1967 MIDDLE EAST CRISIS

The necessity for heavy proration in the late 1950's and early 1960's placed a premium on efficient lease operations and minimized expenditures for lease equipment such as the sizing of artificial lift facilities, separator capacity, water and gas handling capacity. Also, adequate pipeline facilities and tank load capacity have been questioned.

The recent crisis permitted a glance at the status of the producing and transportation equipment, and while this was a brief glance, some things were learned. Similarly, the Texas industry was able to observe well performance at mid-1950 proration levels.

During the 1967 Middle East crisis period, the allowable in the State jumped from 35 percent to 54 percent in a matter of two months. Fig. 6 tabulates the increase in crude oil production for the three supply areas as a result of the 19 percent increase in proration. West Texas experienced the largest volumetric increase, some 261,000 bbl daily; however, this was only 40 percent of the schedule day allowable increase. East Texas and South Texas production was increased by 196,000 and 121,000

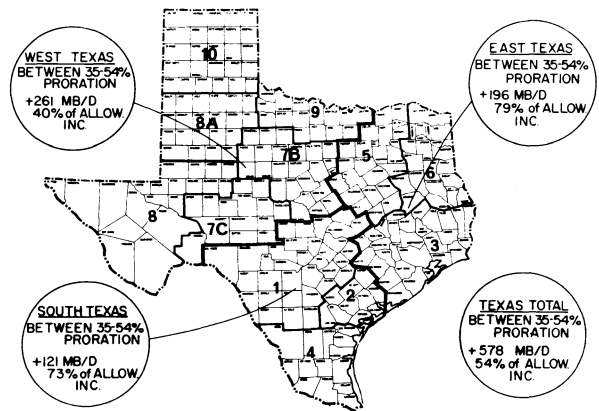


FIG. 6 — PRODUCTIVITY RESPONSE DURING 1967 MIDDLE EAST CRISIS (BETWEEN 35 AND 54 PERCENT PRORATION).

TABLE 2 — TEXAS GROWTH IN CRUDE OIL PRODUCING CAPABILITY (CRISIS TO CRISIS)

PERIOD	PRORATION FACTORS	CRUDE OIL PRODUCTION, M B/D			
		EAST TEXAS	SOUTH TEXAS	WEST TEXAS	STATE TOTAL
Aug. '67	54.0	836.7	539.0	1955.2	3330.9
Feb.-April '57	53.5	840.9	446.4	1845.3	3132.6
Growth in producibility at 54 %		-4.2	92.5	109.9	198.2
% Increase in capability		-0.5	20.7	6.0	6.3

B/D, respectively. In these two areas, the response was over 70 percent of scheduled allowable. The State as a whole increased 578,000 B/D in the 2-month period.

Despite a decline in crude oil reserves and drilling over the past 10 to 11 years, industry's producing capability is higher today at 54 percent proration. As may be seen on Table 2, the State's production in Aug., 1967, was 3,331,000 B/D compared with an earlier crisis period in Feb. and April, 1957, of 3,133,000 B/D at essentially the same factor. West Texas and South Texas both have shown an increase of about 100,000 B/D while East Texas is about the same.

According to available published records, during the June to Dec., 1967, crisis period, some 26 million bbl were shipped from Texas ports to the East Coast and to Europe. Some 11 million bbl of this was exported to Europe with the remaining 15 million bbl going to the East Coast refineries to replace foreign imports. Fig. 7 subdivides these shipments among the four principal port areas in Texas.

The exports data came from U.S. Customs records and are accurate. It appears that the Texas oil movements to the East Coast are understated by 10 to 14 million bbl since we know unused import tickets would require this much more Texas oil. It is apparent that not all movements during this period were reported to the information services by the operators.

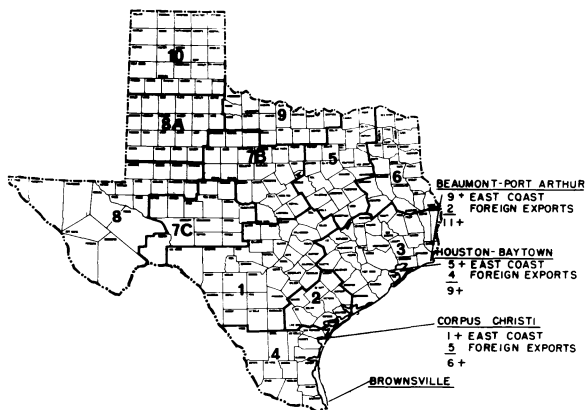


FIG. 7 — TEXAS CRUDE EXPORTS DURING 1967 CRISIS (MILLIONS OF BARRELS).

## TEXAS CRUDE OIL PRODUCING CAPABILITY

Performance during the crisis indicated there was still capacity left in the State with existing facilities or after some minor additions to pipeline pump capacity. This spare capacity was principally in East Texas and South Texas.

The Texas crude oil production of 3,331,000 B/D in August represented a 30,000 B/D buildup for each point of increase between 35 and 54 percent proration factor. Response in production proved to be 158,000 B/D or 26,000 B/D per point of increase between the 48 percent in July and the 54 percent in August. Using the August production as a base and assuming that responsive production from 54 to 100 percent would average 18,000 B/D for each proration factor percentage point, the average initial capacity of Texas wells at 100 percent proration would be 4.2 million bbl daily (Fig. 8). Use of the 26,000 B/D per point demonstrated at the 50 percent proration level would increase the initial daily capacity estimate to 4.5 million bbl, however, significant facility limitations and well incapability are anticipated above 54 percent.

After a sufficient period under sustained high demand, most facility restrictions would be removed. Also, some incapable wells would be stimulated or reworked, further increasing well productivity. It is estimated that daily average production from the State could be raised to 4.6 to 4.7 million bbl after six months of top allowable production.

During 1948, the last year in which the State produced at capacity and a true measure of potential was available, crude oil production averaged 2,454,000 bbl daily.

### IDEAS ON THE FUTURE

The immediate future for the Texas crude oil producing industry is somewhat turbulent. Import levels east of the Rockies are still averaging 150,000 to 200,000 B/D below normal. This abnormal short-term demand coupled with the domestic demand growth — estimated at 3.0 to 3.5 percent this year — recently has created unusually high demand for

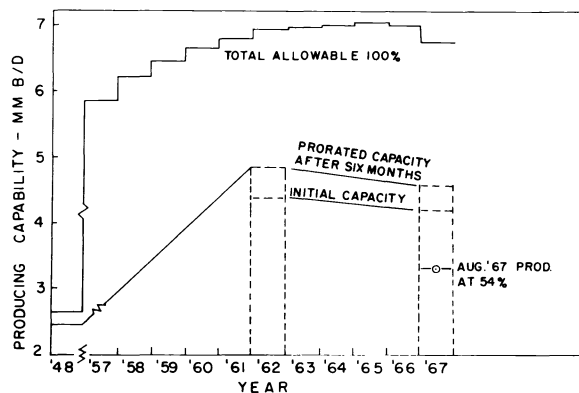
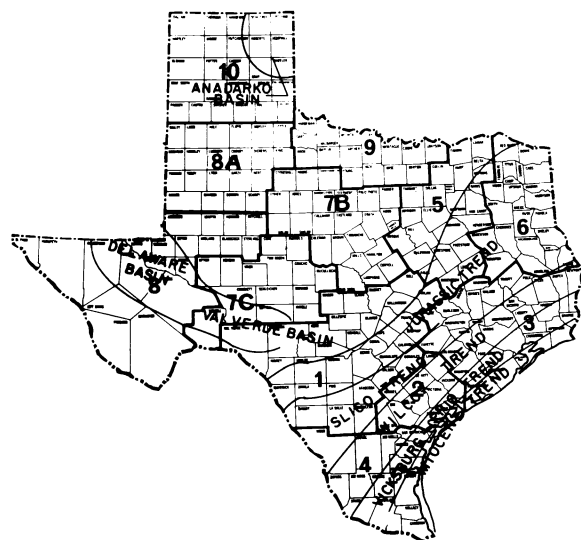


FIG. 8 — TEXAS CRUDE OIL PRODUCING CAPABILITY AT 100 PERCENT PRORATION.

FIG. 9 — MAJOR DRILLING ACTIVITY AREAS, 1968-1969.



Texas crude. Once crude oil tanker availability returns to normal, imports are expected to increase markedly due to the unused 1967 quota and the delayed 1968 imports. These uncertainties make the 1968-69 period difficult to anticipate; however, it is conceivable that the proration factors in Texas will return to the mid-30 percent range later in 1968 and remain there until imports are balanced.

It is expected that drilling activities in Texas for the next few years will continue the exploration and development of the deep West Texas basins and Gulf Coast trends (Fig. 9). Again, a slight drop is expected in well completions. A major Texas offshore lease sale is due in 1968 and this should spur offshore activities. Additional recovery implementation should continue at the current level of approximately 450 to 500 projects yearly.

The direction of the longer-term trend is somewhat more apparent than that for the next few years. Numerous intermediate and long-range estimates of domestic demand have been stated or published by oil executives, Federal agencies, and industry associations; and each of these indicates a rapid growth in oil demand, both domestically and worldwide. An east-of-the-Rockies crude oil and condensate demand growth rate of 2.5 percent yearly over the 8-year period between 1967 and 1975 is predicted, and this should result in an average yearly increase in Texas proration factor of 4 to 5 percent after the current instability is corrected. Such an environment will require the complete cooperation of the Railroad Commission and industry to prevent unnecessary waste of hydrocarbons or reservoir energy.

## CONCLUSIONS

After a review of recent Texas oil industry history, a reflection on the 1967 crisis, and a consideration of the years ahead, the following conclusions are reached.

1. A concerted effort must be made to find and develop new crude oil reserves if the State is to continue as the leading supplier of domestic oil.

2. New technology is needed to exploit the unrecoverable oil in presently discovered reservoirs. This includes additional recovery technology and new or improved stimulation techniques.

3. The Middle East crisis experience in 1967 indicates Texas crude oil producing capacity is approximately 4.2 million B/D initially, and the capability could be increased to 4.6 million after six months of sustained high demand.

4. A significant decline in demand for Texas crude is expected later in 1968 after more tankers become available for U.S. service and the imports increase.

5. Operators must be attentive to oil, water and gas handling capabilities in the future due to rapidly increasing demand in the 1969-75 period.

The Railroad Commission stands ready to assist the oil industry in every way possible in its search for reserves to supply future demand. The RRC is aware of the tremendous task facing the industry, and we will do everything within our authorities of preventing waste and protecting correlative rights to assist in this effort. We recognize the need to encourage exploration, efficient development and production practices, and the advancement of technology in all phases of operations.

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