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Gas Availability from Casinghead Systems

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ABSTRACT

The Hugoton Anadarko Area has seen the growth of several large casinghead systems during the past few years. Since pipe line companies historically look for the long term sources of supply, analyses of various casinghead gas gathering systems have been made. Gas supply from these systems can most generally be depended upon for long periods of time. The system should be located in a developing gas and oil area and should be available early in the development life.

The casinghead reserves per well can be expected to be small and, in order to maintain a break-even position, 20 - 25% new wells must be connected each year. In the successful operation of a casinghead system, the company must be aggressive. The drilling slump has not appreciably effected those systems whose managements are active.

The Hugoton Anadarko Area has 2.5 Tcf [1] of proved remaining recoverable casinghead gas reserves at January 1, 1970.

References and illustrations at end of paper.

INTRODUCTION

The Hugoton Anadarko Area is located on the map shown on Page 5. The proved remaining recoverable natural gas reserves for the total Hugoton Anadarko Area has been steadily declining since 1959 at an average rate of 1.25 Tcf/year, see Fig. 14. However, during this time the casinghead gas reserves continued to increase, peaking in 1965 at a remaining recoverable reserve of 3.6 Tcf of gas. When this trend was noticed in the early 1960's, an evaluation was set in motion to determine some of the more desirable characteristics of a casinghead gas gathering system and if they could be depended upon for long term supplies of gas.

In analyzing this question, two large problems are encountered immediately. The first problem is that all of the casinghead systems are very complex. The second problem encountered is that very little information concerning these systems is available for analysis.

PARAMETERS OF CASINGHEAD SYSTEMS

While gas availability from the individual casinghead well depends on its reservoir properties, some generalizations can be made. In general, the oil potential of a well declines because of depletion of pressure and changes in the saturations in reservoirs. These same factors cause the gas-oil ratio to increase as oil potential decreases early in the life of a well. Later the rate of increase of the gas-oil ratio slows until near the end the gas-oil ratio actually declines. The product of the rate of gas-oil ratio increase and the oil potential decline at any time determines whether the gas availability is increasing or remaining constant or declining. Two factors can influence this ideal picture. Proration can cause the well to produce at rates less than the potential. (So if the potential is greater than the allowable and the allowable is relatively constant, an increase in gas availability is calculated.) The second factor is the presence of a gas cap. This factor can cause a greater gas-oil ratio any time a well bore penetrates a gas-oil contact. The relation between oil potential, allowable, and total effect of gas-oil ratio increase determines how long an increasing gas availability can be expected from any individual well.

Development of these individual wells usually comes in groups. Groups usually correspond with discoveries of different reservoirs within a given area. To offset this cyclic-type development, casinghead operators like to have a few gas wells connected to their system to help level out the peaks. They would rather not have a large percentage of their gas supply in gas wells because of the low liquid content of this gas. Presence of a few of these gas wells keeps the load factor high and makes their operations much more efficient.

It is generally accepted that just the presence of these casinghead gathering systems enhances the possibilities of the development of an area because an oil producer has a source of revenue in addition to simply oil sales. With this added revenue, a company can then afford to drill wells that would be marginal or uneconomical if they were drilled for oil only.

One of the first criterions for successful casinghead operation is for it to be geographically located in a developing gas and oil producing province. This gas is primarily short term gas and new oil and gas wells must be drilled over a period of years for the plant to have any sort of extended gas supply.

One of the most desirable features of a casinghead gathering system is flexibility of equipment. This is accomplished primarily through using portable compressors which can be moved from place to place as gas is available. The second method of obtaining gathering flexibility is by having all segments looped so that gas can go any one of several directions depending upon which segment is loaded at any particular time. Plastic pipe is used extensively for the low pressure gathering lines. It has the advantages of low cost and speed of installation.

One of the most important requirements for a successful casinghead gas operation is an aggressive management. Decisions to gather gas from any particular area must be made early in the producing life of that area. Over and over again the same statement is made by operators, "If you wait until an area is fully developed, you're too late." In areas where plants are owned by several operators, this quickness of decision is sometimes difficult, if not impossible, to achieve. These plants have a better chance eventually to starve for gas supplies, all other things being equal. The plant that has an individual or single company operating it has a better chance for success than a joint operation.

REVIEW OF SEVERAL CASINGHEAD SYSTEMS

The qualitative parameters previously discussed have varying effects on actual production of a casinghead system. To investigate these effects, it was decided to study several older plants from different areas. These plants were to have sufficient production history to give some idea of long term operations.

The Texas Railroad Commission requires all plant operators in the State of Texas to file a monthly GP-1 report which reflects several of the items that are needed for a study of this type. The items reported that have application in a study of this type are number of gas wells, number of oil wells, gas production from both oil and gas wells, systems capacity, and disposition of the products. Several plants were chosen throughout the State of Texas and each one was studied as completely as possible from data which was published. Several factors were considered in selecting these plants. Plants were selected because they had a predominance of casinghead wells as opposed to gas wells. Individual plants had to come from a variety of areas over the State of Texas. Size was not considered and plants of all sizes were used.

The first casinghead system to be analyzed is shown in Fig. 1. This is a very old plant and it has been producing since the late 1930's. The plant has been producing at very near capacity and, in all probability, more gas is available from the wells connected than what the plant can process. This conclusion is made by comparing the number of wells connected versus the volumes of gas processed each year. A large drop-off in well connections, as shown in 1958, does not necessarily correspond to a large volume decline in that same year. You will note in late 1965 the system's capacity was increased with a resulting increase in processed volumes. However, the recorded number of wells connected to this system is somewhat constant from 1965 forward. The important thing to note from this plant is the consistency with which it has delivered volumes over several years.

The second casinghead system is shown in Fig. 2. This plant presents an anomaly during the period of 1955 through 1958. This is the only case studied that showed a general increase in gas production while well count remained constant. This could be caused by the plant running at near capacity. You will note that after volumes did peak in 1962, a decline did set in and even with the steady addition of wells during 1963 forward, this trend has not been reversed.

The plant shown in Fig. 3 first started production in early 1956. Production from the first group of wells peaked early, then started to decline. Secondary development picked up during 1960 and increased production came after a short time lag. The wide fluctuations in well count indicate discrepancies in the way data was reported. There was a general increase in the well count from 1963 through 1965. This system again points out that volumes of gas from casinghead systems can be depended upon for a long term source of supply.

In Fig. 4, this plant shows the effect of heating season demand in the years of 1950 through 1960. The wells evidently were operated at potential during the winter months and were cut back near plant capacity during the summer. The high cycles are so much above plant capacity that a portion was probably being by-passed. Note that when production declined to below capacity in 1962, all cyclic behavior stopped. Addition of a few wells in late 1964 halted the decline. The data ends with a slight increased trend over the last few years.

In Fig. 5, 6, and 7, the effect of well connections stands out. Fig. 5 shows increasing volumes with increasing number of wells connected. Fig. 6 shows a peaking effect on a near constant number of wells connected with a decline setting in in late 1962. Fig. 7 reflects a system that peaked out in the middle 1950's, declined in both wells connected and volumes until the middle of 1960. Apparently drilling activity was rejuvenated in this area and the increased number of wells showed a corresponding increase in the volumes of gas available.

In Fig. 5, the production rate over the period 1951-1954 is extremely flat. This is probably a characteristic of the reservoir that contained the first 60 wells. Increase in production is again correlated to the addition of wells during 1955, 1956, and 1957. A large portion of the production increase in 1959 is due to the addition of about 50 gas wells that are contained in the total addition of nearly 200 wells. Again note the immediate decline as plateaus are reached in well count in 1958, 1960, and 1964.

The plant depicted in Fig. 6 shows a sustained development over a 13-year period. This is shown by the well count curve which reflects both increases and decreases. The decreases could be caused by either unitization or plugging of wells. The development is correlated to the gas production curve which shows a general increasing trend. This general trend ceased in late 1962 when additions of wells stopped. The decline that followed was broken only temporarily by small additions in 1964. The decline was stopped in 1966 by the addition of several new wells, some of which are gas wells. This was enough to reverse the decline trend through 1966 and 1967. It is interesting to note that production exceeded capacity all during the period of 1954 through 1964. It is possible that some gas was by-passing the plant during this period. It doesn't seem likely that the reported figures are wrong as the rate of capacity was changed in 1964, but still not up to the production rate.

Fig. 7 is a classic example of what can be expected from a system that is allowed to stagnate with no new wells added. We see quite a rapid peak as well additions increase in 1954, 1955, and 1956. Then there is an extended period of decline for about ten years. The significant thing to note is that well connections ceased during this period. Finally, during 1966 and 1967, development was again started as shown by the increase in well connections. Accompanying the increase in well count was an increase in gas production.

In Fig. 8 we see the example of a company who is not actively adding wells to their system, which in late 1964 or early 1965 sold their interest to a more active management, and they immediately took steps to improve the operations. They disconnected a group of dead wells and through more efficient operations increased production slightly. The most salient feature is caused by the addition of about 20 gas wells in 1965. This gave a corresponding increase of about 50 million per day in production rate.

Now turning to some examples of casinghead systems in the Hugoton Anadarko Basin Area, we will refer to Fig. 9. Wells in this system have continually increased since its inception in 1964 up to the present time. The system horsepower has increased and each year the forecast of future volumes from this plant has surpassed prior forecasts. This has been an excellent system, it has a very active management, and volumes of gas from this system can be depended upon for several years in the future.

Fig. 10 is a small system. Again, the increase in wells shows a corresponding increase in actual production.

Fig. 11 is another of the small casinghead systems and shows essentially the same trends as Fig. 10.

Another of the large systems is depicted in Fig. 12. The number of connected wells continues to increase and each forecast surpasses the prior forecast.

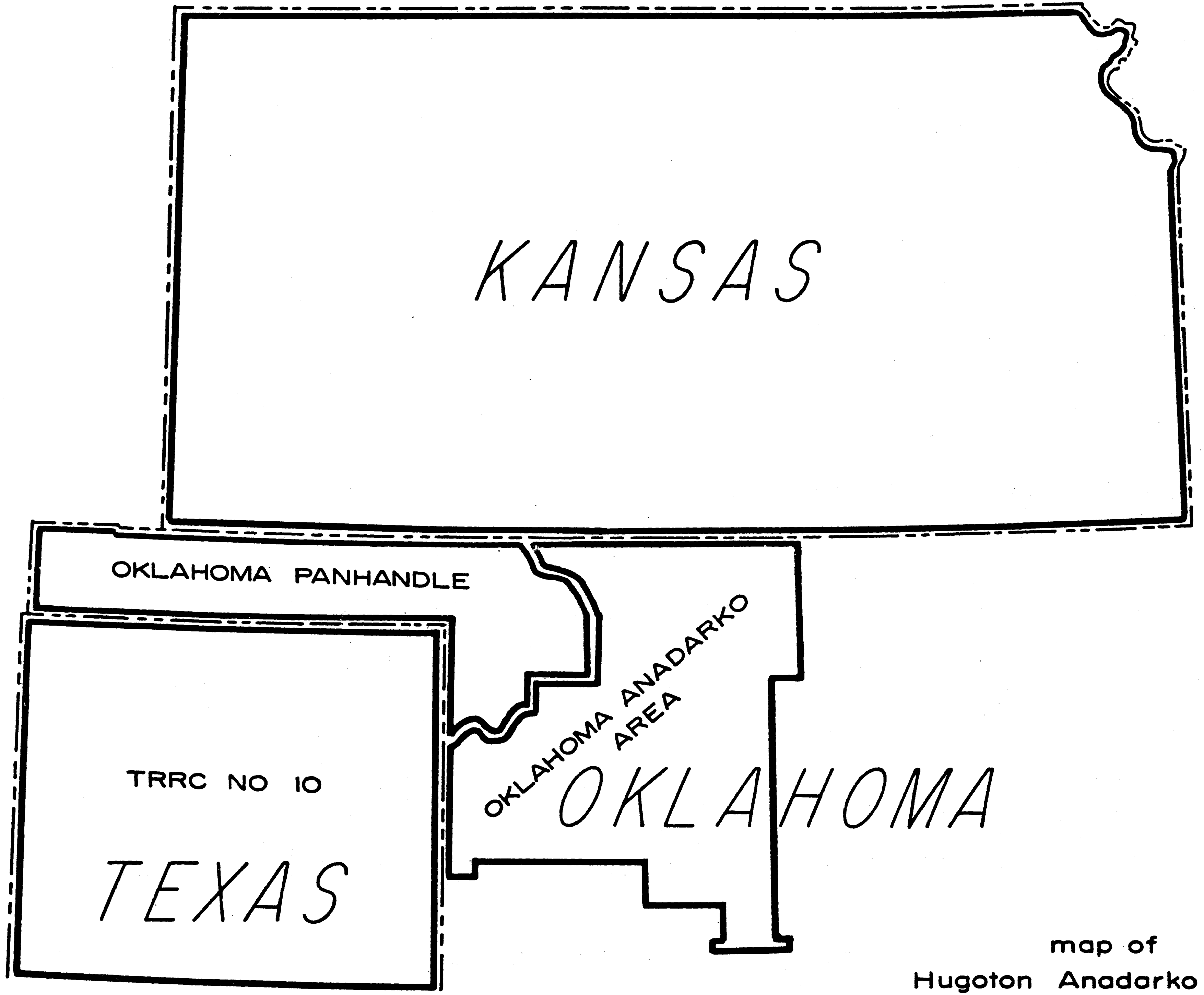
In Fig. 13 this system depicts a declining delivery volume, which again is immediately correlated to the number of wells that is being added. This system is having difficulty in adding wells each year. As a result, the actual production is declining.

CONCLUSIONS

Casinghead systems can be depended upon for long term supplies of natural gas provided that they are located early in the life of an oil and gas producing area. It is better if each system is owned or operated by a single company. The management must be aggressive and must be willing to expand the system on an annual basis.

REFERENCES

1. American Gas Association - Committee Report on Natural Gas Reserves @ 12/31/69.



map of
Hugoton Anadarko Area

VARIOUS CASINGHEAD SYSTEMS

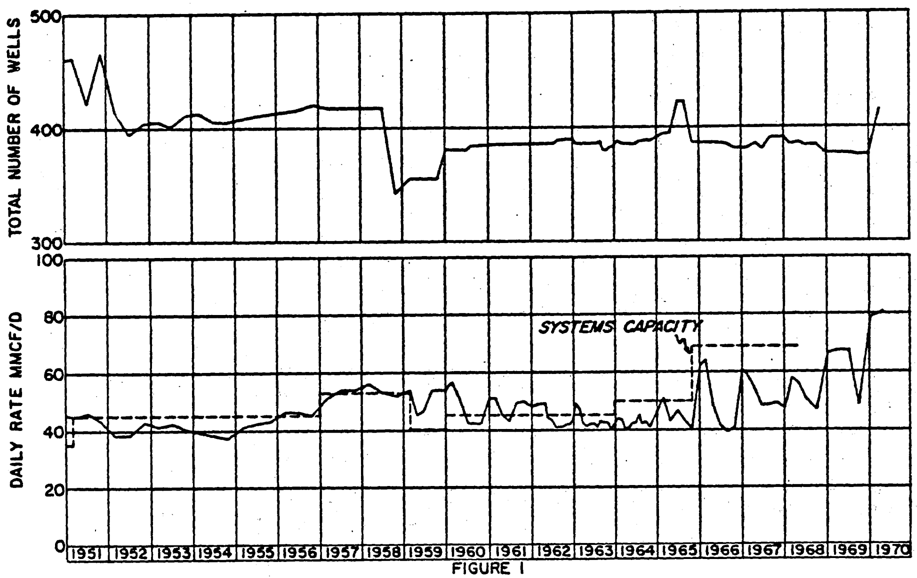


FIGURE 1

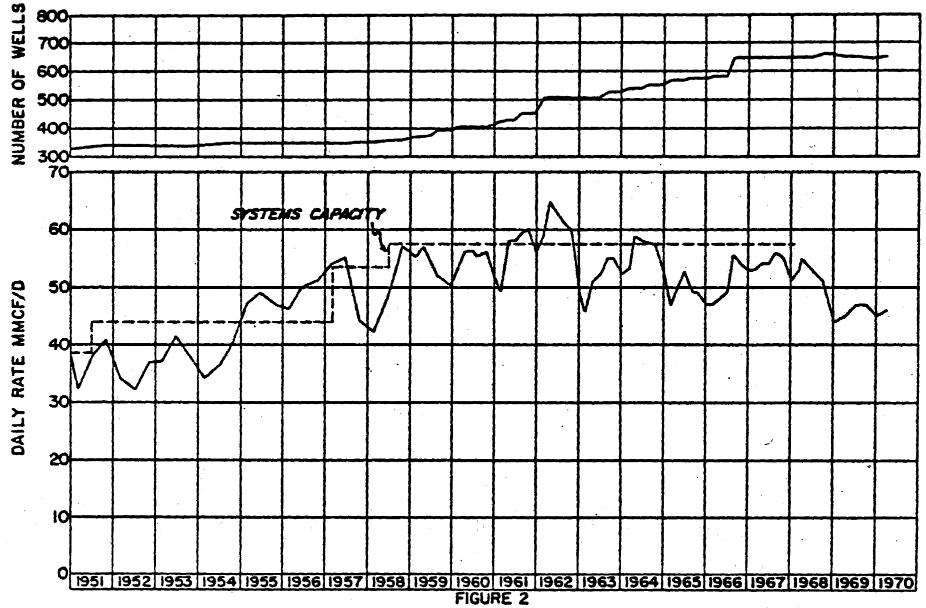
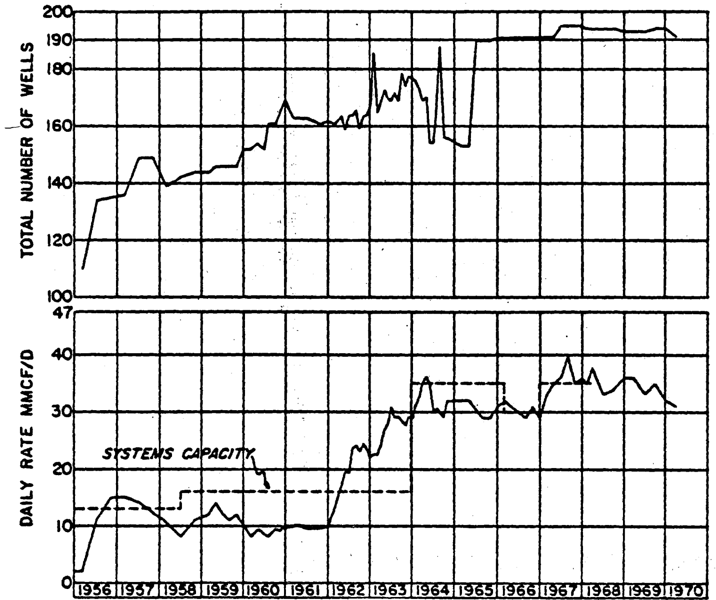


FIGURE 2



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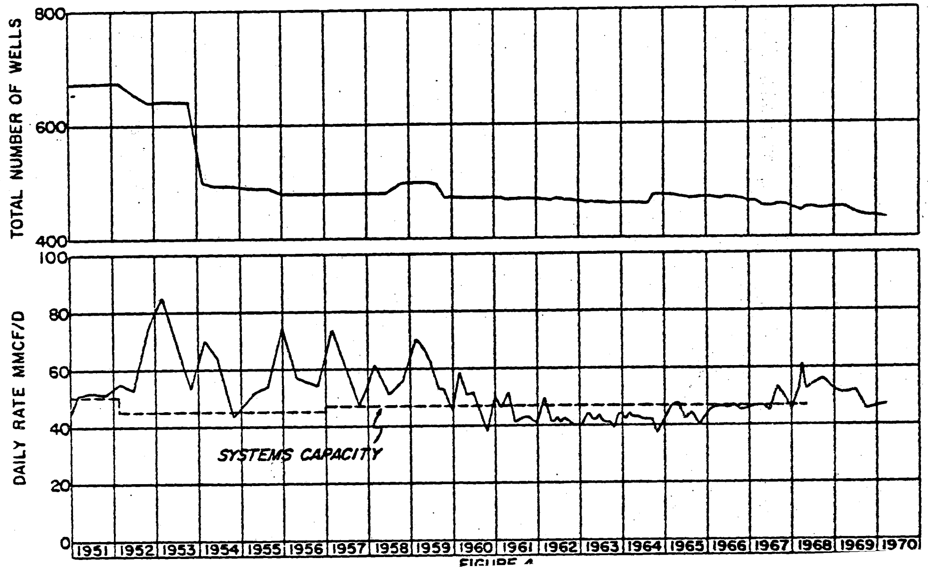


FIGURE 4

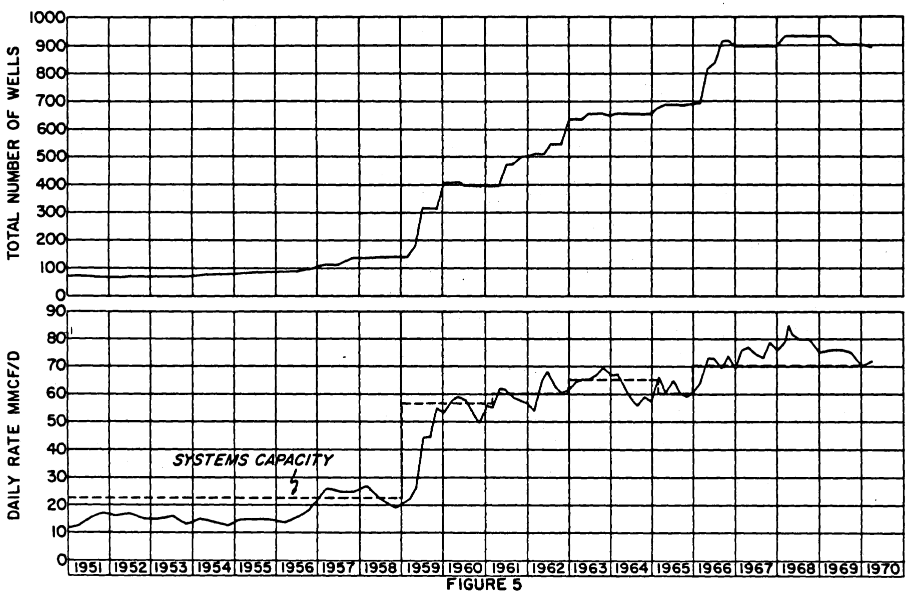
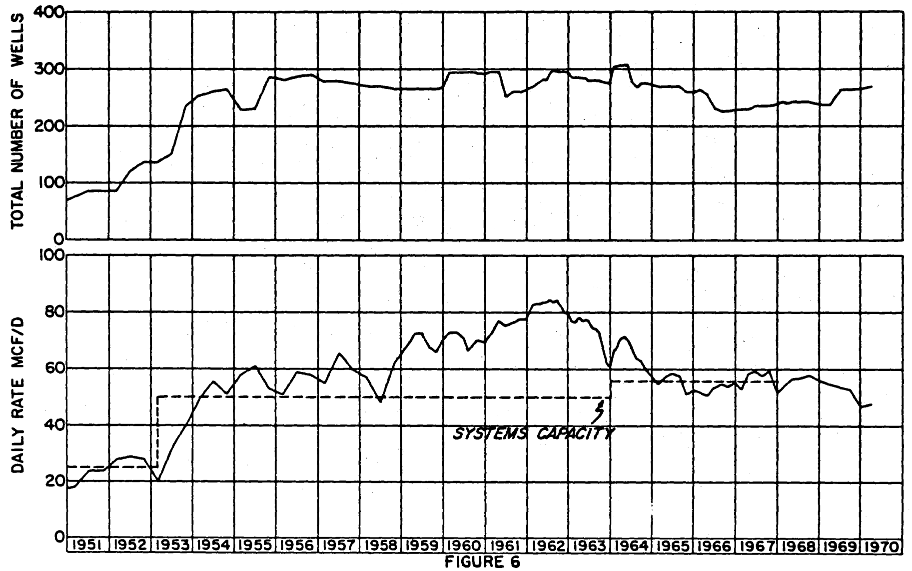


FIGURE 5



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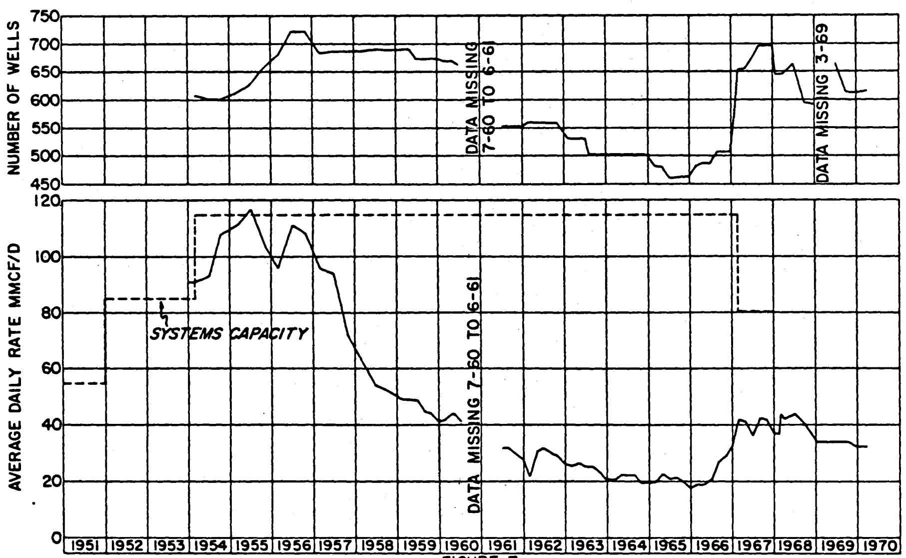

FIGURE 7

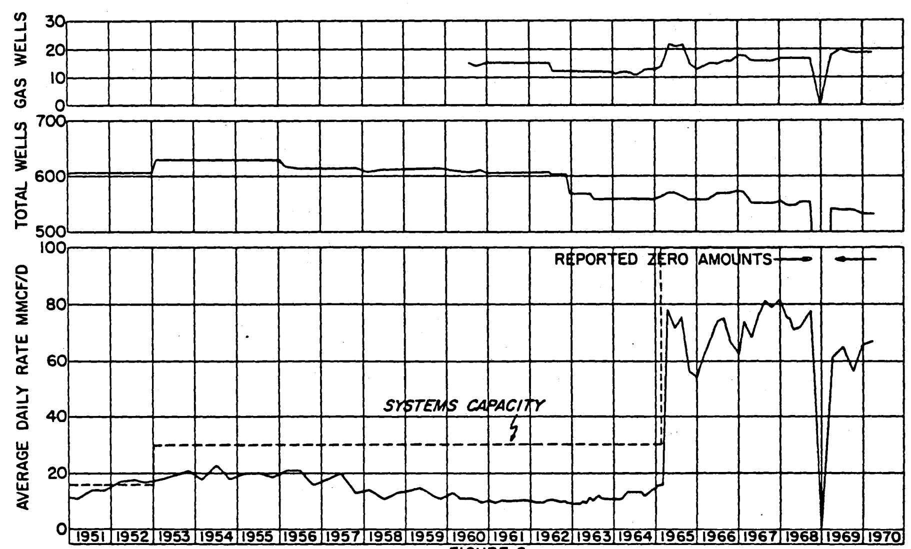

FIGURE 8

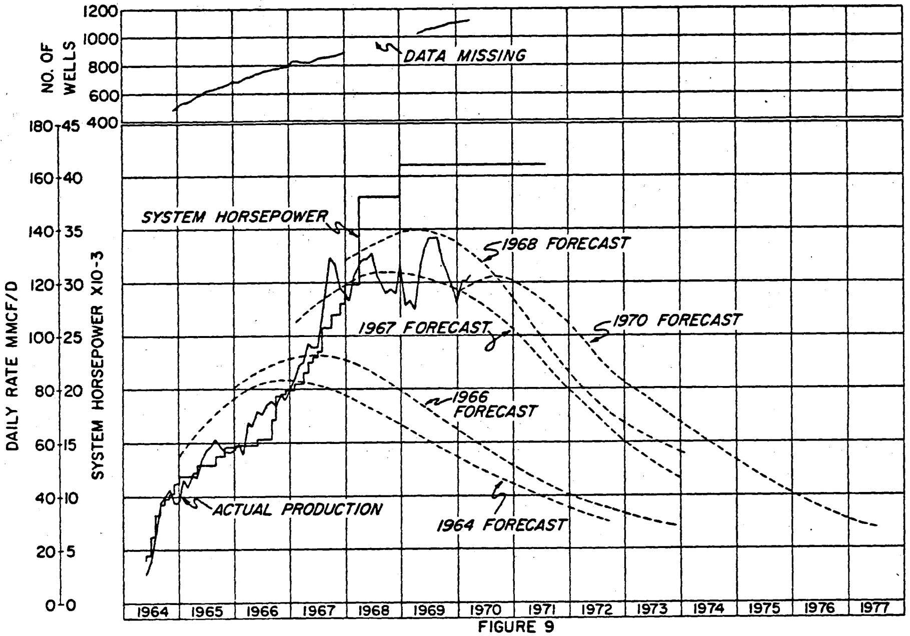

FIGURE 9

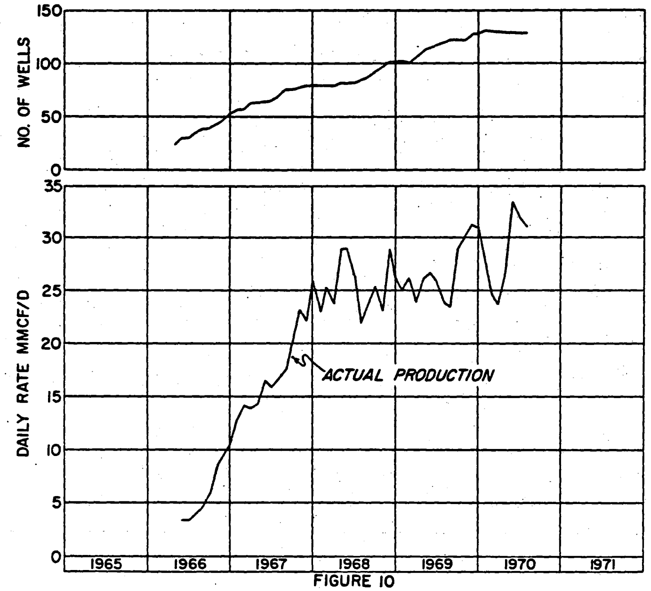

FIGURE 10

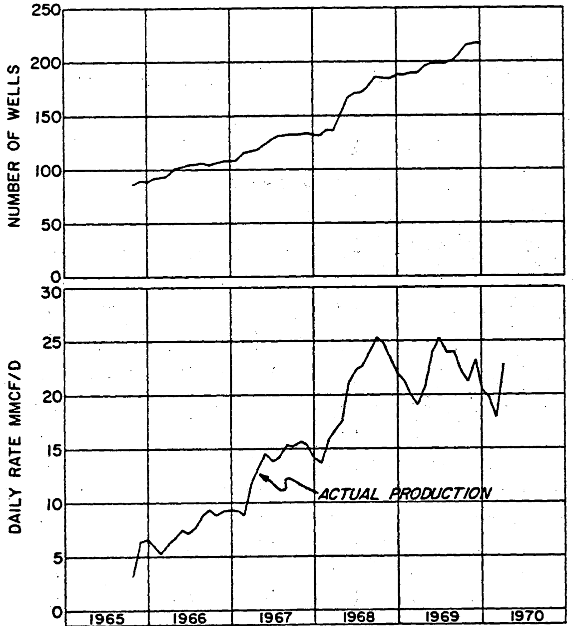

FIGURE 11

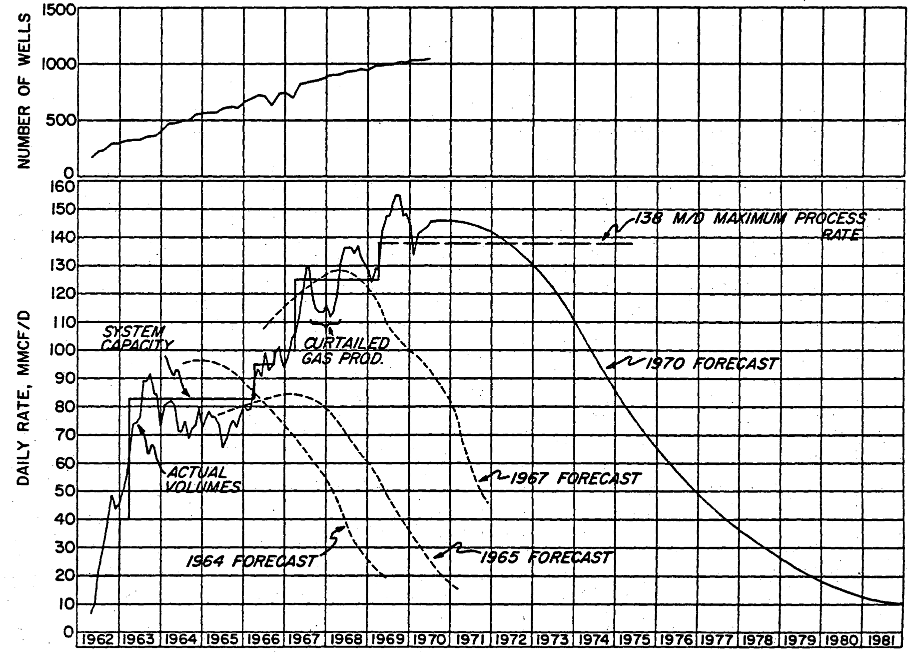

FIGURE 12

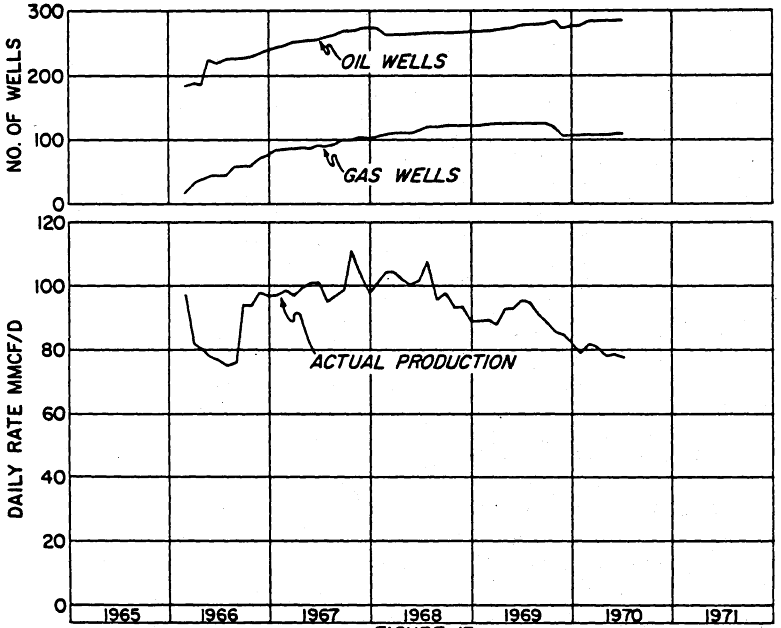

FIGURE 13

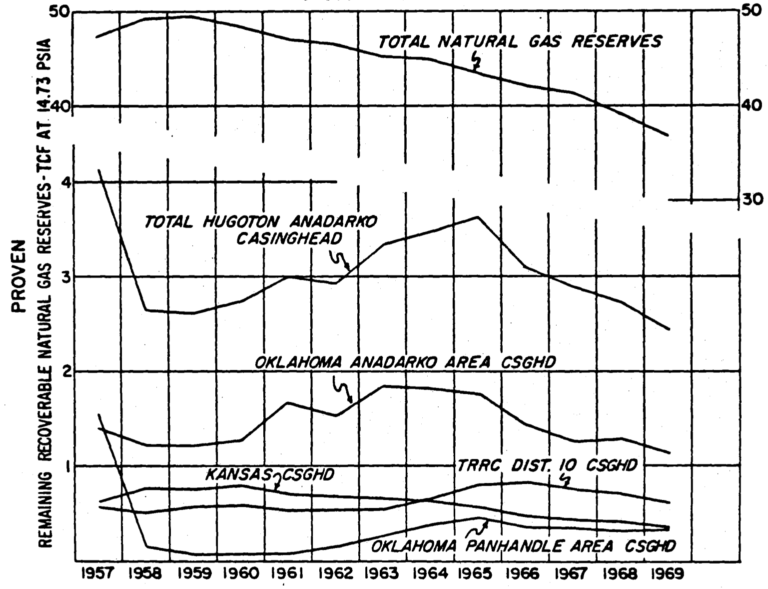

FIGURE 14