SOCIETY OF PETROLEUM ENGINEERS OF AIME
6200 North Central Expressway
Dallas, Texas

PAPER NUMBER SPE 3157

What Price Deliverability ?

BY

L.E. Hanna, Panhandle Eastern Pipe Line Co.

One of the public questions of major concern confronting our nation today is the sufficiency of our energy supply. In recent months we have seen voltage reductions and partial blackouts of electric service in several parts of the country; the development of tight supplies of coal and residual fuel oil, and, of course, the subject of which we are so intimately aware: the decline in new discoveries of natural gas. While it is not my purpose today to launch into the reasons and possible solutions, it is important to keep the entire national picture in focus as we look at one aspect of gas supply.

We all know that reserves don't have much meaning until they are translated into flowing gas. Deliverability on a daily basis is the key to our ability in the transmission business to meet our customer's needs. Our mission today is to examine what has been happening in two of the oldest and, at one time, most prolific sources of flowing gas; namely, the Hugoton and West Panhandle Fields. From time to time I shall make specific references to our own experience, although the conditions now apparent affect all pipeline buyers in these two fields.

Although gas had been discovered some years before, production in large volumes began in the Hugoton and West Panhandle Fields in the late twenties and early thirties. Initial pressure was about 450 psig in both fields.

Panhandle Eastern and the other companies began tying in wells and building gathering systems as the needs of each company developed. The major criteria was to move production into the pipeline at the lowest possible cost, and hence no

Illustrations at end of paper.

pattern of planning of gathering lines was followed. As market became available, wells were attached, and so long as the wellhead working pressure was greater than transmission pressure, the gas kept flowing, and our criterion of low cost was adequately met.

In more recent years the pattern of our transmission operations has changed as gas moved from a surplus to a scarce commodity. Even though we have experienced a decline in wellhead working pressure, we have experienced no decline in the need for gas. So it became necessary to provide additional compression to accommodate the pressure decline. This circumstance was accompanied by proration orders which in many cases maintained allowables greater than could be produced by existing wellhead pressures.

Quite obviously the greater the pressure decline, the greater is the need for compression to get the gas into the pipeline. Sometimes there is a balancing or offsetting effect if the gas volumes drop off as fast or faster than the pressures. However, if the allowables remain fairly constant, the facilities required to get those allowables into the pipeline will increase at an accelerated rate. Figure 1 shows in a very general way the effects of a declining wellhead working pressure on the facilities required to get the gas into the transmission system. Please note the sharp increase in facilities at the very low pressures. In the Hugoton and West Panhandle Fields, those of us with gathering systems are presently experiencing wellhead working pressures as low as 200 psi and 100 psi, respectively. Of course these will vary by locations. And as these pressures continue to decline, more and more facilities will be required to get the gas into the first transmission compressor station.

Figure Numbers 2 and 3 were prepared to show the trend of the wellhead working pressures in the Hugoton and Panhandle Fields.

The Hugoton Field decline curve (Figure No. 2) shows the pressure at our company's Hugoton Compressor Station and illustrates the decline of the field pressure. You can see that our pressure has declined to about 175 psi at the present time, and by 1975, in all probability, it will be down to about 125 psi.

An even worse condition exists in some areas of the Panhandle Field. Figure 3 shows the pressure decline in the West Panhandle Field and shows that we are down to about 70 psi at the present time. A projection of the pressure shows that we will be in serious trouble by 1975.

The normal way to take care of this problem is to add compressor units and pipeline loops in the gathering systems. In the early days when the Hugoton and Panhandle Fields first started producing into the interstate pipelines, the first compression was at the first mainline compressor station. As the pressures started to decline, booster stations had to be installed back in the field. This progression, or is it regression, has continued to the point where individual wellhead compressors are now required. This scheme is indicated in Figure 4.

By this time you, no doubt, have some idea of the trend in investment costs to take care of this problem. Figure 1 showed the effect of declining pressures on the horsepower required for compression. In addition to the horsepower required, additional pipeline loops are required; for as the pressures become extremely low, there are always bottlenecks that show up in the gathering system which can be alleviated only by additional pipelines. Therefore, the total cost effect of this problem follows a trend very close to that indicated in Figure 1.

It is not possible to make an accurate estimate of the total impact of this problem upon the entire industry, but it is apparent that all companies who operate gathering facilities in this region have the same problems. Figure 5 shows the estimated cost of the facilities required by my company over the next five years--about 25 million dollars for Panhandle Eastern alone. Panhandle has about 16 percent participation in the Hugoton Field

and about 9 percent participation in the Panhandle Field. Assuming that all the other companies operating gathering systems are faced with problems similar to ours and using the participation percentage as a basis, the industry is faced with investing over 200 million dollars over the next five years to compensate for pressure decline. There is always a risk in assessing the cost of a problem such as this one with such sketchy information, but the point is that even if this estimate is in error by as much as 50 percent, the cost is still exorbitant.

The critical shortage of natural gas only leads me to believe that it will be necessary and proper to take these fields on down to zero abandonment pressure. It is quite apparent what the effect of this will be on the cost of the remaining reserves in these fields. I am sure this kind of information is good news to compressor manufacturers, gathering line contractors, and supply houses; but to the gas transmission industry, it only makes us realize we must come up with a better way of doing it.

A better approach is needed because there are public interest and regulatory considerations that must be taken into account. In a period of operating cost changes and little, if any, market expansion because of tight supply conditions, the threshold of support for rate changes will not be large among consumers and regulators unless we have demonstrated we can resolve problems in an innovative fashion. The classic notion of build it and put it in the rate base without concern for better and less costly solutions is not acceptable.

From Figure 6, which is a pipeline map of the Texas and Oklahoma Panhandle and Western Kansas, you can see what a maze of pipeline networks there are in that area. This map shows only the principal trunk lines of the several companies operating gathering lines in that area. Behind these trunk lines is an even greater maze of small gathering lines and booster stations.

Figure 7 shows just one small area of the Panhandle Field. This is an area of the West Panhandle Field behind our company's Sneed Compressor Station in Moore County, Texas. During 1969 we started accumulating a considerable amount of underage in this area because we did not have sufficient facilities to take the gas with the rapid pressure declines that we experienced during 1969. Since overages and underages in that area must be balanced every six months, we did not have a great deal of time to get our facilities installed to prevent cancellations. During the summer of 1969, we launched a crash program of adding facilities so that we could balance the allowables in that area by March 1, 1970. We installed nearly a million dollars worth of facilities in order to get this accomplished.

Then in 1970, our allowables remained higher than we had anticipated so we are again faced with under production in this area. We are now faced with going back into that area and adding another $2 million dollars worth of facilities. There are other pipeline companies in this same area with gathering lines, as shown in Figure 7. Some of them have already started a program of looping some of their small gathering lines and adding wellhead boosters behind their gathering compressor stations. We think the pipeline companies can get together and come up with a more economical method of moving the gas in such areas as this.

There are two or three approaches which should be explored. One method would be to pursue a cooperative effort of all companies operating gathering facilities in each area. The purpose would be to make the optimum use of both existing and future facilities. Under this method it may be necessary to disconnect wells from one system and reconnect to another.

It may also be necessary to move compressor units. Even though small wellhead booster units can be installed at reasonable cost, the larger packaged units centrally located can be installed at

considerable savings and would be more reliable. Perhaps exchanges of gas volumes could also be made. Let Company A take all gas from one area and Company B take all gas from another area. Any imbalance in volume could be handled by an exchange. The principal purpose would be to better utilize the facilities.

Another method would be to pursue an all-out unitization program. I don't get a great deal of enthusiasm from my producer friends on this scheme. Not being familiar with the problems of production, I'm sure that I oversimplify this method. I realize this would take the cooperation of the producers, royalty owners, state commissions and the pipelines. No doubt this would be a tremendous task, but certainly would give us the best arrangement for complete depletion of the field with optimum use of the gathering facilities at the lowest long-term cost.

These operating conditions which will grow more difficult with the passage of time, make it necessary for the state commissions to re-evaluate their proration approach. Greater flexibility must be incorporated into the system instead of the current threat of cancellation or the alternative of non-coordinated pressure maintenance investments. It is to the long-term advantage of royalty owners and producers to consider their stake in this problem. And some consideration ought to be given to the need to maintain an orderly flow of gas to market at the lowest possible price.

Like so many problems, this one does not lend itself to easy answers. Some guidelines are suggested here, but I have, by no means, exhausted the subject. It is certainly alarming to think of the wasted facilities that will be installed over the next few years if we continue the way we have been going. This alone should be strong motivation to finding an acceptable answer reasonably soon. We can only compound the waste of manpower and resources if each element that has interest continues to go it alone. Such an approach could invite an imposed solution which could find us in a few years asking why.

Gentlemen, I believe our industry can do better and I hope we can get on with the work without delay.

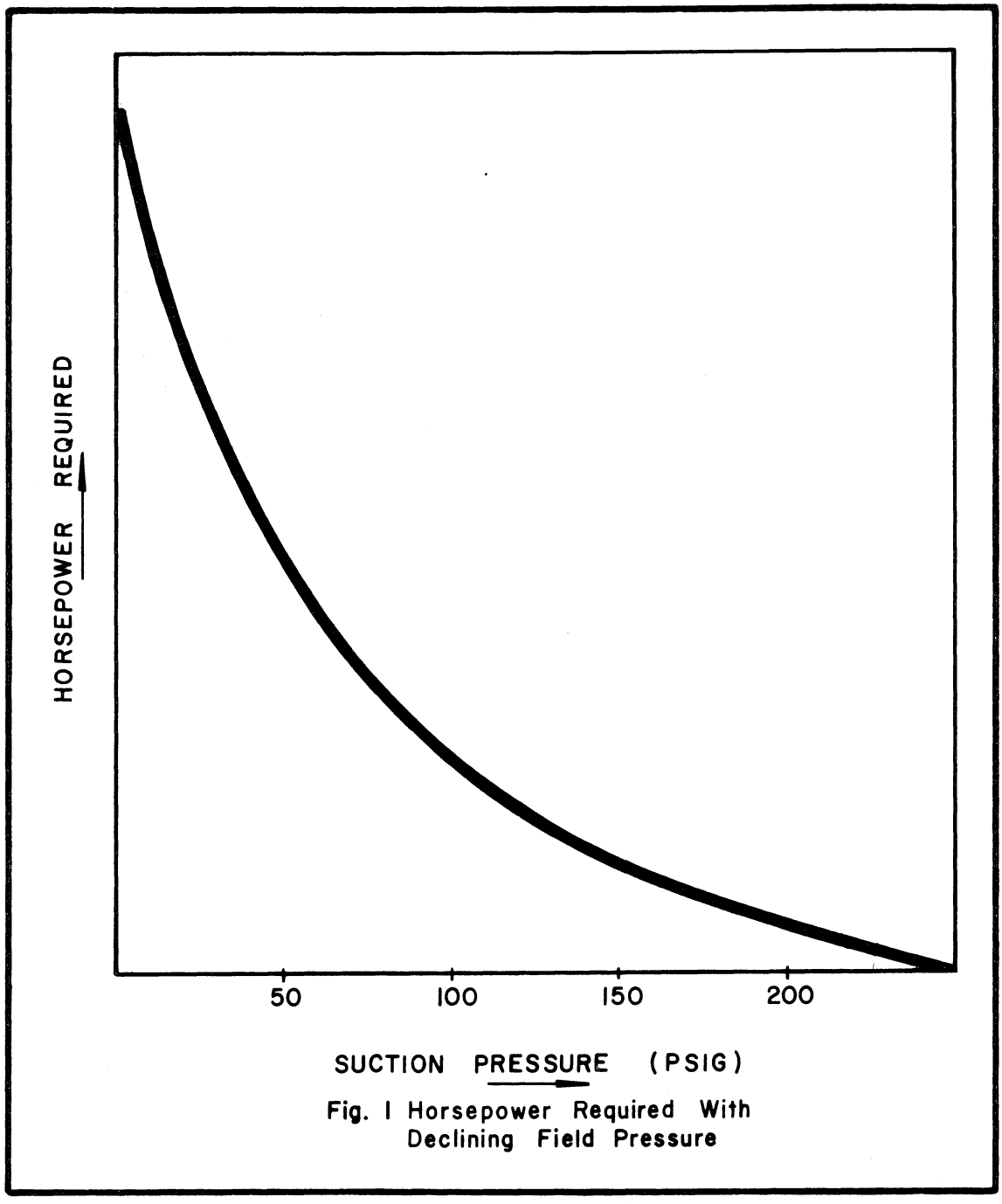

Fig. 1 Horsepower Required With Declining Field Pressure

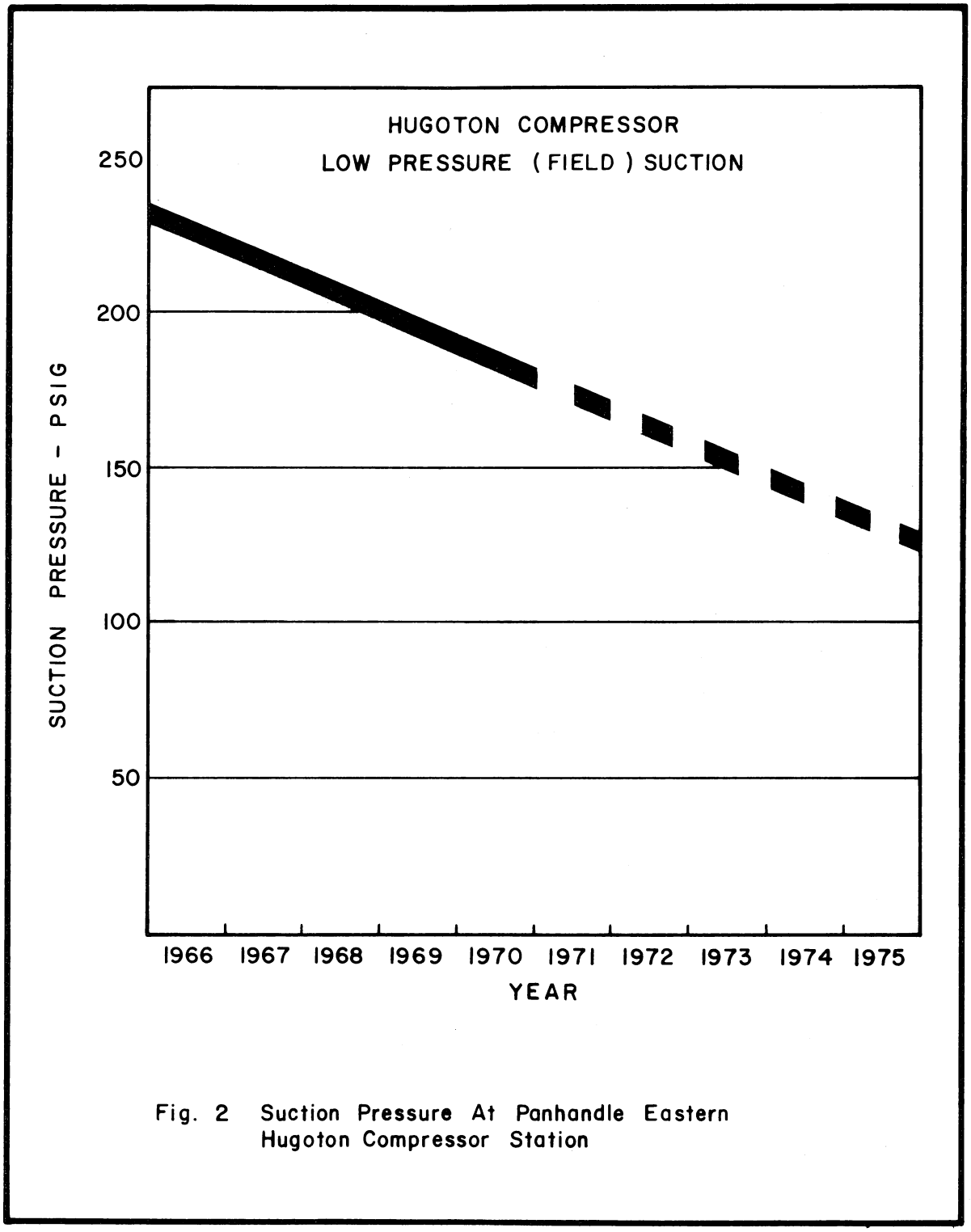

Fig. 2 Suction Pressure At Panhandle Eastern Hugoton Compressor Station

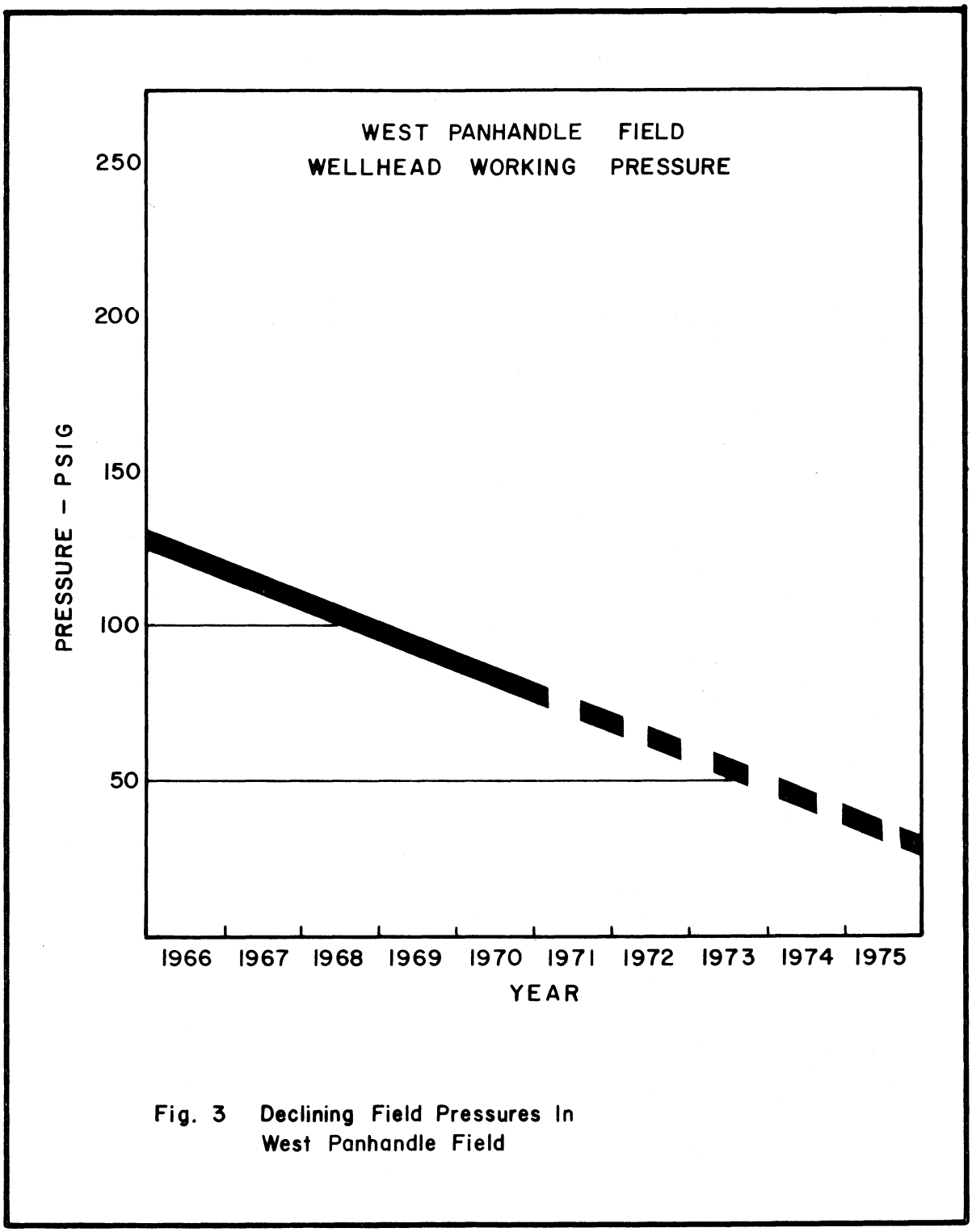

Fig. 3 Declining Field Pressures In West Panhandle Field

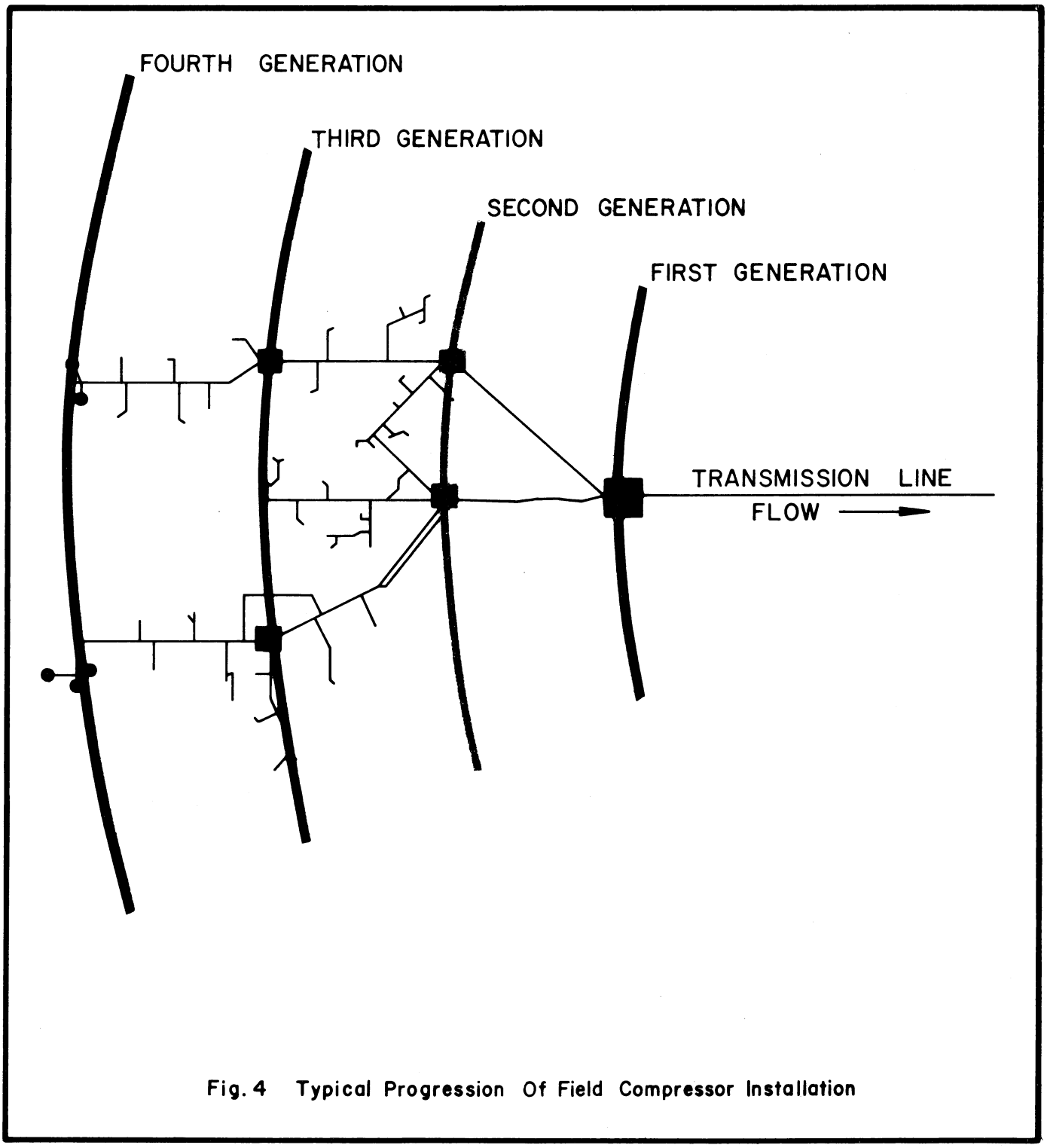

Fig. 4 Typical Progression Of Field Compressor Installation

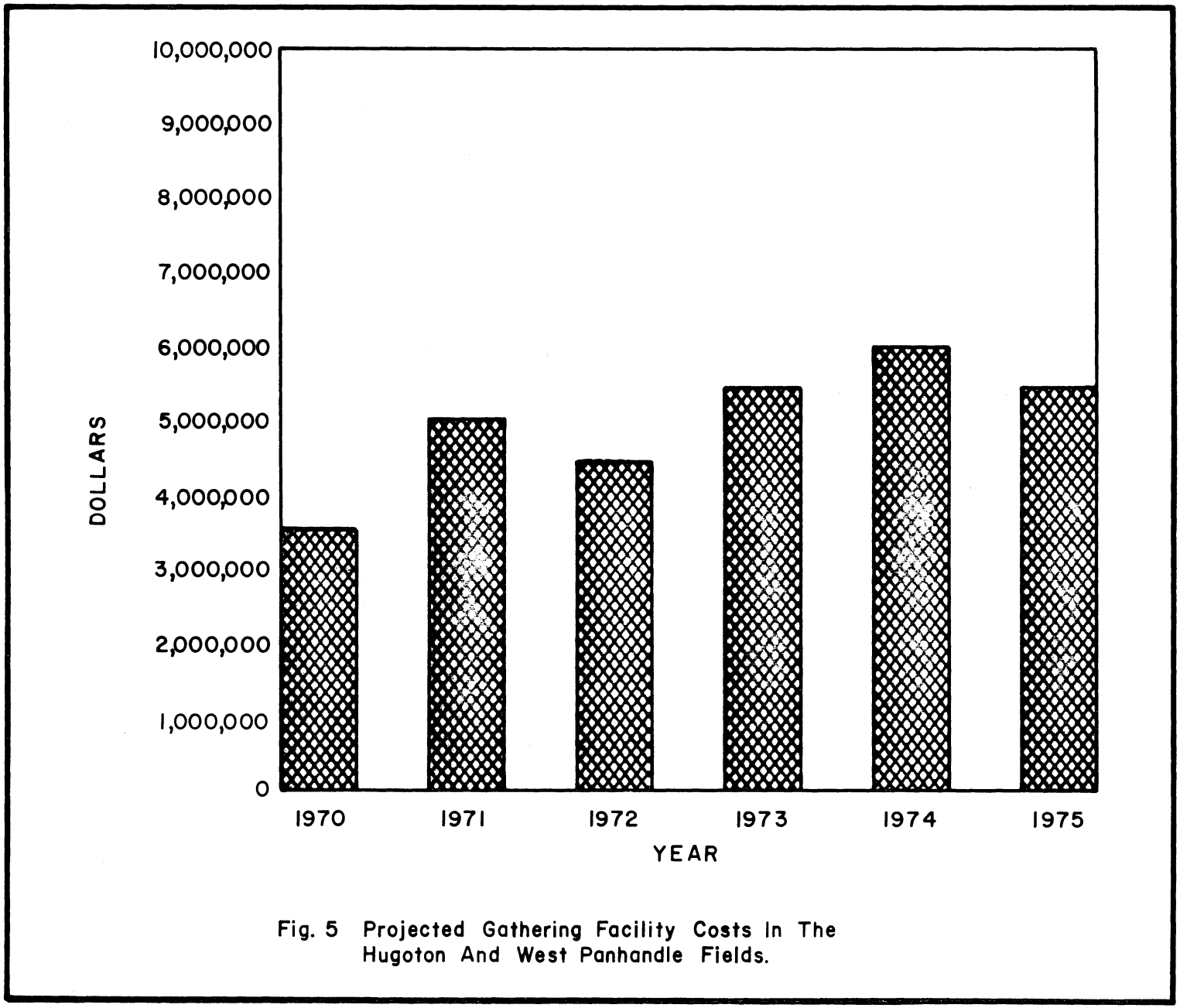

Fig. 5 Projected Gathering Facility Costs In The Hugoton And West Panhandle Fields.

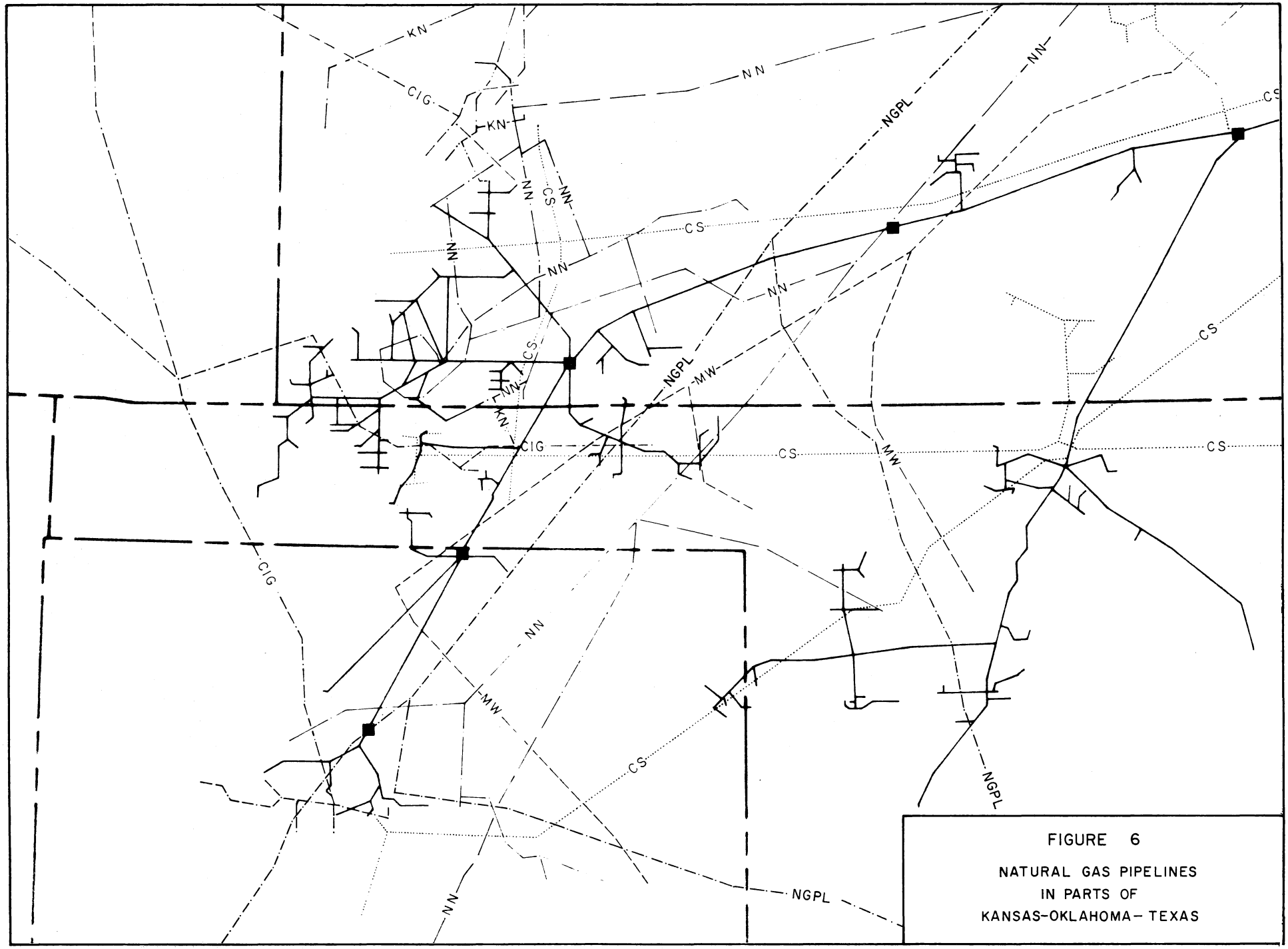

FIGURE 6

NATURAL GAS PIPELINES
IN PARTS OF
KANSAS-OKLAHOMA- TEXAS

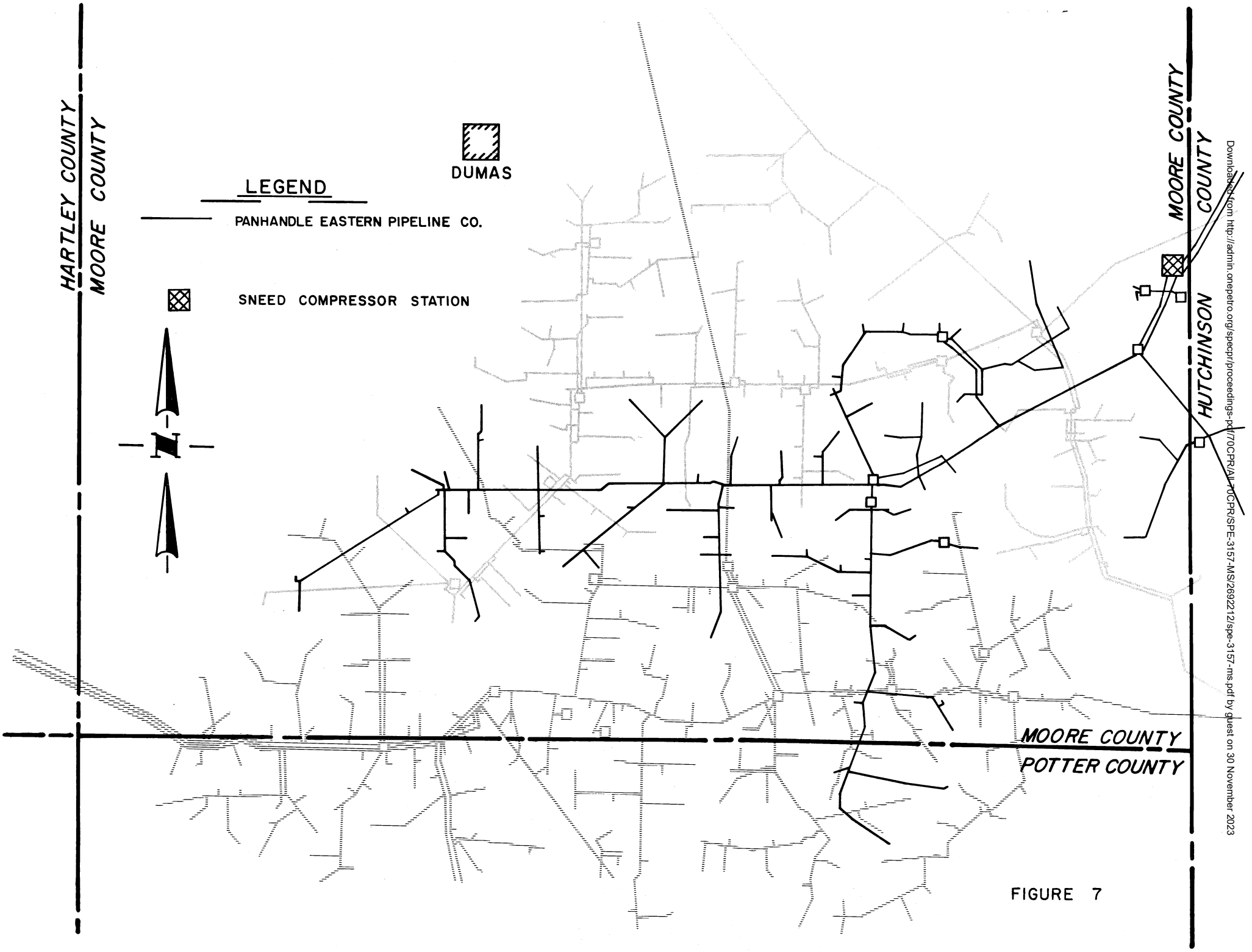

FIGURE 7