

REVIEW OF UNIT OPERATION IN THE ROCKY MOUNTAIN DISTRICT

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The subject of this paper, as assigned to the writer, was covered in considerable detail at the recent meeting of the American Institute of Mining and Metallurgical Engineers, in New York City. For this reason the writer feels justified in deviating somewhat from the subject assigned, and wishes to stress the relation of unit operation to the Government's royalty interests, as applicable in the Rocky Mountain District.

It would seem that comment should be made at this time on a statement that has been made recently, to the effect that a spirit of cooperation in drilling and production programs has prevailed since the earliest discoveries of oil in the Rocky Mountain area.

Without doubt, there have been, and still are, many operators in the Rocky Mountain District who fully believe in and realize the possibilities and benefits of unit operation or cooperation. However, there have been only a relatively small number of operators who have voiced their opinions in the matter, and still a lesser number who have actually put into practice the unit plan of operation. Those companies who have now in operation the actual unit plan are the major oil producing companies in the Rocky Mountain District, such as the Midwest Refining Company, Ohio Oil Company, Texas Production Company, Producers and Refiners Corporation, and their subsidiaries. A few of the larger independent operating companies are also in accord with the unit plan of operation.

It has only been within the past three years that any concerted effort has been made to put into actual practice the unit plan of operation. The unit plan is by no means a new subject. For years Henry L. Doherty has been advocating the unit plan, which idea was later taken under consideration and studied by such organizations as the U. S. Bureau of Mines, Federal Oil Conservation Board, American Petroleum Institute, Mid-Continent Oil and Gas Association, American Bar Association, and the American Institute of Mining and Metallurgical Engineers. It may be said that, except for occasional speculative remarks on the subject and a few somewhat isolated fields operated according to the unit plan, the real interest of the industry as a whole, and the public interest, was not aroused until the large volume of over-production in 1929 forced all farseeing operators to the realization that some extensive and permanent change in operation practices was necessary to save the industry from chaos. Many attempts and experiments in the matter of proration and curtailment of drilling by agreements had been made previous to this time in various parts of the country, from the eastern fields in Pennsylvania and West Virginia to the California fields on the Pacific Coast. Some of these experiments were highly successful and are now being used as a basis for argument for the practicability of the unit plan of operation.

Proration has been and is being used at the present time to some good advantage in practically all of the major oil producing fields in the country. However, proration is like locking the barn door after the horse has been stolen. It merely tends to curtail production to within the limits of refinery, storage and pipe line capacity. It does not necessarily limit production according to the demands of the market. Proration, therefore, is not a cure all, but merely a temporary makeshift measure to attempt to correct the evil after it has occurred. The industry now realizes that a more permanent control of over-production must be devised, and to correct the evil before it has occurred. At the present the unit plan of operation seems to be the most suitable and equitable method of cure.

What is unit operation? What does the term mean? Literally, the term may be understood to mean exactly what the words imply, the operation of a single pool, reservoir or field as a unit. The A.I.M.E., for purposes of study of unitization or unit operation, has defined the term "unit operation" as "any plan whereby the competitive drilling-drainage feature is or will be absent in the development of the pool", a pool being defined as "A single reservoir containing oil and (or) gas. The A.I.M.E., in its unitization study, has also considered the

so-called "near unit operation" and defined this term as "any plan whereby the competitive drilling-drainage feature is or will be reduced and regulated in the development and operation of the pool."

It is interesting to note at this point that Captain J. F. Lucey, in an address on "Unitization" before a recent meeting of the Dallas Petroleum Geologists, made the statement that "There is no such word as unitization and, therefore, I cannot discuss it intelligently, not knowing the meaning of the word, but I do know something about cooperation. Is it not a fact that what we are trying to bring about is a cooperative effort to prevent over-production of oil, stabilize our industry, obtain a reasonable price for our crude, so that the individual, as well as the corporation, can survive?"

With this in mind, Captain Lucey stated that unitization means cooperation, and used the term "cooperation" throughout his address.

Unit operation is cooperation without a doubt, not only in spirit, but in practice. It means the cooperation in management, development, and production, so that a field may be developed as a unit.

There are many advantages claimed for the unit plan, among which are; "(1) The lower cost of production through savings in pipe line investment, storage tanks and water development. (2) Greater ultimate yield. (3) Conservation of gas. (4) Production of oil or gas as needed. (5) Proper spacing of wells. (6) Less loss through evaporation because of fewer storage facilities. (7) Royalty owners will receive a greater return on their investment, although the immediate returns would not be as great as in the competitive plan. (8) Standardization of machinery and equipment."

Among the objections to the unit plan which have been advanced are: "(1) Unitization will take away the opportunities of the "wildcatter" who is responsible for the development of the industry. (2) Will destroy the individual and take away his initiative. (3) Will destroy the speculative royalty market. (4) The independent will not have proper representation in the unit; that major companies are in a position, because of their ample working capital, to purchase large acreage surrounding structures, and, therefore, obtain representation by the increased acreage so purchased. (5) That the individual will not be able to intensively drill up his small holdings; that no recognition will be given to the producer who drills ahead of production and risks his capital in extending the field."

None of the objections listed above will "hold water" except that proper consideration should be given those who drill ahead of production.

What is holding back the putting into effect on a large scale of the unit plan of operation? This question might be answered by stating that it is because of the attitude of royalty interests, independent operating companies, independent operators, and Federal laws. The conflict with Federal laws which tend to prevent restriction of production of an article or commodity to control the price, is not wholly applicable in the case of oil or gas production.

The drilling and producing departments have long been a sore spot of all oil companies. These departments must gamble their good cash in the discovering of and bringing to the surface their life blood, oil or gas. Refineries and pipe line companies do not have this uncertain feature of income and return on their investments. The refineries are only limited as to their profits because of their capacities, lack of sufficient market, and stiff competition. Pipe line departments are only limited by the capacity of their lines, production obtaining, and the available market. The cost of the pipe line is easily estimated, and the amount of oil or gas that it will be necessary to transport through their lines to amortize their initial investment and provide a fair profit. The advantage of these latter branches of the oil industry is proved by the fact that the major operating companies in the United States are establishing their own refineries, their own pipe line companies, and are even entering the field of retailing their products. Why there-

fore, should not the operating companies be allowed cooperation such as is possible under the unit plan of operation, in order that they also might be relatively assured of the return on their investment and an adequate income. The unit operation proposition does not only reduce overhead expenses and operating costs, but also restricts the production of crude according to the demands of the market, allowing sufficient emergency surplus. This to obtain a better price for the crude in order to obtain the profits justly due.

The control of crude oil, to the writer's viewpoint, would not conflict with the Federal laws providing a penalty for restriction of trade and control of price, as the prices of the refined products to the public are not affected to any great extent. The fluctuations in the price of crude oil are not reflected in direct proportion in the retail price of its products, such as fuel oil and gasoline. This is amply shown by the fact that during the present unstable condition of the price of crude oil, no fluctuation in price of retail gasoline was apparent. The unit plan of operation does not intend to restrict production to such an extent that an exorbitant price would be charged for retail petroleum products. It is only meant to prevent overproduction of oil or gas, stabilize the industry, and allow the operator to obtain a reasonable price for oil or gas, thereby entailing a benefit to the Government.

The Government has always tried to help the operator to obtain the best possible price for his crude oil or gas, not because of the pecuniary benefit it may result in to itself, but because of the economic principle involved. The efforts of the Government to establish an 85-cent field base price for Oregon Basin crude is an issue at the present time. In this connection 85 cents a barrel is a necessary price if the producer expects to realize a reasonable profit.

As early as 1923 the Government established, in the Rocky Mountain District, a minimum price of 5 cents per thousand cubic feet for its royalty gas.

The general principles of unit operation, conservation of oil and gas, prevention of economic waste through unnecessary drilling, etcetera, are fully realized and appreciated by the Department, and would undoubtedly receive the approval of the Department. The withholding of formal Departmental approval of unit operation is due to the specific terms of Section 27 of the Act of February 25, 1920, which reads in part: "That if any of the lands or deposits leased**** shall be controlled by any device-----so that they****form the subject of *****any agreement or understanding*****to which such lessee shall be a party of which his or its output is to be or become the subject, to control the price thereof, or of any holding of such lands by any*****control in excess of the amounts of lands provided in this act, the lease thereof shall be forfeited by appropriate court proceedings." The exact meaning of this wording of Section 27 is subject to much controversy. An amendment to the leasing law to clarify the wording of Section 27 and to specifically authorize the Secretary to approve or to require lessees to enter into unit operation agreements in the interests of conservation of resources and avoidance of economic waste would be a cure for the situation and a real public interest measure.

The Rocky Mountain District is somewhat unique in character, as far as the oil industry is concerned. The district is in reality in a classification all its own, and differs greatly from the Mid-Continent District and the California District in respect to geography, geology, development, producing and marketing conditions. Three states in the Rocky Mountain District, namely, Montana, Wyoming and Colorado, are practically independent in respect to oil and gas production and consumption. The production of crude oil and gas from these three states is only able to meet the actual demands within their boundaries. The geographic location prevents major competition from either the Mid-Continent or California Districts. In fact, in the past few years Montana has been unable to supply refineries within its boundaries with sufficient crude oil to allow them to operate at full capacity. Wyoming oils are being shipped into Montana because of this. The refined products of crude oil, such as gasoline, are of course being shipped from these states to the other districts, where they must meet stiff competition. Crude oil from the northwest portion of New Mexico, however, must meet competition with Mid-Continent oils or with California oils shipped to Utah, into which state the majority of these New

Mexico oils are being shipped at present for refining.

The Rocky Mountain District is also unique in its diversified royalty interests. A large portion of the area of this district is owned by the Government. However, much land originally held by the Government has been patented or has been given to some of the railroads traversing this area as a reward for their exploratory work and early development. Because of this condition, Montana, Wyoming and Colorado in particular have four distinct royalty interests; the Government, the State, the patented or fee land owner, and the railroads. As the states hold, in addition to lieu land selections, sections 16 and 36 in practically every township in the district, the patented lands are only found in areas favorable for domestic use, the railroads to which lands have been granted hold every odd numbered section approximately 20 miles on either side of their right of way, and the nature and location of the lands withdrawn are still held by the Federal Government, the patchwork quilt of royalty interests in the Rocky Mountain area is readily discernible.

This diversified interest of royalty holders has resulted in a large and somewhat undue amount of competitive drilling. Under only two conditions is it thought possible in the present limits of the Rocky Mountain Division to have a field under practically one royalty interest, thereby producing competitive or offset drilling. One condition is when all of the land is held by the Government, and the other when the lands are held by private owners.

DEVELOPMENT OF UNIT OPERATION IN THE ROCKY MOUNTAIN DISTRICT

The unit plan of operation has been long advocated in the Rocky Mountain District by the Casper office as a means of adjusting production, especially gas, to establish equitable interests among the royalty holders. The A.I.M.E. has given us a list of so-called unit operations, near unit operations and cooperative agreements. The list of fields under this classification, and already given by the A.I.M.E. is attached to this paper but will not be read at this time because of its length and because the writer differs in opinion as to such list, as will be shown in the discussion to follow. The A.I.M.E. has, in their discussion of the subject, included under unit operations many fields that are being developed as a unit, but solely because the majority or all the acreage in the field is held and operated by one company. The controlling and developing of an entire pool or field by one company is admittedly the ideal type of unit operation. However, under this condition it is not necessary to establish a unit plan of operation, as the field is already a unit in itself. The writer will, therefore, for purposes of discussion in this paper, limit himself to a discussion of the unit plan of operation in fields in which agreements were made between one or more companies and the royalty interests.

There are no true unit plans of operation in practice in the Rocky Mountain District at the present time, that have received Departmental approval, because of the conflict with Section 27 of the leasing act, which has been previously mentioned. The only plans approaching unit operation are those in which royalty to the Government from its oil and gas permits and leases has been equitably established by means of percentages of acreages or location of wells in granting the operators relief from the drilling and producing requirements of permits and leases, and yet fully protect the Government's royalty interests. This adjustment of royalties has been made to fully protect the Government's royalty interests, and is known as compensatory royalty. The subject of compensatory royalty has already been ably presented by Mr. Barton.

LITTLE GRASS CREEK FIELD: The first case in the Rocky Mountain District in which cooperative agreements were made was in the Little Grass Creek Field, Hot Springs County, Wyoming. In this field, which is a small gas producing structure covering approximately 1600 acres, there is but one operator. The estimated total production of the two wells is approximately 40,000,000 cubic feet daily. The town of Thermopolis is supplied with gas for domestic and commercial use from the field. There have been two wells drilled, one on a Government lease carrying a royalty rate of 5%, and one on patented land. Because of its small area, it was soon realized that not more than three wells at the most would be necessary to entirely

drain the structure of gas. With this in mind to grant drilling relief on the Government lands and yet fully protect the Government's interests, a plan of allotment of production for the computation of royalties was established. There are 160 acres of patented land, 160 acres of 5% Government lease, and 1280 acres of permit land in the field. To equitably distribute royalties, the agreement was established in 1927 on the basis that one-fourth of the total production of the two wells in the field would be credited to the 160 acres of patented land, one-fourth of such production to the lease on which royalty is paid to the Government at the regulation lease rate of 5%, and one-half of such production to the permit on which royalty is paid to the Government at the regulation rate of 20%. This agreement is believed to fully protect the Government's interests and eliminate the drilling of additional unnecessary wells and consequent overhead.

REX LAKE OIL FIELD: Rex Lake Oil Field, in Albany County, Wyoming, is operated entirely by one company. The total potential production from the field is estimated at 110 barrels of oil daily. There are two wells on a 5% Government lease and 2 wells on patented land in the field. Drilling relief was granted on "B" acreage on the basis of payment of a compensatory royalty on 50% of the production from the "A" lease wells at the regulation sliding scale royalty rate, and on the remaining 50% of the production from the "A" lease wells at the rate of 5%. This agreement was also arrived at during 1927.

WERTZ GAS FIELD: Wertz Gas Field, Carbon County, Wyoming, is embraced on one Government lease, and is operated by one company. There are 7 gas wells in the field, 4 on "A" leases and 3 on "B" leases, having a total open flow production estimated at 100,000,000 cubic feet of gas. Prior to 1927 the company had been producing gas from "A" lease wells in excess to the production from the wells on the "B" lease. The Supervisor requested the company to produce more gas from the "B" lease to protect the Government's interest. The operator countered with the proposal to divide the total production of gas from all wells equally between the "A" and "B" lease and pay royalty to the Government accordingly. This agreement was also established in 1927.

LITTLE BUFFALO BASIN GAS FIELD: Little Buffalo Basin Gas Field, Park County, Wyoming. This is the only field in which a type of true unit plan of operation is in effect. Two operators control practically all the productive acreage in the field, which consists of Government leases and vacant lands, patented and state lands. The total potential production of the field is estimated at approximately 75,000,000 cubic feet of gas daily. During 1927, after 7 wells had been drilled on the structure, it was realized that additional wells would be unnecessary to properly drain the field. A unit plan was then outlined to which the various royalty interests concurred. The entire production from the field is measured by a master meter and this production prorated to the various tracts within the proven area on an acreage basis. It so happens that in this case a considerable amount of unappropriated Government land lies within the productive acreage of the field, but it was agreed upon that this vacant land should be included with the total acreage of the Government lands under lease. The percentage of the total Government land in this case is 81% of the proven acreage of the structure. 81% of the total gas produced from the field is therefore divided between the four existing Government leases, according to their percentage of acreage. This agreement was established in 1927 and is a noteworthy example of successful unit operation for a gas field.

BIG SANDDRAW, Fremont County, Wyoming. This field is operated by one company. The greater portion of the productive area is Government land, the remainder privately owned. There are 11 gas wells in the field, 4 on Government lands and 7 on private lands. These wells have an estimated total potential production of 50,000,000 cubic feet of gas daily. Because of the fact that the company was producing gas from patented and Government wells in amounts not representative of their respective acreages, the Supervisor, during 1923, requested the operator to drill additional wells on Government land or estimate the drainage from such lands and pay a compensating royalty accordingly. The operator elected to drill rather than pay the compensating royalty. Discussion on a possible unit plan of operation extended over a period of a number of years, until in the early part of 1929 an agreement was made whereby the operator agreed to produce gas from wells on Government land in accordance with the percentage of Government land within the proven area.

OREGON BASIN FIELD: Park County, Wyoming. During 1928 an attempt was made to establish a unit plan of operation in this field, which includes vacant Government lands and leases, patented and state lands. There are five major operating interests in the field. The unit plan of operation was, however, defeated because of the refusal of one large independent company to agree to the proposal as submitted.

BAXTER BASIN GAS FIELD, Sweetwater County, Wyoming. This field is operated almost entirely by the Mountain Fuel Supply Company. There are 12 gas wells in the field, 7 being on private lands and 5 on Government 5% royalty leases. The total potential production from these 12 wells is estimated at 250,000,000 cubic feet of gas daily. The Mountain Fuel Supply Company is at present producing gas from 2 wells on patented land, which is being piped to the town of Rock Springs for domestic consumption. One well on a Government "A" lease is being produced to supply gas for the Salt Lake City-Ogden, Utah, gas line. During the early part of 1929 a meeting was held at Parco, Wyoming, attended by companies interested in the Baxter Basin Gas Field and representatives of the state of Wyoming and the U. S. Geological Survey. At this meeting a unit plan of operation for North and South Baxter Basin Fields was discussed and outlined. The unit plan was later submitted to the Department for approval, but was held suspended due to possible conflict with Section 27 of the leasing act.

HIAWATHA GAS FIELD: This field lies partly in Sweetwater County, Wyoming, but with the majority of the productive acreage of the field extending into Moffat County, Colorado. The field, like the Baxter Basin Fields, is operated almost entirely by the Mountain Fuel Supply Company. There are 6 wells producing in the field, one on private land and 5 on Government lands. These wells also supply gas for the Salt Lake City-Ogden, Utah, gas line. The operator in the field and the royalty interests are at present working out a plan of unit operation which will be equitable and satisfactory to the lessees. The majority of the acreage in the Hiawatha Field is held under permit or lease from the Government. It is interesting to note that in granting, on October 2, 1929, an extension of time of 2 years on 30 permits in the field, the Department recommended, among other conditions, the following: "It is further recommended that in order to obtain beneficiary use without waste of any and all gas developed, each extension of time allowed be with notice that a concerted effort must be made by each permittee within the period of extension, looking to the development of a conservation program for the operation of the particular area wherein the permitted lands are located, such a program to be subject to approval by the Department." The operator believes that the greatest degree of conservation of oil or gas is made possible by unit operation, and, therefore, the above condition promulgated by the Department appears to the Mountain Fuel Supply Company to be a direct endorsement of a unit operation program.

It will be noted that the above discussion of cooperative agreements or unit operations has been on fields located solely within the state of Wyoming, with the exception of one which extends into Colorado. The above fields are the only ones in the Rocky Mountain District in which such agreements or plans have been worked out and put into actual practice, or have already been discussed or contemplated.

Plans are now being made to attempt to arrive at a satisfactory plan of unit operation in the Cedar Creek Anticline Gas Field, in Montana, Model Dome Gas Field, in Colorado, in which field helium is found, and possibly several other fields in the Rocky Mountain District.

An excellent example of unit operation is the Van Zandt pool, also known as the Van pool, in southern Texas. In this field four or five major operating companies held the majority of the acreage. A supervisory committee was formed by one representative from each company. As the Pure Oil Company held the majority of the productive acreage in the field, this company was elected to drill all wells and carry on all development operations in the field. The supervisory committee, composed of the representatives of the various companies interested, supervises the operations as conducted by the Pure Oil Company.

None of the fields in the Rocky Mountain District discussed above under

unit operation or cooperative agreements falls under the classification of the Van Pool or true type of unit operation. In the fields previously discussed, where more than one operator held acreage in the field, no attempt was made to form a supervisory committee and allow one company to carry on all operations in the field. It will be noted that the only relation fields previously discussed bear to unit operation is in the division of royalties, or rather the allotment of production for purposes of computing royalties. The thought that the Supervisor had in mind at the time the above mentioned agreements were made concerning a compensatory royalty in lieu of full compliance with the drilling and producing requirements of the Government leases and permits. Paragraph 2(b) of the lease calls not only for the drilling of wells to fairly offset those of properties other than the Government, or on Government lands bearing a lower royalty rate, but also to begin drilling within three months from date of receipt of lease and to continue drilling thereon until wells are completed equal in number to the 40-acre tracts embraced in the lease. In order to prevent possible over-production, drilling in excess of the requirements of a field, and to promote true conservation, the Department established the policy of granting drilling and producing relief. The moment a lessee fails to comply with the terms of his lease drilling relief is necessary to keep the lease in good standing. Drilling relief, when granted, is conditioned on, among other provisions, the payment of a compensatory royalty. It is almost impossible to equitably compute the compensating royalty due from drainage, and it then becomes necessary to make an arbitrary agreement with the operators upon which to base this royalty. This condition is especially true in gas fields where, under certain conditions, one or two wells may affect the pressure of, or even completely drain, the entire field.

An excellent example of the complications that may arise in the computation of compensating royalties is found in the Cedar Creek Anticline Gas Field in the extreme eastern portion of Montana. This anticlinal structure, upon which are located several distinct domes or pools, is approximately 90 miles long and generally not more than 5 or 6 miles wide. In the major portion of this field the Northern Pacific Railway holds, by land grants, every odd numbered section. In addition to the railway land grants are found scattered tracts of patented and state lands. Scattered throughout the length of the field, especially in two or three of the most productive pools in the anticline, Government permits and leases are located. These separated tracts of Government land will average about 320 acres, each being completely surrounded by lands not belonging to the Government.

Several cases have recently come before the Department in this field in which drilling relief has been requested, and it was necessary to estimate the compensatory royalty that should be paid as a consideration for granting the relief. Drilling has been carried on on this structure in a very unorderly and uneconomical manner. Wells have been drilled without due consideration for drainage. This situation has resulted, in one particular case, in 8 wells on private lands affecting the draining of one Government lease. To fully protect the Government's interest it was necessary to compute the compensatory royalty due from drainage from each one of these wells. These same 8 wells also affected another Government lease and also a permit. A study of the situation in the Cedar Creek Anticline soon brings one to the realization of the fact that the unit plan of operation is the only practical means of developing the field, and certainly the only plan upon which equitable distribution of royalties to all royalty holders interested can be made.

The very nature of the leasing law itself, limiting a permit or lease to a maximum of 2560 acres on one structure, is conducive to intensive and competitive drilling. This is, of course, the primary purpose of such wording of the act; that it should promote drilling, prevent control of an entire field by one permit or lease holder, and furnish an adequate supply of oil and gas for the buyer. However, conditions have changed since the passage of the leasing act in 1920, to the present condition of over-production which has made it mandatory for the oil industry to reduce the supply of crude oil and gas to the market demands. It would seem, therefore, that the Government, the largest royalty holder in the United States, should attempt to aid the industry in every way possible at the present time to establish a plan to prevent over-production, stabilize the industry, allow the operators to obtain a reasonable price for their crude oil and gas,

and to promote conservation.

The purchase of over-riding royalties from private land owners, permittees and lessees has been highly developed in the Rocky Mountain District. More than a half-dozen large companies have been organized and realized their precipitous growth through this means. This has resulted in operators paying as high as 30% over-riding royalties, and in some cases on Government "B" leases where the Government royalty amounts to 33-1/3%, the total royalty that must be paid by the operator may amount to as high as 45 or 50%. This has resulted in a great hardship to a large number of operators in the Rocky Mountain District, as their percentage of working interest obtained from the sale of crude oil or gas has been so reduced as to make it questionable, or in some cases impossible, for the operators to make a profit on their investment and operations.

In conclusion, the writer believes that because of the number and manner in which the royalty interests are divided, the necessity for payment of compensatory royalty to the Government, and the prevailing over-riding royalties, that unit operation is necessary and particularly adaptable to the Rocky Mountain District.