COMMISSIONER OF PUBLIC LANDS

STATE OF NEW MEXICO

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TRANSCRIPT OF RECORD

OIL-POTASH MEETING

Held at Santa Fe, New Mexico

Thursday, March 29, 1951

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OIL-POTASH MEETING

Held at Santa Fe, New Mexico, March 29, 1951

BEFORE: Hon. Guy Shepard, State Commissioner of Public Lands, Chairman

Hon. R. R. Spurrier, Secretary and Director of Oil Conservation Commission

Hon. George A. Graham, Attorney

REGISTER:

F. H. Stewart
Southwest Potash Corporation
Carlsbad, New Mexico

Thomas G. Moore
Southwest Potash Corporation
61 Broadway
New York, New York

T. M. Cramer
United States Potash Company
Carlsbad, New Mexico

Oliver Seth
United States Potash Company
Santa Fe, New Mexico

L. H. Freedman
United States Potash Company
C/o James H. Snowden
Fort Worth, Texas

Joe P. Smith
United States Potash Company
Carlsbad, New Mexico

R. G. Haworth
Potash Company of America
Carlsbad, New Mexico

D. E. Protz
Potash Company of America
Carlsbad, New Mexico

F. O. Davis
Potash Company of America
Carlsbad, New Mexico

G. C. Weaver
Duval Sulphur and Potash Company
Carlsbad, New Mexico

R. A. Shepherd
Duval Sulphur and Potash Company
Carlsbad, New Mexico

Eugene German
Duval Sulphur and Potash Company
Houston, Texas

W. P. Morris
Duval Sulphur and Potash Company
Carlsbad, New Mexico

Caswell Neal
International Minerals & Chemical Corporation
Carlsbad, New Mexico

Ralph Nix
Artesia, New Mexico

Jerry Curtis
Artesia, New Mexico

John M. Kelly
Roswell, New Mexico

S. B. Christy
Sun Oil Company
Roswell, New Mexico

Frank O. Elliott
L. E. Elliott
Roswell, New Mexico

William M. Taylor
Sinclair Oil & Gas Company
Tulsa, Oklahoma

James K. Smith
Stanolind Oil & Gas Company
Fort Worth, Texas

W. M. Jones
Stanolind Oil & Gas Company
Lubbock, Texas

H. S. Cave
Phillips Petroleum Company
Midland, Texas

R. F. Rood
Phillips Petroleum Company
Midland, Texas

Emmett D. White
Leonard Oil Company
Roswell, New Mexico

T. L. Dean
Richardson & Bass
Midland, Texas

Howard W. Jennings
Roswell, New Mexico

J. E. Hill
Richardson & Bass
Fort Worth, Texas

Raymond Lamb
Wilson Oil Company
Santa Fe, New Mexico

J. S. Griffith
Humble Oil & Refining Company

Sid Richardson
Richardson & Bass
Fort Worth, Texas

Ora R. Hall, Jr.
Santa Fe, New Mexico

H. E. Harrington
Malco Refineries, Inc.
Roswell, New Mexico

Harve H. Mayfield
Magnolia Petroleum Company
Midland, Texas

E. S. Grear
Gulf Oil Corporation
Roswell, New Mexico

E. E. Merkt, Jr.
Gulf Oil Corporation
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John H. Bevan
Gulf Oil Corporation
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R. L. Hughston
Shell Oil Company
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M. A. Sherwood
Shell Oil Company
Midland, Texas

G. R. Carter
Texas-Pacific Coal & Oil Co.
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Jack N. Campbell
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Charles G. Loveless, Jr.
New Mexico Oil & Gas Association
Santa Fe, New Mexico

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New Mexico Education Association
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Hon. John E. Miles
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United States Geological Survey
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Artesia, New Mexico

Frank C. Barnes
State Oil Conservation Commission
Santa Fe, New Mexico

Henry H. Bruhn
United States Potash Company
Carlsbad, New Mexico

Paul J. Weaver
Houston, Texas

CHAIRMAN SHEPARD: The meeting will please come to order. This meeting is a continuation of the meeting of February 27th, held for the purpose of determining whether or not certain lands should be withdrawn from oil and gas drilling; and at that time the potash people asked for a continuation of time to allow them to assemble additional material for presentation. The time for this meeting was then set for March 9th, and later set for this date to give every one enough time to prepare for it. The potash people will proceed. Mr. Seth.

do you wish to open the questioning for the potash industry?

MR. SETH: I would like to ask if the testimony at the other hearing held February 27th is to be considered as a part of that to be given today?

CHAIRMAN: Yes, it is a continuation of the other meeting.

MR. SETH: I may then refer to my testimony given at the beginning of that hearing. We come desirous of working out with the Commissioner some procedure which will permit the solution of the technical and mechanical aspects of the problem. We appreciate the action of the Commissioner in having given us time to consult people having experience in this matter. Consultation with engineers and geologists leads us to the conclusion that the matter is of such importance and has ramifications so serious that we appreciate, much more than at the other hearing, the importance of the problem. I believe Mr. Caswell Neal would like to make a statement.

MR. NEAL: My name is Caswell Neal, of Carlsbad, New Mexico, representing the International Minerals & Chemical Corporation. Do I understand that the Commissioner would like to have some proof of what would happen if drilling for oil and gas were permitted in the potash area?

COMMISSIONER: Yes, we want to hear any witnesses you would like to present.

MR. NEAL: I would like to make a preliminary statement. I believe the Commissioner has a copy of the letter dated March 16, 1951, submitted by each of the five potash companies operating in the area under consideration, which generally states the position of the industry in connection with the matter before the Commissioner. We feel that both the federal and

state lands in the area should be withdrawn from the development of oil and gas because of the extreme danger of damage we feel can occur to the potash beds. This is from the danger of overhead water and also from the possibility of oil and gas escaping into the formation. This is a danger not only to the potash formation but also creates a great hazard to the men working in the mines. It is the thought of the potash industry that this matter should be given thorough study, to be made by a board appointed by the Commissioner consisting of representatives from the potash industry and from the oil and gas industry, and also of experts from both the United States Geological Survey and the State organizations; and after such study has been made, to formulate rules and regulations applicable to the lands in the area. Would the Commissioner like to have witnesses sworn?

COMMISSIONER: No, it is unnecessary.

MR. SETH: Some of the witnesses are representatives of certain companies, and think they would like to speak for their own companies. There are others who will give testimony of a general nature.

MR. NEAL calls Mr. Cramer to the stand.

Q Please state your name.

A T. M. Cramer.

Q Where do you reside?

A Carlsbad, New Mexico.

Q What company are you with?

A The United States Potash Company.

Q How long have you been familiar with the potash mines in the Carlsbad Area?

A Nineteen years.

Q Will you describe the formation in which potash deposits are

found in southeastern New Mexico?

A The potash lies in the form of soluble salt in beds 750 to 1500 feet below the surface. The beds are in layers of common salt or sodium chloride. All of the potash is recovered by mining. We go down to the beds with a shaft and then, by means of tunnels, we go out into the area where the potash is extracted. The extraction runs on the first mining from 40% to 75%. A certain amount of the potash is allowed to remain in place to support the roof above the mine. It is planned to eventually extract the greater part of the potash salt which is at the present time allowed to remain in place in the form of pillars or supports.

Q How much of the potash is extracted?

A From 40% to 75% is removed in the first mining. The quantity varies with different conditions within the mine. In some cases as low as 40% is removed, on up to 75%.

Q What remains is left in pillars?

A Yes, sir.

Q These pillar supports are left to hold up the overburden?

A Yes.

Q Will you describe in connection with your mining operations what the conditions of the overlying strata are, the danger of intrusion of water in the mine?

A In general we go down to what is known as consolidated ground. We encounter one brine formation at the surface and deposits of various sorts as we go on down. At several hundred feet we arrive at a dolomite stratum which contains water.

Q Is that what is known as the Rustler formation?

A Yes.

Q Is that general throughout the area?

A Yes.

Q What methods are used for shutting off the water?

A Sometimes we arrange to pump it out if it is found in small volumes, and sometimes we shut it off with solid concrete, and in some places drainage is provided to take care of the water.

Q Have other methods been used that you know of?

A In one recent case they have employed freezing methods, and have gone down through the frozen ground.

Q Are you familiar with the quicksand encountered in the water bearing formation?

A Yes, sir.

Q Will you state the position of your company and the industry, as best you can, relative to the possibility of water getting into the potash formation, and describe the effect of water on the deposits?

A First water would start to work on the salt and dissolve it and if there is no outlet for the water it will remain as stagnant brine; if there were fractures in the salt which would permit that water to come on through in the area in which we are mining, more and more brine would find its way through until we had water in the mine.

Q If the situation developed to where the salt beds above became soluble, or became wet, what would be the effect on your operations?

A It could be very serious. In some of the European operations they have lost mines entirely through this cause.

Q I believe these are not the only deposits found in salt beds.

A Yes sir.

Q Are there beds similar to these in Germany and Russia?

A Yes, sir, with the difference that in America they lie

almost flat, whereas in Europe they almost stand on end in places.

Q You stated that mines have been lost in Europe through the intrusion of water?

A Yes, sir.

Q Will you also describe the feeling of the industry with regard to the production of oil and gas from underlying strata?

A Speaking for our own company, we feel that both the oil and potash industries are custodians of natural resources, that our duty is the conservation of these resources, and we would feel very derelict if we did anything which would cause or contribute to the loss of the mines. We feel the approach to this problem should be open minded and that the best knowledge of producers of both industries should be brought into the efforts toward solution of the question.

Q Have you had any difficulty with gas, explosive or otherwise?

A I can only speak from our experience. We have encountered some gas but that encountered within the mine itself has been so small that our mine is considered non-gaseous. We have had what we call high pressure ore from seams in the mines.

Q What would be the effect if oil and gas operations were undertaken in the area and proper precautions not taken to protect the potash mines?

A The result of escaping gas is incalculable. We might have to abandon the mine if much of such gas were encountered.

Q It is your feeling, I believe, that experts should give their thought to the question and submit the results of their study before action is taken by the Commissioner in this highly important matter?

A Yes sir.

Q Is there any further statement you care to make?

A I believe the state and federal governments have experts who can act in this matter and we are very anxious to have uniform regulations in respect to this problem more particularly because we are operating on both state and federal land between which there are no existing barriers. It would be almost fatal to our operations if we were obliged to carry on under two sets of rules. So that one thing we urge is a uniform policy of state and federal governments, and another thing is that both oil and potash companies be heard before the Commission reaches a decision.

Q I believe the federal government has withdrawn from all oil and gas development certain lands in this area and that is the policy with regard to federal lands in this area?

A Yes, sir.

Q The area contains how many townships?

A I would guess somewhere around 75,000 acres.

Q Which would be something like three townships?

A Yes sir.

Q Of course a very substantial investment is necessary to open a potash mine?

A Yes sir.

Q Can you approximate a figure?

A I would say somewhere between 8 and 10 million dollars.

Q In the event drilling is permitted in any part of the area what is your feeling with reference to requiring a very substantial bond to protect the potash mines from damage which might occur?

A I believe a person who came close to a mining operation should be in position to protect the mine and provide proper

indemnity.

Q I believe there are a few outstanding leases in the area; is it your feeling that in order to protect the industry drilling for oil should not be permitted there?

A With reference to our particular problem, I would say Yes.

Q Mr. Davis, have you any questions?

MR. CAMPBELL: Q Do your statements in regard to the position of your company include everything in the letter to the Commissioner submitted by the other potash companies?

A No, I would say that all representatives of the five potash companies are here and can make their own statements.

Q When were the operations for your company started?

A In 1931.

Q You actually started in 1931?

A Yes sir.

Q Do you know how much ore has been mined?

A I am very sure it is more than 10 million tons.

Q That is crude ore?

A Yes sir.

Q Do you know how much is being mined in a year?

A I would say a million tons a year.

Q How far from your shaft do your tunnels generally extend?

A Some of them from a mile to a mile and a half; others not so great a distance.

Q Like spokes on a wheel?

A They extend out in eliptical form.

Q You say they extend no more than a mile or a mile and a half in the workings?

A Yes.

Q And you have been in continuous operation since 1931?

A Yes.

Q Do you have any estimate as to what has been set aside by the federal government as potash land?

A There is the one general potash area and, I believe an oil reserve.

Q Where is it?

A Northeast of our mine and southeast of the Potash Company of America.

Q Do you know how many sections?

A Four, I believe.

Q Do you know whether the state has withdrawn any land in that area?

A The policy of the state has been pretty well understood to this time, and it was that potash and oil be not taken from any place under the same area. Once in a while we have picked up an oil lease, both state and federal, and we have turned them back. At the January sale an 800 acre tract was placed for lease which lay directly over our mines.

Q You have purchased leases?

A Yes.

Q You now have some?

A Yes, I would say we have purchased them for the general good of the potash industry.

Q Could you tell how much your company has in potash land?

A About 35,000 acres.

Q How much of that is federal land?

A That is fixed by law at 15,000 acres.

Q Is it the intention of your company or what you intend to

mine out -- that entire acreage?

A Yes, we ultimately intend to mine all of it.

Q At your present rate of production that would take considerable time, wouldn't it?

A It would be.

Q I think you have stated in your mining operations that some of the potash remains in the mine in the form of pillars?

A Yes, sir.

Q Which bed is your company mining now?

A The lower bed.

Q Where are the lower beds situated?

A Relatively two hundred feet below the upper.

Q What is the comparison in thickness of those now being mined? Comparison to the upper beds?

A They vary from thicker to thinner.

Q Are they as extensive as the upper beds?

A They are less extensive.

Q You intend to mine out the upper beds after the lower beds?

A Yes, sir.

Q You feel you could not safely subside the upper level before the lower beds are mined out?

A That is right.

Q How far has this method actually progressed -- the technique of it?

A It is a very well known and established practice, not only in potash but in coal and metal mining.

Q How is subsidence avoided?

A I don't say the room and pillar method avoids subsidence altogether. Say a 10 foot subsidence would not necessarily

reach the surface. In the European mines a 200 foot subsidence filled the stopes.

Q Your mines, being flat, present no such problem?

A That is right. We can expect a 10 foot maximum.

Q Has the Bureau of Mines approved any definite plan?

A In 1933-34 a cooperative plan was approved but was never carried through because further investigation seemed desirable.

Q What is the danger of fractures allowing water to come into the mines, regardless of oil and gas drilling?

A We think at the present time it will be possible to bring a roof down in a very substantial area without cracking the area above.

Q You don't think existing fractures have given cause for alarm?

A Up to the present time we have not encountered any substantial amount of water in our mine.

Q Where do you obtain your water for use in your operations?

A From our shaft and by other means.

Q How much of it do you obtain from the shaft?

A I would say a third or a fourth.

Q You just pump it out?

A Yes sir.

Q I would like to ask about your core drilling operations generally.

A We drill down to the surface of the salt with cable tools and then take the core on down.

Q What do you do about water infiltration?

A The common practice is the use of cement. In some instances a certain amount of mud is used.

Q Coming back to the matter of removal of the pillars:

You leave, I presume, a larger pillar in some areas?

A Yes, that is correct.

Q And you would eventually remove them right up to the shaft?

A No, not to the shaft. The work would be done so as not to endanger life underground.

Q Is it your thought there would be any extensive movement when this is in process?

A We don't have a complete answer. We do know there is lateral movement. We have movement in two directions, that is vertical as well as lateral. We also know we have encountered so-called heavy ground.

Q You speak of lateral movement -- Does that extend into the areas now reserved and not actually mined?

A I am not competent to say how far you might have migration of air or gas. Some one else here can testify as to the lateral movement of hydro carbons.

Q You do feel that the danger is remote?

A I would say there is a calculated risk within a certain distance of an open oil well.

Q With regard to the bond mentioned in connection with drilling operations: How much would it be?

A It would have to be shown that the person undertaking the work was financially responsible but I don't think any one would know what amount should be set up.

COMMISSIONER: Are there any more questions? Mr. Protz, Mr. Morrell?

Q (Cont.) Are you actually doing any subsidence work?

A In limited areas we are actually removing parts of the pillars. As we remove the pillars there is a certain amount of what is called convergence and as we go on with the extraction we can determine what convergence takes place and when.

From the work done by the Bureau of Mines, we feel that we can safely make these tests as we work on the pillars, and learn what to expect.

Q What is your subsidence procedure? Do you work toward the shaft?

A We go out to commence, and work toward the center.

Q Suppose the ground gave way?

A If the ground below gave way and broke there might be but very little subsidence at the top.

COMMISSIONER: Are there any further questions?

MR. NEAL: I have some further questions.

Q How much of a pillar do you leave around your core test wells?

A Certainly up to 100 feet.

Q On all sides?

A Yes, in diameter.

Q That is 100 feet in all directions?

A Yes, sir.

Q In the event of oil and gas well drilling operations, what is your feeling as to the necessary area to be left for proper protection of the mine?

A I don't feel competent to estimate on that. Of course the pressure in an oil well would be a factor to be considered.

Q Would it be a dangerous operation?

A I would say so.

Q Do you know of any way to protect the mine in case of lateral movement?

A No.

Q What would occur if the casings were sheared or broken?

A The result would be intrusion of oil or gas into the mine or into the beds.

Q Do you leave the pillars where core tests have been drilled?

A Yes, sir.

Q How many of those are there?

A I believe there are ten in the coring area.

TESTIMONY OF MR. G. C. WEAVER

MR. NEAL: Q State your name, please.

A G. C. Weaver.

Q What is your business and profession?

A Consulting engineer, mining and petroleum.

Q Your education?

A I am a graduate of the Colorado School of Mines.

Q What has been your experience?

A I have had sixteen years experience; eight with one company, the Potash Company of America and four with International Minerals & Chemical Corporation and four as an independent.

Q Are you familiar with the Carlsbad potash area?

A Yes, sir.

Q In connection with your experience in potash mining, are you familiar with all of the known beds in the Carlsbad area?

A Yes, sir.

Q Please state what the beds consist of and the approximate area they cover?

A We generally think of four mineralized beds. Number four is the sylvanite bed.

Q What is the bed being worked by International Minerals & Chemical Corporation?

A That is the No. Two bed, the langanite bed.

Q Mr. Weaver, I believe you have seen the letter addressed to the Commissioner of Public Lands, dated March 16, 1951, in which the views of the potash industry are set out in regard to oil and gas drilling in the potash area?

A Yes, sir.

Q Is it your feeling that oil and gas drilling operations can be carried on without danger to the potash mines?

A I think there is great danger in such operations.

Q Will you please state to the Commissioner your feeling as to the danger from a geological and mining standpoint?

A Well, the thing that worried me more than any other factor is subsidence. I don't know of any way in the world to control that in the event of a drilling operation in that area. Subsidence is not a controllable factor, and it is unpredictable. There is a certain condition known as bumping and if it happened to shear the casing it would cause the loss of the mine.

Q What is your feeling as to endangering the mine by water encroachment if drilling operations were started?

A I think you would have a better chance of controlling that, but it still would be a very serious hazard. It would be a problem which would take a long time to solve, and great expense.

Q Is it your feeling that no matter what precautions were taken in drilling for oil and gas in the potash area, there is no manner in which positive assurance can be had that the wells will not cause destructive subsidence?

A I do not think any oil and gas wells could be drilled and be absolutely certain that there would not be some escape

of gas or oil either through corrosion or faulty threads in the pipe, or some other cause. These things happen every day in drilling wells, and strange and unforeseen things have already happened, and will continue from now on.

Q Do you know of the existence of any oil or gas wells in any part of the area being mined for potash?

A Yes.

Q Where?

A In the holdings of the Potash Company of America. It is within their projected area.

Q Has any oil or gas been encountered in the area?

A The Potash Company of America did encounter some oil and gas.

Q Fugitive?

A Yes.

Q Where did it come from?

A I would rather have some one else answer that question.

MR. CAMPBELL:

Q I gather your primary concern in the matter of oil well drilling in this area is subsidence?

A That is right.

Q You speak from an operational point of view?

A Yes.

Q How many levels are there in the International Minerals & Chemical mines?

A Three.

Q How extensive are the workings in the lower bed?

A

Q That is away from the shaft?

A That is right.

Southwest Potash Company?

A Yes, sir.

Q Where is that?

A In Section 9.

Q The shaft is being put in there, isn't it?

A Yes.

Q Have they located the shaft?

A Yes.

Q Are there abandoned oil wells in that area?

A Yes.

COMMISSIONER: Are there any further questions? If not, you are excused, Mr. Weaver.

MR. NEAL: I believe Mr. Thomas G. Moore of Southwest Potash Corporation would like to make a statement.

MR. MOORE: Our position in New Mexico is unique in that we are not now in operation and, therefore, have the opportunity to develop a mining system on a proven ore body from the outset. It is also true that our position is somewhat different from the operating mine owners in that our land is covered by oil and gas leases. I have here a prepared written statement which I would like to have made a part of the record:

"STATEMENT OF SOUTHWEST POTASH CORPORATION"

Southwest Potash Corporation has 13,082 acres under lease for potash from the State of New Mexico. On November 10, 1950, the company made application to the state to withdraw and exclude 320 acres of this land, not now held under oil or gas leases, from leasing and, to provide that the non-producing oil and gas leases on 1,440 acres of the above lands not be renewed or extended. No application was made,

nor is one intended to be made, on the remaining 11,322 acres still held under State lease. Copy of the application of November 10, 1950, was read into the record of the hearing held before the Commissioner of Public Lands on February 27, 1951. The Company also holds 7,678 acres under three Federal Potassium Leases and on November 10, 1950, made application to the Bureau of Land Management, Department of the Interior, not to renew or extend the oil and gas leases which now cover all of this acreage. Southwest Potash Corporation has therefore made application for a total of 9,438 acres to be excluded from further oil or gas leasing.

The above total acreage covers proven commercial potash ore with only a reasonable margin at the edges of this ore to provide for irregularities in its outline.

Southwest Potash Corporation contemplates the early extraction of pillars with a mining system designed to work toward a complete extraction of the ore body. The removal of pillars or a high initial extraction of the ore will cause subsidence of the overlying formations. A study of the longwall mining methods and consequent subsidence of overlying formations at various potash mines in France and Germany, which practice has been carried out in these countries for many years, has been made by Southwest Potash Corporation in connection with the designing of its mining system. Strong horizontal movement as well as vertical is inevitable in such subsidence and

precludes the maintenance of operating oil wells in areas subject to subsidence.

The success of these mining systems, as practiced abroad and as contemplated by Southern Potash Corporation, is based on virtually complete extraction of the potash ore. Even and unbroken subsidence of the overlying formations is necessary to prevent the influx of overlying water. Pillars around producing oil wells would prevent such unbroken and uniform subsidence and cause rupture of the overlying formations allowing water to flood the mine. Therefore, the choice is between total extraction and complete subsidence or the maintenance of full pillar support and the prevention of any subsidence whatsoever. Adequate pillars to support the overlying formations and prevent subsidence, would necessitate leaving up to 40% of the Southwest Potash ore body in the form of pillars. Consequently, the existence of even a few producing oil wells within the limits of the known potash ore body could prevent the extraction of the above large percentage of the ore.

The major part of the 9,438 acres stated above are covered by either State or Federal oil and gas leases. However, they have not yet been drilled and are non-productive, whereas the Southwest Potash Corporation has diligently developed the State and Federal potash leases granted to it and are committed and entitled, under such leases, to extract the proven ore to its fullest extent in accordance with good mining practice.

It is therefore reasonable to ask for protection of this ore body and the large capital investment required to bring it into production by withdrawal of the aforesaid 9,438 acres from further oil or gas leasing.

Southwest Potash Corporation submits that:

1) The mining of potash ores and the production of oil or gas from identical acreage is wholly incompatible.

2) It is not to the best interests of conservation of natural resources to prevent the extraction of up to 40% of the proven Southwest Potash ore body by allowing oil well drilling within it.

3) The exclusion of 1,760 acres of State land and 7,678 acres of Federal land containing proven potash ore from further oil and gas leasing is not only reasonable, as no productive oil or gas structures are known within this area, but essential in the best interests of conservation, the State and the general public.

Southwest Potash Corporation therefore respectfully requests that its application to the State, submitted November 10, 1950, be acted upon favorably.

Southwest Potash Corporation recognizes that any policy decision with respect to oil and potash in this area will have far-reaching effects and that for the good of all, the policy to be followed by the State and Federal Government ~~Government~~ should be coordinated. It hopes that this question will be given complete and detailed study by a joint commission of the appropriate State and Federal authorities and a policy developed only after thorough consideration.

Southwest Potash Corporation will be glad to submit

to the Commissioner of Public Lands or to a joint commission such information, in regard to subsidence and in regard to the effect of subsidence on producing wells, as it now has or may be able to obtain.

March 29, 1951."

(MR. MOORE, CONT.) Mr. Campbell has brought up the matter of the production of oil in Section 16, which is adjacent to our present shaft. The production in that area is on the edge of our commercial ore body. Furthermore, if you will trace the production of that field you will find it has been decreasing rapidly for the last few years. Apparently, from the oil records, within a reasonable time, the wells in that field will be non-productive. Only three are now producing.

MR. NEAL: Q From your statement do I understand that you expect to employ different mining practices from the other potash companies operating in the area?

A The only difference would be that the other companies have left their pillars and are now working toward their removal. We expect to initiate a different pillar extraction program.

Q As I understand it you expect to develop the mine from the outside in.

A Yes.

Q And in your operations you would expect to go from the edge of the ore body toward the center?

A Yes, and subsidence would begin at the edge.

MR. CAMPBELL:

Q What effect do you think your operations would have on the adjoining potash areas?

A There are none adjoining.

Q Isn't there a reserve in 19 - 30?

A Not so far as potash is concerned.

Q Wouldn't the effect be adverse?

A Frankly, I don't believe so. We would not expect subsidence to have any great effect other than as stated.

Q It would have an effect on oil and gas wells?

A Yes.

Q Do you say you would commence potash mining operations in Section 16?

A The first potash mined would not come out of Section 16.

Q The danger to oil wells is true whether the well is producing or abandoned, isn't it?

A The abandoned well can be plugged.

Q You plan to plug these wells?

A There is a well which we would expect to plug.

Q How do you plan to plug it?

A I think Mr. Stewart can tell you.

MR. STEWART: We have talked to several oil people and the procedure would probably be to pull the casing and plug.

Q You will rely on the opinion of a good oil man in that respect?

A We would. We hope when we have to mine Section 16 we can obtain the right to go in and plug these wells. If water has got through to the outside of the casing, we would want to be sure it was plugged off.

Q There is an abandoned well in Section 10, isn't there?

A Yes, and we have tried to get the log of that well.

Q Do you plug your core test holes?

A Yes, our core tests are plugged from the bottom to the top.

Q How many beds of potash do you encounter?

A One main bed.

Q How extensive are your core drilling operations?

A We have drilled 66 holes.

Q What is the thickness of the beds?

A It varies from 9 to 4 feet.

Q How much of an area have you tested?

A Nine thousand acres.

Q Do you plan to mine all this out immediately?

A Depending on conditions.

Q You figure the wells in this area are wearing out fast?

A The records so indicate.

Q What will be the effect of subsidence in this area upon the surface?

A You have asked that question, and I say again subsidence doesn't break up the surface when it is evenly distributed.

Q What would be the effect of a general subsidence?

A The whole question of mining method and extracting is one of development to meet conditions as the work progresses. Mining has not yet been done in the Carlsbad area by the method we propose to follow although it has been done in Europe successfully. Different methods have been developed for particular areas.

Q Your method has been approved by the United States Geological Survey?

A It has been discussed.

Q You do not know that it will be approved?

A Yes, sir, but you don't make a blueprint until you have developed a method to meet the conditions encountered. We are not yet underground in our operations.

COMMISSIONER: Are there any further questions? If not, we are in recess until 1:15 P. M.

TESTIMONY OF MR. R. G. HAWORTH

MR. NEAL: Q Will you please state your name?

A R. G. Haworth.

Q Where do you live?

A Carlsbad, New Mexico.

Q What is your business?

A Potash mining.

Q What company are you connected with?

A The Potash Company of America.

Q What position do you hold with the Company?

A Assistant resident manager.

Q How long have you been familiar with the potash operations in that area?

A Since 1942 when I started work there.

Q How long has the Potash Company of America been in operation?

A Since 1934.

Q Can you give us an estimate of the approximate underground miles you have worked through your tunnels?

A The lineal extent is about 200 miles.

Q What area does it cover?

A Our operation is in approximately four sections.

Q Are you able to tell how many sections of state land there are in your lease?

A We have approximately six sections in that area.

Q Have you been operating some of the state lands?

A Yes, we have.

Q In connection with your operation of the mine have you encountered any difficulty with running into fugitive oil or gas of some sort?

A Yes, we did encounter some oil and gas, I believe, in 1947.

Q Where was it encountered?

A In what we call the main south tunnel.

Q As a result of encountering this oil and gas did you make any changes in your operation of the mine?

A We abandoned part of the entries we had driven and offset our main entry about 300 feet.

Q Are you able to say how much production of potash had to be abandoned on account of the situation encountered?

A I cannot say because the oil and gas we encountered was not in contact with the potash formation; it was some distance above it. We were driving this tunnel in about 9,000 feet and about this distance we found a sinclinal fold and above that fold there was a zone of broken material and some clay beds which showed evidence of movement, and that was where we encountered the oil and gas.

Q Did you form an opinion as to the source of it?

A The only source we could agree upon was an abandoned oil well about 1200 feet from this tunnel, because we had not come across any in any other place.

Q: Is it your opinion that the presence of oil and gas within the area of your operations creates a hazard?

A It creates a hazard and each oil well is a hazard. Each oil well means more potash we will have to leave in pillars, as well as the precautions we will have to take in avoiding

a major disaster of some kind.

Q You say in this tunnel you found some evidence of shifting in these formations?

A Yes, the beds were folded down this way, and across, and when the tunnel encountered this particular clay bed we came across the oil and gas. There was no evidence of a fissure; it came in along that particular trough. I think the circumstance does indicate that oil and gas can migrate laterally.

Q You have heard the statements of Mr. Weaver and other gentlemen as to the danger not only from seeping oil and gas into the mine itself, but the danger of water, or flooding the mine. Are you in agreement with them?

A Certainly if the drilling operations were done the way most of them do it, I would not want to have any drilling done through our mine, because there would be a good possibility of getting water in.

Q Do you have any other statement you would like to make?

A I do not believe that our company problems are identical with those of other potash companies. I think there is such variation in conditions that come up, and probably in the operations of the oil people as well, that the only solution would be to settle each one as it comes up, more or less, and perhaps arrange for regulations which would be agreeable to every one.

Q Is it your opinion, with reference to the oil and gas leases within the potash area, that some sort of regulations should be made with relation to the potash mining?

A Yes, I do not think they should drill in any of the proven potash reserves.

MR. NEAL: I believe Mr. Davis has some questions.

MR. F. O. DAVIS : Q Isn't it a fact that because we ran into this migratory oil and gas that we found it necessary to do our exploratory work all over, and had to back off and move our entry several hundred feet, all at a cost of $40,000 to $50,000?

A Yes, it cost us approximately that. We had to plug off any seeps that continued; we managed to back away from it before we broke into it completely.

MR. NEAL: Q How many shafts have you sunk?

A We have started and abandoned two on account of quicksand and we are now sinking another by means of freezing the ground.

Q Is there a very heavy stratum of water there?

A Yes.

Q If it should go into the potash beds it could do an extreme amount of damage, couldn't it?

A It would be very difficult to shut it off. One fracture or one leaky casing would allow water to come down and make a larger opening all the time. It is not quite the same situation in a metal or coal mine. If they have water in a mine they can pump it out. We have to seal out all the water because potash beds are soluble.

COMMISSIONER: Mr. Campbell, do you have any questions?

MR. CAMPBELL: Q What did you state your position is with the company?

A Assistant resident manager.

Q Are you familiar with the production history of the company?

A Yes sir.

Q You started operations in 1934?

A Yes, sir.

Q What has been your total production, approximately?

A About 15 million tons, or better.

Q What is your present operation per year?

A It will exceed one million, quite a little -- maybe 1½ million.

Q What do you consider is your acre ton production?

A The recovery in the first mining will average somewhere in the neighborhood of 60%.

Q Do you have any estimate how much you recover per acre?

A That depends on the thickness of the ore.

Q Can you give me an average?

A I never worried about acre tonnage.

Q Couldn't you approximate a figure?

A Possibly 10,000 an acre, gross. That is very thin ore.

Q That is about a hundred acres a year?

A I think that would be about the figure.

Q Do you know the extent of your potash state leases?

A Somewhere in excess of 50,000 acres.

Q Do you know what the amount is on federal land?

A The maximum allowable -- 15,000 acres.

Q Then you would have at least 65,000 acres of these leases?

A Yes.

Q Then it would take you 650 years to develop the area you have under lease?

A That would depend on how much of it was productive and on increased production.

MR. NEAL: Q There is a great deal of your acreage that is not productive, isn't there?

A We have some which we are prospecting. Most of that is wildcat.

Q You spoke of having to take extra precautions in that area.

Are you familiar with the precautions that would have to be taken if any oil well drilling was done there?

A We know we would have to take the precaution that the driller knows what to do.

Q Are you acquainted with this core test drilling operation?

A Yes.

Q Do you drill your core holes on a pattern?

A Normally, yes.

Q How frequent would they be?

A It depends on what the problem is. Sometimes we might drill on every 40 acres. In other cases we might drill on section corners.

Q You use cable tools to drill down to the salt?

A Sometimes cable tools are used and sometimes rotary.

Q What do you do then?

A They case and cement in the top of the salt.

Q After you have taken your core what do you do?

A We have the drillers run the rods in the hole and pump in the cement.

Q That is in the salt section?

A Yes.

Q What do you do in plugging a core test hole?

A We are required by the United States Geological Survey to seal off the water with cement and then use mud in between.

Q How about casing?

A Well, we don't have any casing for one thing. Casing might tend to pull away, if it were used, and possibly break through at the water zone.

Q I understand your view was that each case should be decided on its merits. Is that your idea?

A I should think so. There might be areas in which oil men would not think of drilling and there would be no conflict; and there might be cases of state and federal land which would have to be regulated by officials.

Q That would pretty well eliminate the drilling of a large acreage?

A That would depend on the fact of such acreage being withdrawn. I do think where potash is found no wells should be drilled.

MR. CAMPBELL: I don't have any questions but I believe Mr. Weaver has.

MR. PAUL J. WEAVER: Q You mentioned, I believe that at the point where you found this oil there was clay?

A Yes, sir.

Q You also stated that this oil was migratory.

A Yes sir, that was a question and I answered yes.

Q Do you have evidence that this oil was under pressure? When you say "migratory" that indicates it was moving.

A When we found this seepage we drilled a small hole about 1½" in diameter, and we had a man there with an axe and he drove a plug in. It was not pressure such as is found in our mine. We found gas somewhere else under pressure.

Q Where was that?

A I believe one of our cores did show some oil, but it was very difficult to determine the source.

Q Was that in the area of abandoned oil wells?

A I believe it was.

Q Now about subsidence: I don't believe anybody has decided about how subsidence in an area corresponds with the cavity underneath. Isn't it true that practically all the evidence is that when you have an area letting down onto a cavity that

the break takes place at about a 45° angle. Wasn't this established in an issue of the Independent Engineer -- that subsidence does not affect an area more than about the distance out?

A I may not have read that article. I have had some experience with subsidence. I know if you have an area that is moving, it can affect something not directly over it.

Q But isn't the distance to which it goes at an angle of about 45°?

A I should think it could be much greater.

Q Isn't it a fact that the removal of areas in this mining area should not be expected to move installations laterally?

A That would depend on the mine.

COMMISSIONER: If there are no further questions you may be excused.

TESTIMONY OF MR. F. O. DAVIS

MR. NEAL: Q Will you state your name?

A F. O. Davis.

Q What is your business?

A I am Vice President and Treasurer of Potash Company of America, residing at Carlsbad, New Mexico.

Q How long have you been with that company?

A About fifteen years.

Q Are you familiar with its operations?

A In a general way; of course I am not an engineer, but as a director of the company reports of our activities come to me.

Q There has been some discussion regarding cave-ins and back filling? Will you please tell us your ideas?

A We have made extensive studies in regard to back filling

and pumping back any foreign product which may be used. Our estimates are so far that it cannot be done within our margin of profit. In connection with the margin of profit, in New Mexico our competition is with several foreign companies. They can lay down here at our market cost and they are doing it, and we would have to absorb any back filling expense incurred. Another problem in back filling is the replacement of material and consequent double handling of it.

Q Is there anything further?

A One thing is the area under lease by the potash companies. Reference has been made to holdings of 65,000 acres. Actually the majority of that acreage is held for exploration. We do not anticipate that all of it is going to be underlaid with potash.

Q Are you familiar with the holdings of International Minerals & Chemical Corporation?

A I understand they also have approximately 15,000 acres under federal lease, which is the maximum. A further point in regard to acreage held for exploratory purposes is that if you have not developed it within a certain time it reverts to the state.

MR. CAMPBELL: Q Will you make a restatement regarding exploratory holdings?

A In addition to your federal lease you have the possibility of holding lands under prospecting permits. If no ore has been developed, the lands revert. Under the state leases you have a ten year period to carry on your initial exploratory work; a certain minimum amount of work is required and if no commercial quantities of potash are found, it reverts to the state after ten years.

Q Do you know of any exploratory lands having been withdrawn?

A Only supplementary withdrawals would have been made since 1939. When we took our leases the withdrawal order of 1939 had already been issued.

MR. NEAL: Mr. Cramer would like to have a correction recorded of a statement he made this morning.

MR. CRAMER: Our company has very close to 30,000 acres in state potash leases, a little over 15,000 acres in federal leases and about 45,000 acres in so-called reserve, which were withdrawn for oil and gas leases. That 45,000 acres cover three potash companies.

Q You do not mean proven potash lands?

A No, sir.

Q Does that mean you automatically seek withdrawal when oil and gas leases are issued?

A No sir, not that I ever heard of.

Q You said the leases and withdrawals were about the same time?

A Our leases were issued in 1932. The federal withdrawal order was in 1939. I don't know about the International leases. There were four sections withdrawn subsequent to 1939 for all leases. The government prospected it and found potash.

MR. CAMPBELL: One phase of this matter we did not get to on that prior hearing, and that is in relation to the migratory possibilities of oil and gas. Mr. Hill, you have previously testified in that prior hearing that you have had considerable experience in oil fields in Texas?

A Yes, sir.

Q Have you had any experience in the Texas fields where wells have been drilled close to each other and were producing from different horizons?

A We have some in the Keystone formation in Winkler County which were drilled five wells to forty-acre spacing. The deepest well is 660 feet location in the centre, and the other wells vary in distance from 110 ft. to 220 ft. from this centrally located well. The deepest well produces from the Ellenberger, which is 10,000 feet, and came in originally with a pressure of 4250 pounds to the square inch. At no time has there been any migratory evidence due to any faulty cementing or channeling that would have allowed such migration to occur.

Q You drilled through a salt section?

A Some 1200 or 1300 ft. of salt.

Q And you drilled subsequent wells in the immediate vicinity?

A Yes, sir.

Q What is the result if there is any migration?

A You have a blowout, and in no case did we encounter one.

Q In other words, you are convinced there is no migration of oil or gas between wells drilled 100 to 200 feet of each other?

A Yes, sir.

MR. NEAL: Q It is true, isn't it, that in drilling in salt areas you do hit areas of gas, either natural or nitrogen?

A We have had some of these instances, but we believe they are accumulations and not migratory from adjoining wells.

Q They blow out all around the well?

A There is no way to control that.

Q But they do occur, however, and if something of that kind occurred over a potash bed there would be extreme damage to the mine, wouldn't there?

A I don't think so.

Q Why?

A I don't think if you ran into this sort of accumulation of gas, unless it was a migratory condition, which I doubt that it would be, that it would have sufficient force to damage anything.

Q I have in mind a well immediately south of Lovington which blew out. Do you remember that?

A No, sir.

Q It blew out a large area around the well.

A I am not very familiar with the Lovington area.

Q But you have seen that occur?

A But not petroleum gases.

Q Whatever damage it did do over a potash bed could be serious?

A You could have the same condition in core drilling.

Q But it would be more likely to occur in drilling for oil, wouldn't it?

A There is no casing used in core holes and we would not have that hazard.

Q The well near Lovington was some 4,000 feet deep.

A You have not stated whether they were drilling with cable tools or rotary?

Q Well, whatever they are, if a well blows out and gets away from you it could be extremely damaging if it were over a potash mine.

A I don't believe an operator would allow himself to get in that position.

COMMISSIONER: Are there any further questions? Mr. Seth, do you have a witness?

TESTIMONY OF JOSEPH P. SMITH

MR. SETH Q Please state your name?

A Joseph P. Smith.

Q And what is your business?

A I am employed by the United States Potash Company as geologist.

Q How long have you been so employed?

A Almost twenty-two years.

Q Were you so employed when the potash development was started in the Carlsbad area?

A Just before the operation was started.

Q What is your training?

A I am a graduate of Louisiana State University and have done graduate work at Stanford.

Q You have been at Carlsbad since 1929?

A Yes, sir.

Q Are you generally familiar with the geology of this particular area?

A Yes, sir.

Q You have had an opportunity to observe underground conditions, formations and potash deposits by way of core tests and other means?

A Yes, sir.

Q Are there layers within the United States Potash leases where the water bearing beds are in direct contact with the salt?

A Yes.

Q Is the amount of water in these beds of large magnitude?

A It is a little difficult to tell. We have never made an attempt to bail or run pumping tests, but I would say there is considerable.

Q Do you know whether there are water bearing beds under

the salt?

A:No, I don't know, but recently a well near Malaga found considerable water underneath the salt section.

Q Do you have available some cores from the various core drilling tests in this area? Do you have some with you that you would like to show the Commissioner?

(Mr. Smith produces a section of core test material)

A This core is from the salt section. Not at the top, but at 100 foot depth. This is a core that goes all the way through. You can see it is extremely fragile, and only by chance is it preserved as well as it is. That proves that the salt is porous . . . . This is not a core but a piece of mudstone . . . . The interesting thing about this are the curves, which indicate a lateral movement. It underlies the salt, and the slope is something like 2 degrees. The direction of these curves is this way -- and if turned over another set of curves is different. Not only one lateral movement, but two.

Q Can you say this is fairly representative of conditions throughout the salt section?

A Certainly much more so than most of us have realized. An open crevice was found in one of the International levels.

Q How would you describe it?

A It certainly is a very positive bit of evidence.

Q When they speak of salt beds aside from the salt, are they comparable in porosity?

A By salt we don't mean homogeneous. We have salt of this character and some extremely tight, and others in which streaks of clay, anhydrite, etc., occur. I have a core in which the clay seams have been invaded by the salt. These are occasional occurrences, but this, by and large, is

characteristic of salt. Although I would not say these zones of porosity are found uniformly, it is odd chances that you will get this.

Q Is there anything else, Mr. Smith?

A I would like to say that in our processes, when we get through coring we fill our hole with cuttings, granular salt and sand and then put in a wooden plug and then a cement plug on top of that.

Q What is the effect of fresh water in these beds?

A It would take it up very rapidly until satisfied.

Q Are they readily soluble in water?

A Yes.

MR. CAMPBELL: Q Are you acquainted with the procedures in drilling oil and gas wells to protect against water encroachment?

A A well operator in Artesia approached us about drilling a well and after considerable negotiation we found he was intending to drill, at least in part, without benefit of casing.

Q I take it you didn't allow him to drill the well?

A No, sir.

Q In connection with your coring operations, have you found the salt is not a very uniform formation?

A I would say not. It is interrupted by clays, anhydrites, etc.

Q How does that affect your views of subsidence?

A I know very little about subsidence. If you are dealing with a homogeneous salt it would behave uniformly. The salt will not bond with clay or anhydrite. In my very limited point of view you would get subsidence clear to the top.

Q You have heard Mr. Weaver's comments on subsidence?

A If you want me to express an opinion, I think it depends on the character of the section and the mine.

MR. NEAL Q It is true that you have encountered areas where the potash has been eroded away, isn't it?

A The surface of the salt going from west to east is something like this (illustrating). The salt has been eroded and removed.

MR. CAMPBELL: Q Isn't it true there are areas where they have endeavored to induce secondary recovery by the use of back filling methods?

A Yes, back filling was used as an additional prop but not in entirety.

Q Isn't it true that the cost of back filling is greater than would justify its use?

A I rather think that is true. We have made some experiments with bulldozers and found settling takes place to the extent of twenty per cent very quickly.

COMMISSIONER: Are there any further questions? If not, you are excused.

TESTIMONY OF MR. HENRY H. BRUHN

MR. SETH: Q Please state your name and occupation.

A Henry H. Bruhn, resident manager of the United States Potash Company at Carlsbad.

Q Are you a mining engineer?

A Yes, I graduated from the University of Arizona, where I majored in mining and geology.

Q You have heard the testimony already given. Will you please discuss the matter of subsidence, whether or not it entails the fracturing of the beds or whether means and devices used can prevent the fracturing of the overlying beds?

A So far complete tests in the removal of pillars have not

been carried out. We have tried some back filling to find out what the results would be. It is my own opinion that even with packed in material there would be a foot of space. The back filling material would also have a tendency to close down and you would get possibly three feet of when you robbed the pillars in between. Some experiments have been tried in what I call pin or spindle pillars, and if a large enough area is robbed the area would tend to spring down and close up. One thing I think has not been brought out is that any time you take out masses of material under a 1000 ft. overburden you have a terrific load. We also find places where the back is very heavy and has to be supported until we get out of the area. When the supports are removed it will drop. With that type of movement I would be very nervous if we had an oil well casing even through a thick pillar, and I would be concerned about gas getting into the workings.

Q Then there is movement resulting from your own operations?

A We have heavy ground in our No. 1 shaft and sometimes we notice as much as 6" movement.

Q Isn't it a fairly common occurrence to have a shifting of two or three inches?

A I have seen much greater.

Q And these result from the mining operation?

A We have all of this weight above, and it is hard to say just where it occurs or why in some cases.

Q Have you encountered any gases which have injured lives or interfered with the operation of the mine?

A We do find pockets of air or nitrogen both above and below and sometimes within the potash beds. We have found cracking

at the back and have drilled up to release the gas and stop the cracking.

Q What would be the effect if natural gas were permitted to enter the workings?

A It would be a terrible hazard. We have men at six or seven thousand feet, and if any amount of gas got in there it would certainly create a serious condition.

Q How many men work on an ordinary shift?

A I would say 90 or 100 men.

Q What would be the effect of the introduction of crude oil or gas into the workings?

A It is mainly a fire hazard. You don't have to have very much fire to fill an underground cavity with smoke, and the results are very dangerous.

Q Is there any way of controlling water in a mine?

A It would depend on the water. I would state you cannot bulkhead it. It just cuts and channels its way into the salt. If you attempted to pump it out, and it was saturated with brine, I don't know where we could put the brine without damaging the surface lands.

Q Is there anything else?

A I have seen a great deal of caving in mining in Arizona and I think your break is about 45°. But I seriously question whether the results in metal mining would be comparable in salt beds such as ours. Our experience with that plastic formation was that it would spring down or pinch right at the top. Our problem is to take down enough of the area so it would spring down. However, some of the geological survey men might be able to give some better information. In the case of the United States Potash company we are very hesitant about putting bail holes through the workings. We

have considered them for power, but have given it up because we are fearful that one of these movements might cause shearing of the casing, and we have large quantities of water which we don't want in the mine.

MR. CAMPBELL: Q I understood Mr. Cramer to say that you will not remove the pillars around the core holes in the mine?

A Yes, sir.

Q And if you did, as I understand, you run the risk of vertical movement?

A Yes.

Q You saw the core shown here. Have you come across similar indications of fracturing underground?

A I have definitely encountered them in cores, but I have never found any underground.

Q Your comment that there is risk of shearing pipe is based on the assumption that it is a single pipe, isn't it?

A Yes.

Q Suppose there were four strings of pipe?

A I have never seen a horizontal movement that would not shear a pipe.

Q Your principal concern is oil wells in an actual mining area, isn't it?

A Yes.

MR. SETH: Q This horizontal movement -- you assume it would have sufficient force to shear a number of strings of pipe?

A It would be quite possible to shear four or five strings. I have seen movement in metal mines where it was as much as forty or fifty feet.

MR. WEAVER: Are you familiar with the subsidence

that takes place when sulphur is removed from a mine? There are extensive records of these operations. This is perhaps analagous to that situation. There are areas where there are as many as 100 wells in close proximity to mines having such deposits, the surface is subsiding and the wells producing.

A I am familiar with those operations in only a general way. Are you absolutely sure that there is never any fracturing due to that subsidence?

Q What I would really like to have you express is the diatance out from the area to which you think the movement would reach rocks. Do they move a mile -- about the same distance out as is the depth?

A There is some limit there. I think it is probable we can only go on supposition.

MR. NEAL Q Of course in your sulphur mines you have no men.

A That is always in my mind.

COMMISSIONER: Any questions? If not you are excused.

TESTIMONY OF MR. L. H. FREEDMAN

MR. SETH Q Please state your name?

A L. H. Freedman.

Q What is your business?

A We have our own producing company: James H. Snowden, Fort Worth, Texas.

Q Have you had considerable experience in drilling for oil and gas?

A Yes, sir.

Q Approximately how long?

A I have been around oil wells since about 1918.

Q Were you connected with some drilling operations at the

place where the potash deposits were discovered?

A Yes, sir. It was our wildcat well, drilled by Snowden & McSweeney, that resulted in the finding of this potash.

Q Have you more or less kept in touch with the development there?

A Yes. I have been in touch with all the coring and various phases of the operations prior to the actual mining.

Q Have you also had experience with cementing techniques?

A Quite a great deal.

Q In your opinion, in using commonly accepted methods of cementing, are there still substantial possibilities of error or failure?

A Yes, I consider the handling of cement as one of the uncertain factors in completing an oil well.

Q The results are erratic then?

A Yes, sir.

Q As I understand it there is no way of telling whether you have been successful until a test is made?

A No, you don't know whether you have accomplished your purpose until you test.

Q What pressure would you expect to encounter in an 8,000 to 12,000 ft. well?

A It would vary with the amount of gas. I would expect around 5,000 or 6,000 pounds.

Q Do you have any experience in this particular area?

A No, not in this area. We have drilled some shallow wells there, but no deep wells.

Q What means must be taken to prevent the intrusion of water and gas in drilling in the potash area?

A I would think it would be very dangerous to drill through a mine where men are working in shafts and tunnels because

you are disturbing the rock underneath; you have water above and below; you have no assurance that you can always shut that water off after drilling because that rock is salt, and it crumbles and a cement job is not as good as where it has something solid to stick to; furthermore, you don't always get a shutoff.

Q If drilling by ordinary methods, what would be the procedure in the initial stages?

A If you were drilling with a rotary system, the weight would have to be balanced to any pressure underneath.

Q And that would mean several thousand pounds to counterbalance the pressure while drilling over this salt bed?

A It would be a very substantial pressure, besides the weight of the fluid.

Q Are there chemical difficulties encountered in cementing?

A Yes, there are a lot of things to be encountered.

Q Are there occasions when you find a cementing job unsatisfactory?

A Yes, sir.

Q Is there anything further you would like to say?

A No, except that it is not a certain thing at all.

MR. CAMPBELL: Q Your company is also in the potash business, isn't it?

A They own part of it, but have nothing to do with the operation.

COMMISSIONER: Are there any further statements or questions? If not, the witness will be excused.

MR. NEAL: We do feel that the Commissioner should give consideration to the appointment of a committee from both industries, federal and state agencies and the Commission itself to get together and work out something in the way of

regulations to best serve the requirements of all concerned. We request that the letter of March 16th addressed to the Commissioner be read into the record of this meeting and be made a part thereof.

COMMISSIONER: It is so ordered.

The letter follows:

Carlsbad, New Mexico
March 16, 1951

Honorable Guy Shepard
Commissioner of Public Lands
State Land Office
Santa Fe, New Mexico

Dear Mr. Shepard:

On February 27, 1951 a meeting was held in the office of the State Land Commissioner with a view to reconciling the proposition that potash and oil can be produced from the same land. Witnesses from both the potash and oil industries appeared and gave evidence which left matters in such an uncertain status that the Commissioner of Public Lands proposed a further hearing, the date for which was set for March 29th. In the notice of March 2nd, advising of this meeting, the Commissioner stated that it was his desire to make a ruling and dispose of the matter promptly.

This situation is of such vital importance and the final decision may be so serious that it is respectfully proposed by the potash companies that no final decision be made until a full study has been made of the harmful conditions which could occur by reason of dual operations on the same land. In the hearing of February 27th a large number of competent experts, representing the potash industry, voiced their fears with regard to any drilling in or immediately adjacent to the present potash workings. It is assumed that both the Commissioner and the other interested parties

will want to take advantage of the best technical advice available from all sources before any decision is announced.

Production of potash in the United States is of relatively recent origin and it has been conslusively demonstrated in the last two world wars that the mineral is of the utmost importance to the economy and the war efforts of the United States. In both wars the importation of any potash was effectively barred by the fact either that the foreign producing country was an enemy or shipment was made impossible by submarine warfare, etc. The nation was made dependent solely on the production from within the United States. Of the domestic production between 85% and 90% of all of the product is produced in the Carlsbad, New Mexico area. About 10% of the national production comes from brine lakes in California and a very small production is secured from brine lakes in Utah. For all practical purposes, therefore, it can be stated that the nation is completely dependent upon the potash produced in the Carlsbad, New Mexico area and anything which might be done to endanger this production could create serious consequences.

It can be granted that the production of oil is also important to the national economy but the points at which oil can be produced are wide-spread throughout the nation and the small area involved in the potash district would in no sense endanger the nation's oil position. Furthermore, the fact that there might be some restriction placed on the production of oil in the potash area would not hurt the position of either the state, the nation or any interested oil producers. The oil would remain available in the ground until such time as production could be secured without danger to the potash reserves.

During the past several decades it has become increasingly evident that the major factor to be considered in mineral production of any type is the conservation of such minerals

so that they may be produced in an orderly manner and in the best interests of the nation or the state where the minerals are located. If, as a result of comprehensive study, it should be decided that the best interests of conservation could be served by not permitting production of oil from known potash lands, this would not serve as a barrier to oil production but would merely represent a deferment of such production. Such action would permit orderly development of and production from the relatively small acreage of known potash lands, the product of which is so important to the agricultural and general economy of the United States.

Danger exists in more ways than one if unrestricted development of oil in the potash area should be permitted. The first bedded deposit of potash found in the world is located in the Permian Basin in Germany, in similar conditions to those which exist in the Permian Basin in New Mexico. Early in the 20th Century haphazard development of the German deposits was permitted with the result that a number of mines in that country were lost because of improper protection against overhead water. All of the currently producing New Mexico potash mines have a tremendous amount of water contained in the strata above the salt bed and it is necessary to maintain constant vigilance so that no breakthrough will occur in the area of the potash deposits. It is not at all far-fetched to assume that a potash operating area could be destroyed by a breakthrough of water and even with the most stringent type of regulations it is still possible that a breakthrough could occur in the event of subsidence or convergence due to mining which could, in a moment, result in the rupture of casings and the destruction of any protective devices which had been undertaken. Coincidentally, the oil well would be destroyed with consequent heavy capital loss.

Second, a real point of danger exists through the possible migration of gases or oil into the potash working areas. This condition could arise either through the failure of casing from subsidence or other causes, the corrosion of casing penetrating the potash beds, or through natural fracturing of the salt beds and underlying strata. The hazard in this instance is not solely restricted to the proposition that a mine could be irremediably damaged but an extremely important factor of safety is involved. To date, the potash mines of New Mexico have been relatively free from any dangerous gases but if any condition should permit the entrance of such gases into the working areas it would result in hazardous conditions, perhaps leading to either explosions or poisonous effects on the workmen. Therefore, a serious condition of personal safety is involved as well as safety to the operation.

The importance of arranging proper conservation of the potash deposits was recognized by the Federal government in 1939, when the Department of the Interior issued an Order withdrawing certain of the known potash lands from oil or gas development. The suspension of the granting of oil and gas leases on these lands was in the following form:

> For the purposes of protecting and conserving the potash deposits belonging to the United States, it is hereby ordered that, until further notice, no lease under the oil and gas provisions of the Act . . . will be issued for the following described lands, and no application for oil and gas lease will be accepted . . .

Informally, Department of Interior Officials have advised various potash company representatives that certain proposals for removal of the restrictions have been made, and that the Department considers the situation of great importance and proposes to undertake a complete study to ascertain what the future course will be. It is felt by the potash producers that similar study should be undertaken by the state authorities and that the important decision as to permitting concurrent production of oil and potash from the same lands

should not be made until it is determined what the overall effect would or could be.

At the hearing of February 27th, in the State Land Office, representatives of the oil industry gave as their opinion that the concurrent production of the two minerals was not incompatible but none of the oil representatives could state what would happen, despite the most stringent regulations, if any failure should occur in the oil or gas casings by reason of subsidence in the potash properties. The whole question of safe mining, both from the standpoint of working personnel and conservation of the potash deposits has been a matter of study by engineers at the potash companies for many years. Without exception, all of these engineers advise that there is a grave danger if oil exploration and development should be permitted on the potash lands. With such a wide divergence of stated opinion by the two interested groups, the need for complete and unbiased study is further pointed up. Expert advice is available to both the state and federal departments which are charged with conservation and supervision of production of minerals and every effort should be made to make use of such expert advice.

It is important that not only the potash deposits be protected but that if any oil or gas drilling is undertaken in the Permian Basin this should be done under regulations which would protect any possible future deposits of potash which might be found. The intermingling of state and federal lands in the potash district make it important that uniform regulations, insofar as possible, be adopted by both the state and federal authorities and a joint study by the two bodies would be most desirable. Discussions with Department of Interior officials have been carried on recently and these officials indicated that a joint study would be agreeable so that a full measure of conservation and protection could be afforded to all.

The Carlsbad potash companies have met together in this situation in order to give serious consideration to the problems involved. It is urgently recommended by these companies that the State Land Office proceed most cautiously in making its determination and that no endeavor be made to immediately render a decision following the hearing of March 29th. A great responsibility devolves upon the Department official charged with making the decision as to the propriety of concurrent production of oil and potash inasmuch as not only the interests of the state are involved but also the interests of all citizens of the United States who must look to continued production from and development of the New Mexico potash deposits as an insurance for their continued well being.

The potash industry will be glad to join in any study which might be undertaken and will furnish members for any deliberative or consultative body which might be formed to review the situation. It is recommended that an advisory board be set up to make not only an initial study and recommendations but to act as a continuing board to formulate policy and protective measures to the end that the interests of both the oil and gas and the potash industries will be recognized and protected. Also, we are of the firm belief that the problem should be considered jointly by Federal and State authorities and any regulations found necessary should apply uniformly to both Federal and State lands. This procedure would result in the formulation of the best possible policy for the conservation and protection of the mineral resources of the State of New Mexico.

Yours very truly,

UNITED STATES POTASH COMPANY

_____
President

POTASH COMPANY OF AMERICA

_____
Vice President

DUVAL SULPHUR & POTASH COMPANY

INTERNATIONAL MINERALS & CHEMICAL CORP.

President

SOUTHWEST POTASH CORP.

General Superintendent

MR. CAMPBELL: I would just like to say a word for the forgotten man -- Mr. Ralph Nix, whose application started all this. I realize that the matter is one of wide importance and that it will have to be worked out from an operational point of view. I also feel that nothing has been brought out at these hearings to indicate that the State of New Mexico should not lease available lands. Mr. Nix requests that his application be granted.

MR. NEAL: To which we certainly object, because we have endeavored to bring out at this hearing that additional lands in the potash area should not be leased for oil and gas exploration and production. There are some leases in effect which nothing can be done about, but we still feel that the state has benefited very greatly by this potash and that all potash deposits now known or to be discovered should be reserved for potash development.

COMMISSIONER: Is there anything further? At this time I believe that both oil and potash can live together there but I cannot render a decision right now because there will have to be some special provisions in these leases. I am going to appoint a committee of both potash and oil representatives for this area. This committee will be appointed tomorrow. The federal government will sit in and will appoint their men. This will be done immediately as I don't have any desire to have the matter drag on indefinitely. We hope to arrive at a decision as quickly as possible. If there is nothing further, the meeting will stand adjourned.

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OIL CONSERVATION COMMISSION

STATE OF NEW MEXICO

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TRANSCRIPT OF RECORD

OIL-POTASH MEETING

Held at Santa Fe, New Mexico

Tuesday, February 27, 1951

OIL CONSERVATION COMMISSION

STATE OF NEW MEXICO

OIL - POTASH MEETING

Held at Santa Fe, New Mexico, February 27, 1951

BEFORE: Hon. Guy Shepard, State Commissioner of Public Lands, Acting Chairman

Hon. R. R. Spurrier, Secretary and Director

Hon. George A. Graham, Attorney

REGISTER:

T. M. Cramer
United States Potash Company
Carlsbad, New Mexico

Oliver Seth
United States Potash Company
Santa Fe, New Mexico

R. H. Blackman, Jr.
Potash Company of America
Carlsbad, New Mexico

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Carlsbad, New Mexico

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Potash Company of America
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John M. Kelly
Independent Oil Operator
Roswell, New Mexico

L. B. Hodges
Independent Oil Operator
Roswell, New Mexico

Jack N. Campbell
Atwood, Malone & Campbell
Roswell, New Mexico

J. E. Hill
Richardson & Bass
Fort Worth, Texas

T. L. Dean
Oil Operator
Midland, Texas

K. C. Howard
Fort Worth, Texas

Ralph Nix
Artesia, New Mexico

Jerry Curtis
Artesia, New Mexico

CHAIRMAN SHEPARD: The meeting will please come to order. At the time this meeting was called we thought we would all get together in the office, but so many have come that we have moved down here. This is not a regularly called hearing, but an informal meeting where we want to try to work out the question whether oil and potash can work together. The procedure will be, first to hear from the potash interests why oil leases should not be issued at the same place where potash is being mined.

MR. SETH: The potash company we represent is willing to provide any information you may need which we can supply, and we welcome the opportunity to discuss the matter. There is no organization, so to speak, of the potash industry interests, but we thought we would come and offer such information

as we have been able to gather, and to hear what the proposals from the various oil interests are with regard to the mining of potash and oil operations within the same area. They are seeking to bring about a change of policy on the part of the land office and we would like to hear what they have to offer and we will put forward such technical information as we can in response to their case. It would appear that they are asking for rather a radical change in the Land Office policy, which will have a very far reaching effect; and I think it should be borne in mind that there are still a great many unknown factors which will arise in connection with this matter and which will be subject to some considerable careful study by all concerned. There is a great deal yet to be known about migration of liquids and gases underground, and the mechanical problems of oil well drilling and cementing underground; and it would appear that, in view of all these aspects that the proponents should be prepared to demonstrate that they have virtually a fool-proof method of protecting the other interests in the land. Also, there are a number of different questions or approaches to the matter. In the first place, the policy of the Land Commissioner as to leasing and other questions; how to handle leases in the potash areas, and priorities as to potash and oil leases. Speaking more or less personally, and from what little I know about the situation, it would seem that the oil and gas people are in better position to demonstrate what precautions they propose to take in connection with their drilling methods, protection of the various beds, including water beds, during the processes of production and plugging of abandoned or dry holes. Technical problems and mechanical problems are those of the oil well drillers and the operators of the wells after production.

We cannot make any intelligent suggestions or offer any constructive information in the matter until we know what the oil well drillers propose to do; and for that reason we are really not ready to present any formative showing, but we will be glad to have any suggestions the Commission may have after we know what the oil and gas companies propose, and if we do not have the information of any type you would like we will get it. We are more than anxious to present any information you may need in order to make your decision.

MR. CHAIRMAN: Perhaps it would be well to hear what the oil and gas men have to say, and find out what their proposals are.

MR. CAMPBELL: My name is Jack M. Campbell, representing Mr. Ralph Nix. The people in the oil industry are likewise here to furnish any information they can. From what we understand of the problem we see no reason why the two industries cannot operate in the same area. What we are seeking we do not consider is in opposition to the policy of the Commission in this area. While there are several potash operations in this area, we feel that before Mr. Nix submits to a withdrawal we should know what the necessity is for such withdrawal. We have no objection to putting on any testimony the Commission may require or desire. We feel that it behooves the State of New Mexico to proceed with the development of any oil lands, and I am sure these people will agree that if there is any way to do so it should be done. Mr. Chairman, is the testimony to be given under oath?

CHAIRMAN: It is not necessary; this is an informal meeting.

MR. CAMPBELL: I would like to have Mr. J. E. Hill take the stand.

Q Please state your name.

A J. E. Hill.

Q By whom are you employed?

A Richardson & Bass of Fort Worth, Texas.

Q What is your position?

A Superintendent of drilling and operations.

Q What is your profession?

A My education - I am a graduate of Petroleum Engineering University of Oklahoma, 1929, and I have worked in the oil business for the last twenty-two years.

Q Are you familiar generally with the salt formation present in that area in Eddy County, New Mexico, where potash is being mined?

A Yes sir. I have read their reports of the process, geology and technique.

Q In connection with your work, have you in other areas had occasion to find salt formations of this type?

A In the Keystone Field in Winkler County, Texas, we have drilled 250 wells, dating from 1935, and in this field have penetrated some 1100 to 1200 feet of salt section, by both cable tool and rotary drilling. This salt section is overlain by a geologic formation called the Rustler which, I believe, overlays the salt section in the vicinity of these mining operations. The salt at the Keystone Field is some 700-750 feet deeper than it is in Eddy County, New Mexico, in the vicinity of this potash, but not quite so thick. It is my understanding that in Eddy County it is some 1600 feet thick, whereas in Winkler County it is some 1100 to 1200 feet thick. In our cable tool drilling, as well as rotary drilling, we cemented at the surface to protect the water sands, and after penetrating the salt section we set a second string and cemented it back to the surface. This second string is usually set at

approximately 2300 to 3800 feet, depending on our location in that area. To insure the cementing of our strings we run temperature surveys to check the top of the cement, and if it has not reached the desired level we recement until we do get it to the surface. I see no reason why this method could not be applied with safety to oil well drilling in Eddy County.

Q You do not experience any communication after following this procedure in the salt area?

A We have never found any signs of communication and have further tested it in the last two years by liquified petroleum gas storage wells in the salt section. In this case we have set our casing strings at the very top of the salt section and, contrary to our ordinary drilling practice, which is the use of saturated brine solution to prevent washing out or dissolving of the salt -- in this case we use as pure water as we can to create storage space; and at the present time we have created as much as 300,000 bbls. of storage within the salt section; and by actual test we have found we were able to recover 100% of our liquified gases, which shows there is no communication within the salt section itself, and is a perfect traffic channel for fuels.

Q In your opinion there would be nothing to prevent the use of the salt formation for other purposes after a well were drilled through the salt layer?

A It would depend upon the location of your salt pillars and barriers within your mine. A core would have to be taken, of course, and holes drilled as nearly as vertical as possible. Advanced cementing techniques would have to be applied and mechanical devices used to aid in the protection of a cement job, like centralizers, etc.

Q With relation to the directional control of drilling, what

precautions can be exercised under modern methods?

A I think wells in this formation can be limited definitely to a deviation under three degrees, and possibly one degree.

Q You think you can drill with that degree of accuracy?

A Yes sir, knowing the underground conditions and having accurate surface locations we can.

Q Do you have any reason to believe the operations which you have outlined would have any interference with potash mining operations?

A I cannot see how they would. I don't know what their techniques are, but under all the evidence I have seen until now I would say that it can be done.

CHAIRMAN: Do you care to ask any questions?

MR. SETH: It is very difficult to create underground storage areas. Does it take very long?

A It has taken as long as sixty days.

Q How big an area?

A Approximately 100,000 bbls., thirty foot diameter by about 700 foot column.

Q What type of salt?

A Primarily a Halite - I don't think a core analysis was made of the salt section as such. Anhydrite fingers and ledges were necessarily inserted in the section.

Q What about overlying water getting into the salt base?

A We definitely preclude any migration of overlying waters by our cement technique. We drill wells through the salt section and definitely have no trouble.

Q You believe you have by using all the technical devices available now. But have you made any underground investigation?

A No, I have made no personal underground investigation, but by studies of wells and drilling of storage wells in the center of a four-spot group of oil wells, and by injection of liquified gas, if there should be any communication we think

it would have been in evidence by now.

Q You say your recovery of liquified gas is 100%?

A Supposedly, yes.

Q What would your opinion be as to the life of the cement?

A I think definitely as long as the field would produce.

Q In years - how long?

A This field is presently 17 years old and I would say would produce another 35 to 50 years. I know of a few abandoned wells where casing damage and deterioration is definitely caused by bad planning and improper cement protection.

A Are there any chemical problems in cementing through the various salt beds?

A I am not qualified to answer that question, but I think a test with various brines and Portland cement would determine it, and I definitely see no reason why effective cementing could not be done in this potash area.

Q As I see it, success depends on the amount of circulation you are able to secure behind the casings, and success is also dependent on the life of the cement?

A Yes sir, that is right.

MR. GRAHAM: Suppose you were to drill a well right through a mine where there was potash work going on?

A I do not think that type of drilling would be attempted. There must be complete cooperation between the potash operators and the oil and gas companies.

Q You mean some sort of agreement between them?

A Yes sir; and if not by friendly agreement between themselves, then by rules and regulations issued by your office whereby such cooperation is absolutely necessary under the requirements.

Q What sort of column or pillar would the potash company have to leave around a well drilled on one of their leases?

A I do not think it would require any greater pillar or column than they now leave. In some of the plans and reports I have seen they will leave as high as 250 feet, and in others as high as 25 to 40 feet.

MR. SETH: You don't feel you could drill through a 25-40 foot pillar?

A I think so, yes sir.

Q Do you think you could protect it?

A I think so, with the use of core drilling methods. This would be where cooperation would come in. These cores are obtained without any leaching or demolition.

Q At a thousand feet below the surface would you have any column of mud, or what solutions would you have?

A With a rotary you would necessarily have a column of fluid.

Q How much would it weigh?

A About 4.5 pounds per foot of depth.

Q The pressure alone, disregarding any solution, would destroy the pillar, would it not?

A I don't think so. Of course this is just a discussion -- in my opinion it would be dependent upon the surface or location. I would say definitely it would be incumbent upon us to set a 20" Rustler string.

Q As to the problem of gas: Suppose gas was encountered below the salt beds; what would be the extent of migration during the drilling operation?

A I don't think any, with correct casing program. Unless there is an accumulation of gas within the salt section. We would immediately case the well after the penetration of the salt section with casing not less than 13-3/8" and that would be cemented back to the surface. I also think it would be entirely protected by sound and modern cementing techniques.

MR. GRAHAM: In case you drilled an oil well in the potash area and the potash company then developed in that direction, what actual information would be necessary for the potash company so as to leave the necessary column around the well?

A That would have to be determined.

MR. SETH: What would be the effect of a well subsidence of 25 to 30 feet?

A My first guess would be that your well could be destroyed - at least your outer surface strings could be sheared and the thing to do would be to pump your well full of cement.

MR. GRAHAM: Would a spacing program be of any benefit?

A At the present time you could not make a spacing plan, but there could be - I cannot see any good reason why certain areas would require larger than forty-acre spacing, depending on mine conditions.

MR. SETH: Would it be possible to cement a hole down to the first point where there was a shear, and beyond that point lose your control?

A No; because of the multiple strings in your well and different sizes of tubing, I cannot see any reason why each of these strings would be sheared.

Q In case of a lateral movement of three or four feet, everything would be sheared, would it not?

A I cannot feature this type of bed having that kind of a movement.

MR. MOORE: You have mentioned cooperation of the potash and oil industries, and the possibility of working together. I think we are all conservation minded, perhaps the potash industry to a somewhat greater extent. This discussion between Mr. Seth and Mr. Hill has indicated that there

is a certain strong possibility that any subsidence that would damage the casings you would put in would consequently permit the intrusion of either oil, gas or water from the outside of the casing. At the present time the mines are Roman (?) pillar mines. Large percentages of the potash in that area are in pillars. In fact a considerable percentages of the developed potash in the United States are in pillars. It certainly cannot be long before some of that potash in pillars must be recovered to supply the United States with potash. A program of having wells in pillars would appear to me from this questioning to condition the further winning of potash of now developed reserves of potash from the existing mines. That is not a technical question to you. But it is in answer to your mention of the conservation point of view in which we are all concerned.

MR. HILL: Let me make this answer: In the removal of your pillars -- and I cannot prove this -- but generally I would say that should subsidence occur when the pillars are removed, that the one surrounding the well would not have to be removed; The chances of subsidence, I think, would be in direct ratio to the underground condition and, of course, your overburden there is necessarily going to fall vertically when it does make its movement, but with your casing strong I think it would be fairly safe. Another thing - this modern completion of oil wells usually calls for the packing of the annulus between the tubing and the outer string, and this annulus is ordinarily left filled with mud or water. Should subsidence occur and shearing take place in the well, the mine would not be affected.

MR. MOORE: You have pointed up, I think, the real problem regarding the one well. It would be one pillar which

supports this well, and you have so conditioned the problem. I do not think that any of us can answer this problem at this time. I do think, however, that if you are experimenting with the potash mining of the United States, you cannot be faced with pillars which cannot be extracted. You must allow each to go gradually. The problem is one that will take study and is now being worked on.

MR. HILL: What is the normal height of a mine level?

A. Fourteen feet with distances of 25 feet.

MR. HILL: You would not expect subsidence in that distance. I cannot see that a gradual subsidence, or even a sudden subsidence of 14 feet could damage materially an oil well that had efficient casing protection.

MR. CRAMER: The Bureau of Mines in studying the extraction of pillars has recommended a flexure of beds above the mine. The idea was to leave the lateral relationship of these beds intact. They could be brought down gradually with filling of the edges ten or twelve feet without breaking up of the areas above to any great extent. The point Mr. Moore mentions, of a pillar standing in there, would absolutely defeat the matter of bringing down these upper beds by flexure, and would mean a very sudden coming down, which I doubt if the Bureau of Mines would look upon with favor. Potash companies hold leases as a matter of trust. We work under the direction of the United States Geological Survey and we are held responsible for the maximum extraction of the pptash. We have shaft pillars in our mines which are of 500 feet radius, a solid block of material which is going to be left there with a minimum amount of breaking up of the underground foundation, as a protection to the mine. I have recently been in Europe where they operate with the Longwell (?) method of extraction. The roof does come down and subsidence is evident on the surface; and those mines are 2,000 feet deep.

MR. MOORE: Have you any idea about projecting into the future?

MR. CRAMER: Every operator will be limited to the acreage which he can mine.

MR. CAMPBELL: Approximately how much area is actually being mined as distinguished from leases?

MR. CRAMER: I have not figured on that, Mr. Campbell, but of the areas Mr. Nix has applied for, two of them are directly over our mines. We extend something over a mile in every direction - not less than two miles in diameter. We have made extractions as low as 40. We have gone as high as 70 and left 30 behind. But it has never been our idea that we would not get all of it before we get through.

MR. MORRIS: I would like to supplement -- that subsidence could not be anticipated in any of the Eddy County mines. A great deal of preliminary work has been done in connection with pillars in mines. But very little actual work has been done on it up to date. However all that has been done has indicated that before any second mining can take place on any scale other than a limited one, potash would have to be extracted by the Roman pillar system, leaving the shaft area as the last to be worked. Preliminary plans on such a program would indicate that subsidence would have to be handled very carefully to prevent breakage through the zones being mined. Probably a large area would have to be opened up and pillars gradually cut down, so as to prevent vertical breakage. It has been assumed that the major production would have to come from the first mining.

MR. GRAHAM: Can some of the engineers tell us the ton volume of potash in a 500 foot diameter column, say ten

feet high? Just as a matter of relative values of potash and oil?

MR. CRAMER: About 500,000 tons of ore. Let me say that to make an estimate of relative value in dollars might be skating on thin ice. During the first war it was $500 a ton, and last year, $20 a ton, and it has not been inflated, which I think should not be counted against us.

MR. GRAHAM: How would you estimate the whole field?

MR. CRAMER: This area represents more than 85% of the whole United States. I think it should be looked upon as an increasing requirement of agriculture.

MR. GRAHAM: What would be your estimate of the value of 40 acres of oil land?

MR. HILL: There is no way to predict what the production would be; but on an acre foot basis, assuming 4,000 bbls., taken at a value of $2.50 per bbl., it would be $10,000 per acre foot, gross.

MR. WEAVER: I would just like to mention that one bad casing job or one slip can lose a mine.

MR. SETH: In relation to the discussion of subsidence and flexing; in drilling after the flexing had occurred, the pillars withdrawn, and the mines closed, what would be your operation?

MR. HILL: I think you would definitely have to test out and possibly improve your foundation condition by some method.

Q It would be a mechanical problem?

A Yes.

MR. PROTZ: I would like to bring to your attention a problem we ran into in driving a tunnel to the south of our

present operation. After driving about a third of the distance on a calculated slope, we ran into a definite occurrence of oil in the beds. It occurred, of course, after the men went back into the face to clean out the material of that particular round. In running into that of course the whole problem presented itself instantaneously, you might say. It was a complete surprise, excepting as we had encountered very slight oil stains in other areas. In testing a little bit further with a small drill we ran into a show of oil that ran almost full. It was, of course, plugged immediately. We did not go on in that place, but backed up and made other calculations in order to go around. The thoughts in connection with this were in relation to the tremendous volumes of water above the salt. I just did want to mention that the oil did traverse the beds in that area. In fact, in going off on a slant to go round this area we ran into another seep in other beds overlying the potash beds in that area. It does show a very definite threat of oil, gas and water.

MR. CAMPBELL: Did you determine the source?

MR. PROTZ: It was coming from an abandoned, dry oil and gas test, so reported, located about 1500 feet away, at which we encountered a little seep. We are quite definitely satisfied that this was the source after having explored the possibilities. That is a relatively small volume of oil, and it does give specific evidence as to the distance of migration within the salt section. The plugging record on this well appears to be very good. They seem to have taken proper precautions and at least met the requirements of government regulations before it was abandoned. The well was drilled in 1930-1931. It could have been because of the highly corrosive nature of the solutions occurring near the top of

the salt that there was a hole in the casing.

MR. SETH: Would you discuss the course of the water above the salt there?

A We encountered the first water in the PCA area at depths of 50 to 100 feet. The operation was abandoned because of the high flow of water and the nature of it, making it inadvisable to proceed further. We were pumping at right about 1200 gallons a minute and just barely keeping even. We did not know but that we might encounter tremendous volumes of water. The vertical distance was 400 feet and when you compare that with the small volume of our mine workings it is very evident that a sufficient volume, once it started entering the mine, would be impossible to pump out.

Q What system did you use to plug the water?

A We used a system impossible in oil and gas operations. We poured solid cement plug through another salt section, with a wooden plug driven in at the top of the salt section, as full protection, and then plugged through each water horizon above that. This was done for two purposes: As a safeguard against seepage, and also to separate saline water from fresh water.

MR. HILL: You say it is impossible to create the same condition in an oil well?

A We have a solid cement plug, where you have cement merely on the outside of the casing.

Q Your production could be coming from a third string inside.

A You still have an opening for production, I don't care whether there are four or five strings. In other words, we have a solid cement plug as against one on the outside of the casing.

Q Is your core test confined to pillar locations?

A No, not necessarily confined to the pillar arrangement. We leave 100 ft. radius around core tests.

MR. SETH: The test hole is completely filled?

A Yes.

MR. HILL: That would depend on the location.

MR. PROTZ: We do know we can get migration from 1500 feet, and how far beyond we do not know. We are dealing not with oil, but water from above us.

MR. HILL: This 1500 foot migration - you do not know whether it was due to communication within the salt mass or faulting?

A We know we have shearing within certain beds in the salt section. They will shear and make very good migration.

Q Is there absolutely impervious covering over your salt after you leave the Rustler?

A I would not say impervious.

Q There must be some lack of communication.

A The beds are a relatively average regional dip of about 90 feet per mile.

Q Do you have any other cases of so-called proven migration?

A Not in our part of the area. I have been told of at least one other case where oil was encountered in the vicinity of Hobbs, but that I have been told was due to a faulty casing job. As to the distance, I don't know.

MR. HILL: Of course, not only drilling and casing techniques have improved in the past 22 years; and this job you mention was probably cable tool drilled in 1931. Rules in those times called for relatively meagre cementing. But today we study all subsurface waters and those formations have to be protected. Also, those plugged wells 20 years ago contained just mud solutions, as against cement now.

MR. PROTZ: This well was drilled after the potash area was established and under the same regulations as today.

(Mr. Hill, cont.): When was that well abandoned?

A I believe in the early thirties.

Q Do you know that the oil migrated 1500 feet?

A Yes. we are satisfied that it did, and all geological evidence points to that as being the source of the oil.

MR. GRAHAM: In that potash area not all of the land has potash. Is this on federal or state land?

A It is on federal land.

Q It is true there are state lands within that area isn't it?

A Yes, there are producing wells on state lands in that area.

MR. MORRIS: By way of further explanation: An operator has many problems other than just production. Possibly the first three major problems are protection of the mine, protection of the men, and protection of the equipment, the last being the least of the three. In our mines in the Carlsbad area our main fear is water, because we know of no way to control water if it were to enter the worked out areas. In hard rock or coal you can build bulkheads. In a potash mine bulkheads would be useless because when water was trapped behind them and came in contact with the materials, it would just be a matter of time until some openings occurred and the water would work around, and the bulkhead would no longer serve the purpose for which it was erected. We therefore take a very cautious position with respect to any circumstance which might permit water to enter the mines. As to the second consideration, the protection of the men: Some of the greatest catastrophies have occurred as a result of the explosion of gases in such concentrations as might occur in nature or otherwise. As far as equipment is concerned, it is a minor problem, although it is lost in a mine under water. I might just amplify for a moment the

question about plugging of wells. It seems to me that an abandoned core test, properly plugged, in case of lateral displacement would afford proper protection, whereas a producing well with an opening in it, if you do have lateral displacement, and if there is any room at the point of lateral displacement, would naturally permit fluids to come out into the open area at the point of displacement.

Q Does it occur to you Mr. Hill, that with proper cooperation and control, drilling can be done in these areas with safety?

MR. HILL: I am still of the definite opinion that it can be achieved.

MR. GRAHAM: Can any one give us a line on the attitude of the federal government?

MR. CRAMER: These discussions have brought out quite clearly the fact that these two large industries are each in possession of a great deal of technical knowledge of which the other has only a smattering. In the state there is the State Bureau of Mines and the Oil Conservation Commission, and in the federal government under the Department of the Interior the Department of Mines and the United States Geological Survey. These four are able to bring together the knowledge of the entire problem. It would be our thought that the state and federal government agencies cooperate in assembling this information, and that no move be taken until it was possible to take advantage of this information. I think this policy might develop some very constructive conclusions. As you know, the particular purpose of the federal government is the protection of this 85% of the potash deposits in this country which is found in this small area.

MR. GRAHAM: Can you say what is the attitude of the United States Geological Survey?

A Of course the federal government holds ten times the area held by the state. I know what their attitude was fifteen to twenty years ago, and whether their ideas have crystalized I could not say.

MR. BLACKMAN: My impression is that they do not want any drilling. So fas as I know, there is not any information on subsidence in that field. However, there is considerable literature on the northern Colorado coal fields, where there is somewhat the same situation. That information can be readily available, and I would be very glad to have it sent to you if you desire. Subsidence doesn't occur straight up and down, but goes out; to a considerable extent that depends on the overburden, but at several thousand feet depth you would not have a pillar on the surface -- only a cone. As I have said, I would be very glad to have that information sent to you.

MR. CAMPBELL: This particular application of Mr. Nix does not cover federal land; and if all of the lands are to be withdrawn from oil and gas development, it seems to me a very serious problem. It occurs to us there is no particular reason why, under proper cooperation and control, it should not be developed by drilling.

MR. CRAMER: As I understand it, Mr. Nix is particularly interested in Tract 23. This is not only part of our mine, but part of it is federal land. I mean part was land we were mining under federal lease.

MR. GRAHAM: Does the Southwest Potash Corporation care to discuss this application made last November?

MR. MOORE: We would like to know what the State feels in regard to it.

MR. GRAHAM: Some of that land is held by production and some under lease that pre-dates your lease. You have some oil wells right on your lease.

A Of course, in Section 16 there is a producing well.

MR. GRAHAM: The policy on that one well might work out for the entire area, if we could be in position where we could rule on that.

MR. MOORE: We have been talking about the production of oil and potash on the same acreage. There would have to be some thought given as to what that policy might be.

MR. GRAHAM: We feel that the State would prefer not to make a decision with which the federal government might not agree.

MR. CAMPBELL: It seems to me the state is depriving itself of considerable revenue.

MR. SETH: Looking at it from the point of view of the state, there is apparently no serious difficulty in drilling an area after the potash has been removed, and from the state's point of view it seems to me it could wait for a few years until the potash could be removed. Oil will be here, but the potash industry would be gone. The technical aspects are subject to considerable study.

MR. KELLY: I think the question has resolved itself into two phases. One is the overall development of southern Eddy County. It is my understanding that potash

interests not only hold leases around the mines but control those of other companies. If oil wells cannot be drilled on land that is prospective potash land, then the State of New Mexico and the federal government will lose considerable revenue. The Delaware Basin area is one of the few in the country with very great oil reserves. Is it the request of the potash companies to withdraw them from oil development?

MR. SETH: It goes both ways, doesn't it John?

A We are not trying to prevent the mining of potash. I think the fact we drill there helps the potash industry.

MR. SETH: The state is not going to lose it.

A Yes, I think we can lose it in the same manner the coal fields in New Mexico have been lost. The state is not getting anything from it.

Q Is it an economic prognostication you want?

A It is a question of considerable importance as to public lands.

MR. GRAHAM: Is it a geological assumption that oil is there in marketable quantities?

A Yes sir. I think the gentlemen from the major oil companies could answer better on account of their research staffs.

MR. HILL: I think it is a purely practical matter, whether it can be done. We think it can.

MR. SETH: Don't you think it is a matter of time?

MR. HILL: We know that both of the resources are desperately needed, and compared on that basis it doesn't seem to me that potash production outweighs that of oil.

Q But you will admit that the area of potential production of oil is many times greater than potential potash production.

A But the potential reserves of oil are getting smaller

and smaller all the time.

MR. GRAHAM: Is potash only known in the Carlsbad area?

MR. CRAMER: We don't say that -- but 85% of the potash in the country is there. There is an old brine lake in California, but I don't know what the potash content is.

MR. GRAHAM: I meant in the state.

A I don't know of any other. I want the record to show that the state and federal workings in our mine are not only contiguous but open, and if our state operations are jeopardized the federal mine area would be jeopardized to a greater extent because the greater part is on federal land.

MR. HILL: If the state land put up had been a township away from where you are working would you have taken the same position?

MR. CRAMER: We have not taken a position. If it became necessary to spend a few thousand dollars to protect our mine, we would not hesitate. The company in the past has had certain federal oil permits, as I recall, which we gladly relinquished at the time of the creation of the reserve. We hold some oil leases at the present time on top of the potash areas and we saw fit to get both the oil and potash leases, and it was our intention to protect the potash when we did so. We did feel the state had a policy with respect to the area. With men underground even a 1 degree or a 3 degree tangent means much more than the thickness of one of our pillars.

MR. GRAHAM: The Southwest Potash Corporation also had the lease, but there were preexisting oil and gas leases on the land.

MR. NIX: They took the lease when oil operators had a

right to drill, and we are only asking the same in return.

MR. GRAHAM: All I can say is that this is an actual written application for a regulation in that area.

MR. KELLY: Mr. Cramer stated his company holds oil and gas permits and that the permits were taken to protect the potash mining operation. What is the intent of his company at this time?

MR. CRAMER: I did not mean to state that we hold any federal permits at the present time. We did in the early days and as I recall, from memory, we relinquished them.

MR. KELLY: At the present time doesn't the potash industry hold tremendous acreage outside of the present known fields?

A Yes.

Q Is it their intention to request that that land be restricted to potash mining?

A I don't think so.

MR. GRAHAM now read the following petition of the Southwest Potash Corporation:

Southwest Potash Corporation
61 Broadway
New York 6, New York

November 10, 1950

To: Commissioner of Public Lands
State of New Mexico
Santa Fe, New Mexico

Sir:

The undersigned SOUTHWEST POTASH CORPORATION, a Delaware corporation, duly authorized to transact business in New Mexico, and having offices at 61 Broadway, New York 6, New York and at Carlsbad, New Mexico, hereby submits the following:

(1) The undersigned is the owner and holder of

Potash Mining Lease No. M-2657 issued by the State of New Mexico and dated March 30, 1948.

(2) Extensive drilling by the undersigned has demonstrated the existence of a commercial potash ore body on the following portions of the lands covered by the above lease:

(A) T. 19 S., R. 29 E.
Section 11, SE 1/4
Section 12, S 1/2
Section 13, All
Section 14, All

(B) T. 19 S., R. 30 E.
Section 16, All

(3) In the above lands the said potash ore body is at a depth of approximately 750 feet. The ore occurs as a flat-lying bed averaging approximately 52 inches in thickness.

(4) The undersigned contemplates the expenditure of approximately $10,000,000 in mine development and the construction of a plant to process its potash ores in New Mexico, of which the ores contained in the above mentioned tracts are a part.

(5) There are presently in effect oil and gas leases issued by the State of New Mexico covering the above described lands.

To the best of the undersigned's knowledge, there have been no oil or gas discoveries within the lands listed under (A) above, but Tract (B), Section 16 of Township 19 S., R. 30 E. contains a producing oil field.

(6) Exploitation of the potash ores and drilling for oil and gas on the same lands are not compatible for the following reasons:

A. It is necessary to leave large pillars (at least 100 ft. in radius) around oil and gas holes in areas where potash ores are to be mined. Such pillars can never be recovered and result in the permanent loss of potash, a national resource of limited quantity.

B. The leaving of pillars because of oil and gas wells interferes with the laying out of the underground mine workings, the mine development, and extraction of the ore, all of which must be planned in advance and carried out by methods which will assure maximum recovery of the potash ores.

C. Oil and gas wells in potash ore bodies are a hazard to the orderly and complete extraction of the potash ores because water may enter the mine workings through the oil and gas wells and dissolve the potash and salt. This is dangerous and can result in serious damage to the mine and loss of a national resource.

(7) The existence of the potash is known. In contrast there are no known oil or gas deposits beneath said lands, except in Tract (B).

WHEREFORE, the undersigned respectfully requests that the appropriate body, agency or authority of the State of New Mexico, in order to protect and prevent waste and damage to the potash ore bodies already discovered and developed by the undersigned on lands

listed herein forthwith issue such orders, rules, regulations and directives as will:

(a) Withdraw and exclude the above described lands from the issuance of State oil and gas leases.

(b) Provide that any and all existing non-producing oil and gas leases on said lands be not renewed or extended.

Respectfully submitted,
SOUTHWEST POTASH CORPORATION

By (Sgnd) JOHN PAYNE, Jr.
Vice President

(CORPORATE SEAL)

ATTEST:

(Sgnd) H. COHEN
Asst. Secretary

MR. GRAHAM: Within that particular area seem to lie all of the problems we have discussed.

(Recess)

CHAIRMAN: The meeting will please come to order. As I recall, you were going to make some comments, Mr. Campbell.

MR. CAMPBELL: Are you now mining what you consider to be the only commercial vein on your properties, or are there others?

MR. WEAVER: There are other and higher elevations.

Q You would not take the pillars out?

A That all depends. There are so many things to be considered. There is another mine opened up by the International

Chemical at three levels.

Q Where you take out your pillars, is that pretty well controlled? You can tell pretty well where you will have subsidence under normal conditions?

A We know where we would expect it to be. However, there is a lot of research work to be done in this basin. We don't know exactly.

Q Do you work out your core drilling operations -- how frequently -- or some pattern?

A Some companies operate on a pattern of about every 160 acres -- or one based on the center of each pillar.

Q You leave a pillar around a hole of 100 foot radius?

A Yes, that is right.

CHAIRMAN: Has any one else any further questions?

MR. SETH: I do not think there are any further questions. We would like to make a request. I would just like to say that we are glad of this opportunity to have the benefit of Mr. Hill's testimony; but we would like to do some more research work ourselves and give the matter a little more thought, not only as to mechanical and technical matters, but also matters of policy. This is the first opportunity we have had for full discussion, and to hear the problems of the oil people presented. As somebody has already mentioned, each of us has a lot to learn about the other's business, and, of course, I have a lot to learn about both. We would like, if the Commissioner sees fit to do so, to have another hearing, when we would be in better position to present a little more engineering data and to be able to answer direct questions which have been put in regard to matters of policy, engineering, etc. This is of

very great consequence to the state and to the potash companies, who have already made their very large investigations in this area. We will not only get information on the specific problems already presented, but if the Commissioner desires to go into any other aspects of the matter we will be most happy to do so, and try to gather additional data on any subject involved that you wish.

MR. CAMPBELL: One thing I would like to stress is that of the time element. Applying for and winning this lease does not contemplate any drilling immediately. Getting the lease and drilling are not only far apart -- but we do not even know that we will drill. We did not even seek this land originally, but do feel that it is to our interest to have it disposed of, at least, as soon as you can. We, too, appreciate the chance to present our views on this matter. It does have material consequence beyond this application, and we think it very wise of the Commissioner to call a hearing.

CHAIRMAN: Any one else? If not, I would like to say that I think this thing is going to have a far reaching effect, probably for a long time to come. So, I am going to hold this open for any additional testimony or information until the 9th of March ** and we will hold another hearing at 10:00 o'clock on the morning of that day in this room, and I hope at that time to be able to make a decision within a day or two.

NOTE: ** The Commissioner later designated another date - the 29th of March instead of the one first set.

MR. BLACKMAN: I think it would be very beneficial

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

IN THE MATTER OF DEFINING BOUNDARIES OF POTENTIAL OIL PRODUCING AREAS IN EDDY AND LEA COUNTIES, NEW MEXICO, WITHIN WHICH POTASH MINERALS ARE BEING PRODUCED OR POTENTIAL POTASH PRODUCING LANDS ARE LOCATED.

CASE No. 278
ORDER No. R-111

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission," on June 21, 1951, and for further hearing on July 10, 1951, and the Commission, a quorum being present, having considered the testimony adduced and the exhibits introduced in evidence and arguments presented and being fully advised in the premises,

FINDS, (1) That due notice having been given, according to law, and all interested parties having appeared, the Commission has jurisdiction of this cause, and the subject matter thereof.

(2) That an area defining potential oil and gas reserves within which are proved and potential potash deposits, and the promulgation of rules and regulations for the orderly development of oil and gas resources in such an area known to be productive of potash is within the authority of the Commission for the protection of correlative rights, the promotion of conservation, and the prevention of waste.

IT IS THEREFORE ORDERED:

That this order shall be known as THE RULES AND REGULATIONS GOVERNING THE EXPLORATION AND PRODUCTION OF OIL AND GAS IN CERTAIN AREAS AND SUB-AREAS HEREIN DEFINED AND KNOWN TO CONTAIN PROVED AND SEMI-PROVED POTASH MINERALS IN THE AREA AND SUB-AREAS HEREINAFTER SET OUT.

I
OBJECTIVE

The objective of these Rules and Regulations is to prevent waste, protect correlative rights, assure maximum conservation of the oil and gas resources of New Mexico and permit the simultaneous economic recovery of potash minerals in the area hereinafter defined.

II
THE POTASH - OIL AREAS

(1) These Rules and Regulations are applicable to oil and gas operations and to exploration for and production of oil and gas in proven or potential Potash-Oil areas herein defined as "Area A" and "Area B."

(a) The potash-oil area represents the area in various parts of which potash mining operations are now in progress, or in which core tests indicate potential potash reserves are located and is described, as follows:

T. 19 S, R. 29 E
Sec. 11 - SE/4
Sec. 12 - S/2
Sec. 13 and 14 - all
Sec. 23 - N/2
Sec. 24 - N/2

T. 20 S, R. 29 E
Sec. 12 - NE/4 SE/4 and S/2 SE/4
Sec. 13 - NE/4 and S/2
Sec. 22 to 27, inclusive
Sec. 34 to 36, inclusive

T. 21 S, R. 29 E
Sec. 1 and 2, all
Sec. 3 - E/2
Sec. 10 - E/2
Sec. 11 to 14, inclusive
Sec. 15 - E/2
Sec. 23 - N/2
Sec. 24 and 25 - all
Sec. 35 - E/2
Sec. 36 - all

T. 22 S, R. 29 E
Sec. 1 and 2 - all
Sec. 3 - S/2
Sec. 9 - E/2
Sec. 10 to 16, inclusive
Sec. 17 - E/2
Sec. 20 - E/2
Sec. 21 to 28, inclusive
Sec. 33 to 36, inclusive

T. 23 S, R. 29 E
Sec. 1 to 3, inclusive
Sec. 4 - E/2
Sec. 9 - E/2
Sec. 10 to 15, inclusive
Sec. 22 to 27, inclusive
Sec. 34 to 36, inclusive

T. 18 S. R. 30 E
Sec. 12 - S/2
Sec. 13 and 14 - all
Sec. 15 - SE/4
Sec. 21 - SE/4
Sec. 22 to 24, inclusive
Sec. 25 - W/2
Sec. 26 to 28, inclusive
Sec. 29 - SE/4
Sec. 32 - SW/4 and E/2
Sec. 33 and 34 - all
Sec. 35 - W/2

T. 19 S, R. 30 E
Sec. 2 to 5, inclusive
Sec. 6 - SE/4
Sec. 7 - NE/4 and S/2
Sec. 8 to 30, inclusive
Sec. 32 to 36, inclusive

T. 20 S, R. 30 E
Sec. 1 to 36, inclusive

T. 21 S, R. 30 E
Sec. 1 to 11, inclusive
Sec. 12 - S/2
Sec. 13 to 22, inclusive
Sec. 23, - N/2
Sec. 24 - N/2
Sec. 27 to 34, inclusive
Sec. 35- S/2

T. 22 S, R. 30 E
Sec. 1 to 24, inclusive
Sec. 25 - W/2
Sec. 26 to 35, inclusive
Sec. 36 - W/2

T. 23 S, R. 30 E
Sec. 1 - S/2
Sec. 2 to 36, inclusive

T. 24 S, R. 30 E
Sec. 1 - N/2
Sec. 2 - N/2
Sec. 3 - N/2

T. 18 S, R. 31 E
Sec. 18 - W/2

T. 19 S, R. 31 E
Sec. 9 and 10 - all
Sec. 11 - W/2
Sec. 14 - W/2
Sec. 15 to 17, inclusive
Sec. 19 to 22, inclusive
Sec. 23 - W/2
Sec. 25 - S/2
Sec. 26 to 36, inclusive

T. 20 S, R. 31 E
Sec. 1 to 36, inclusive

T. 21 S, R. 31 E
Sec. 1 - N/2
Sec. 2 - N/2
Sec. 4 - W/2
Sec. 5 and 6 - all
Sec. 18 - S/2
Sec. 19 - N/2

T. 22 S, R. 31 E
Sec. 4 to 9, inclusive
Sec. 17 and 18 - all
Sec. 19 - N/2

T. 23 S, R. 31 E
Sec. 7 - all
Sec. 8 - S/2
Sec. 16 - SW/4
Sec. 17 to 20, inclusive
Sec. 21 - W/2
Sec. 28 to 33, inclusive

T. 24 S, R. 31 E
Sec. 4 to 6, inclusive

T. 19 S, R. 32 E
Sec. 23, S/2
Sec. 24 to 27, inclusive
Sec. 28 - S/2
Sec. 31 - S/2
Sec. 32 - S/2
Sec. 33 to 36, inclusive

T. 20 S, R. 32 E
Sec. 1 to 36, inclusive

T. 21 S, R. 32 E
Sec. 1 to 17, inclusive
Sec. 21 to 27, inclusive
Sec. 35 and 36 - all

T. 19 S, R. 33 E
Sec. 19 - all
Sec. 30 and 31 - all

T. 20 S, R. 33 E
Sec. 5 to 9, inclusive
Sec. 15 to 23, inclusive
Sec. 25 to 36, inclusive

T. 21 S, R. 33 E
Sec. 4 to 9, inclusive
Sec. 16 to 21, inclusive
Sec. 28 to 33, inclusive

T. 22 S, R. 33 E
Sec. 4 to 6, inclusive

T. 20 S, R. 34 E
Sec. 31 - all

(b) Area "A" represents the area in various parts of which potash mining operations are now in progress and is described, as follows:

T. 19 S, R. 30 E
Sec. 9 - SE/4 NW/4, E/2 SW/4, S/2 NE/4, SE/4
Sec. 10 - SW/4 NW/4, W/2 SW/4
Sec. 15 - NW/4 NW/4
Sec. 16 - N/2 NE/4, NE/4 NW/4
Sec. 26 - S/2 NW/4, SW/4 NE/4, W/2 SE/4, SW/4
Sec. 27 - S/2 NE/4, SE/4 NW/4, NE/4 SW/4, S/2 SW/4, SE/4
Sec. 28 - SE/4 SE/4
Sec. 33 - SE/4 NW/4, NE/4 NE/4, S/2 NE/4, E/2 SW/4, SE/4
Sec. 34 - all
Sec. 35 - NW/4, W/2 NE/4, NW/4 SE/4, N/2 SW/4, SW/4 SW/4

T. 20 S, R. 30 E
Sec. 2 - W/2 NW/4, NW/4 SW/4
Sec. 3 - N/2, SW/4, N/2 SE/4, SW/4 SE/4
Sec. 4 - E/2, SW/4, E/2 NW/4, SW/4 NW/4
Sec. 5 - SE/4 NE/4, E/2 SE/4, SW/4 SE/4, SE/4 SW/4
Sec. 7 - SE/4 SE/4
Sec. 8 - E/2, E/2 NW/4, E/2 SW/4, SW/4 SW/4
Sec. 9 - N/2, SW/4, N/2 SE/4, SW/4 SE/4
Sec. 10 - NW/4, W/2 NE/4, NW/4 SE/4, N/2 SW/4
Sec. 16 - N/2 NW/4, NW/4 NE/4
Sec. 17 - W/2, N/2 NE/4, SW/4 NE/4, W/2 SE/4
Sec. 18 - E/2 NE/4, E/2 SE/4
Sec. 19 - NE/4 NE/4
Sec. 20 - N/2 NW/4, NW/4 NE/4
Sec. 25 - SW/4 SW/4
Sec. 26 - SE/4 SW/4, S/2 SE/4
Sec. 35 - E/2 NW/4, NE/4, N/2 SE/4, NE/4 SW/4
Sec. 36 - W/2 NW/4, NW/4 SW/4

T. 21 S, R. 29 E
Sec. 1 - SE/4, S/2 NE/4, SE/4 NW/4, NE/4 SW/4, S/2 SW/4
Sec. 2 - SE/4 SE/4
Sec. 11 - NE/4 NE/4, S/2 NE/4, SE/4 NW/4, E/2 SW/4, SE/4
Sec. 12 - all
Sec. 13 - N/2, SE/4, N/2 SW/4, SE/4 SW/4
Sec. 14 - E/2 NW/4, NE/4, NE/4 SW/4, N/2 SE/4
Sec. 24 - NE/4 NW/4, N/2 NE/4
Sec. 25 - SE/4 SW/4, S/2 SE/4
Sec. 36 - E/2 NW/4, E/2 SW/4, E/2

T. 22 S, R. 29 E
Sec. 1 - E/2 NW/4, SW/4 NW/4, SW/4, E/2
Sec. 2 - SE/4 NE/4, E/2 SE/4
Sec. 11 - E/2 NE/4, NE/4 SE/4
Sec. 12 - N/2, N/2 SW/4, N/2 SE/4

T. 21 S, R. 30 E
Sec. 6 - SW/4 NW/4, W/2 SW/4
Sec. 7 - NW/4 NW/4, S/2 NW/4, SW/4 NE/4, SW/4, W/2 SE/4
Sec. 18 - NW/4, W/2 NE/4, N/2 SW/4, SW/4 SW/4, NW/4 SE/4
Sec. 19 - NW/4 NW/4

T. 21 S, R. 30 E
Sec. 29 - SW/4 SW/4
Sec. 30 - S/2 SW/4, S/2 SE/4
Sec. 31 - all
Sec. 32 - W/2 NW/4, W/2 SW/4

T. 22 S, R. 30 E
Sec. 5 - W/2 NW/4, NW/4 SW/4
Sec. 6 - N/2, SW/4, N/2 SE/4, SW/4 SE/4
Sec. 7 - N/2 NW/4, SW/4 NW/4, NW/4 NE/4, NW/4 SW/4

(c) Area "B" is defined as that area in which core tests indicate potential potash reserves and includes the entire potash-oil area as described under "The Potash-Oil Areas" Sec. (1) (a), of this order, except and excluding lands defined and described as area "A" in "The Potash-Oil Areas," Sec. (1) (b) of this order.

(2) Area "A" and "B" as hereinabove defined may be contracted or expanded by the Commission from time to time as circumstances or conditions may warrant, after due notice and hearing.

III
EXPLORATION OF AREAS

(1) Area "A"

(a) Drilling of oil and gas exploratory test wells shall not be permitted in Area "A" except upon leases outstanding as of the effective date of these regulations, provided, that oil and gas exploratory test wells shall not be drilled through any open potash mines or within 1,320 feet thereof unless agreed to in writing by the potash lessee involved.

(b) Any oil or gas leases hereafter issued for lands within Area "A" shall be subject to these regulations.

(c) All future drilling of oil and gas exploratory test wells in Area "A," shall be further subject to these rules and regulations.

(d) Where oil and gas wells are in production in Area "A," no potash mine opening shall be driven to within less than 100 feet of such wells so that protection of both wells and mine can be afforded.

(e) Proposals to unitize with respect to land within Area "A", as herein defined and described, will be considered on their merits.

(2) Area "B"

(a) Oil and gas exploratory test wells may be drilled in Area "B" in accordance with these rules and regulations.

(3) Upon the discovery hereafter of oil and gas in Areas "A" or "B", the Oil Conservation Commission shall promulgate field or pool rules for the affected area after due notice and hearing.

(4) Nothing herein shall be construed to prevent unitization agreements involving lands in Areas "A" or "B", or both.

IV
DRILLING AND CASING PROGRAM

(1) For the purpose of the regulations and the drilling of oil and gas exploratory test wells, shallow and deep zones are defined, as follows:

(a) The shallow zone shall include all formations above the base of the Delaware sand or above a depth of 5,000 feet, whichever is the lesser.

(b) The deep zone shall include all formations below the base of the Delaware sand or below a depth of 5,000 feet, whichever is the lesser.

(2) Surface Casing String:

(a) A surface casing string of new, second-hand, or reconditioned pipe shall be set in the "Red Bed" section of the basal Rustler formation immediately above the salt section, or in the anhydrite at the top of the salt section, as determined necessary by the regulatory representative approving the drilling operations and shall be cemented with not less than one hundred and fifty percent (150 percent) of calculated volume necessary to circulate cement to the ground surface.

(b) Cement shall be allowed to stand a minimum of twelve (12) hours under pressure and a total of twenty-four (24) hours before drilling the plug or initiating tests.

(c) Casing and water-shut-off tests shall be made both before and after drilling the plug and below the casing seat, as follows:

(i) If rotary tools are used, the mud shall be displaced with water and a hydraulic pressure of six hundred (600) pounds per square inch shall be applied. If a drop of one hundred (100) pounds per square inch or more should occur within thirty (30) minutes, corrective measures shall be applied.

(ii) If cable tools are used, the mud shall be bailed from the hole, and if the hole does not remain dry for a period of one hour, corrective measures shall be applied

(d) The above requirements for the surface casing string shall be applicable to both the shallow and deep zones.

(3) Salt Protection String:

(a) A salt protection string of new, second-hand, or reconditioned pipe shall be set not less than one hundred (100) feet nor more than two hundred (200) feet below the base of the salt section.

(b) The salt protection string shall be cemented, as follows:

(i) For wells drilled to the shallow zone, the string may be cemented with a nominal volume of cement for testing purposes only. If the exploratory test well is completed as a productive well, the string shall be recemented with sufficient cement to fill the annular space back of the pipe from the top of the first cementing to the surface or to the bottom of the cellar, or may be cut and pulled if the production string is cemented to the surface as provided in sub-section IV (5), (a), (i) below.

(ii) For wells drilled to the deep zone, the string must be cemented with sufficient cement to fill the annular space back of the pipe from the casing seat to the surface or to the bottom of the cellar.

(c) If the cement fails to reach the surface or the bottom of the cellar, where required, the top of the cement shall be located by a temperature or gamma ray survey and additional cementing shall be done until the cement is brought to the point required.

(d) The fluid used to mix with the cement shall be saturated with the salts common to the zones penetrated and with three (3 percent) percent of calcium chloride by weight of cement.

(e) Centralizers shall be spaced on at least every one hundred fifty (150) feet of the salt protection string below the surface casing string.

(f) Cement shall be allowed to stand a minimum of twelve (12) hours under pressure and a total of twenty-four (24) hours before drilling the plug or initiating tests.

(g) Casing tests shall be made both before and after drilling the plug and below the casing seat, as follows:

(i) If rotary tools are used, the mud shall be displaced with water and a hydraulic pressure of one thousand (1000) pounds per square inch shall be applied. If a drop of one hundred (100) pounds per square inch or more should occur within thirty (30) minutes, corrective measures shall be applied.

(ii) If cable tools are used, the mud shall be bailed from the hole and if the hole does not remain dry for a period of one hour, corrective measures shall be applied.

(h) The above requirements for the salt protection string shall be applicable to both the shallow and deep zones except for sub-section IV (3), (b), (i) and (ii) above.

(4) Intermediate String:

(a) In the drilling of oil and gas exploratory test wells to the deep zone, an intermediate string shall be set at sufficient depth to case-off all formations in the shallow zone and shall be cemented with sufficient cement to fill the annular space back of the pipe from the casing seat to the surface or to the bottom of the cellar.

(b) Cementing procedures and casing tests for the intermediate string shall be the same as provided under sub-sections IV (3), (c), (f) and (g) for the salt protection string.

(5) Production String:

(a) A production string shall be set on top or through the oil or gas pay zone and shall be cemented as follows:

(i) For wells drilled to the shallow zone the production string shall be cemented to the surface if the salt protection string was cemented only with a nominal volume for testing purposes, in which case the salt protection string can be cut and pulled before the production string is cemented; provided, that if the salt protection string was cemented to the surface, the production string shall be cemented with a volume adequate to protect the pay zone and the casing above such zone.

(ii) For wells drilled to the deep zone, the production string shall be cemented with a volume adequate to protect the pay zone and the casing above such zone; provided, that if no intermediate string shall have been run and cemented to the surface, the production string shall be cemented to the surface.

(b) Cementing procedures and casing tests for the production string shall be the same as provided under sub-sections IV (3) (c), (f) and (g) for the salt protection string.

V
DRILLING FLUID FOR SALT SECTION

The fluid used while drilling the salt section shall consist of water, to which has been added sufficient salts of a character common to the zone penetrated to completely saturate the mixture. Other admixtures may be added to the fluid by the operator in overcoming any specific problem. This requirement is specifically intended to prevent enlarged drill holes.

VI
PLUGGING AND ABANDONMENT OF WELLS

All wells heretofor and hereafter drilled within Areas "A" and "B" shall be plugged in a manner that will provide a solid cement plug through the salt section and prevent liquids or gases from entering the hole above or below the salt section.

VII
LOCATIONS FOR TEST WELLS

Before drilling for oil or gas on lands in Areas "A" or "B", a map or plat showing the location of the proposed well shall be prepared by the well operator and copy sent by registered mail to the potash lessee involved, if any. Upon proper showing of such notice and if no objection to the location of the proposed well is made by the potash lessee within ten days, a drilling permit may be issued and the work may proceed. If, however, the location of the proposed well is objected to by the potash lessee on the grounds that the location of the well is not in accordance with the foregoing regulations, the potash lessee may file a written objection within ten days for consideration and decision by the Oil Conservation Commission.

VIII
INSPECTION OF DRILLING AND MINING OPERATIONS

A representative of the potash lessee may be present during drilling, cementing, casing, and plugging of all oil or gas wells on his lease to observe conformance with these regulations. Likewise, a representative of the oil and gas lessee may inspect mine workings on his lease to observe conformance with these regulations.

IX
FILING OF WELL AND MINE SURVEYS

Each oil and gas lessee shall furnish not later than January 31st of each year to the Oil Conservation Commission and to the potash lessees involved, certified directional surveys from the surface to a point below the lowest known potash-bearing horizon for each oil or gas well drilled in Area "A" during the preceding calendar year. Each potash lessee shall furnish not later than January 31st of each year to the Oil Conservation Commission and to each oil and gas lessee involved, certified plat of survey of the location of open mine workings underlying outstanding oil and gas leases.

X
APPLICABILITY OF STATEWIDE RULES AND REGULATIONS

All general statewide rules and regulations of the Oil Conservation Commission governing the development, operation, and production of oil and gas in the State of New Mexico not inconsistent or in conflict herewith, are hereby adopted and made applicable to the areas described herein.

XI
ADOPTION

The foregoing Rules and Regulations are hereby adopted by the Oil Conservation Commission and adopted, ratified and confirmed by the Commissioner of Public Lands of the State of New Mexico this _____ day of November, 1951.

DONE at Santa Fe, New Mexico, this 9th day of November, 1951.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

Edwin L. Mechem
EDWIN L. MECHEM, Chairman

Guy Shepard
GUY SHEPARD, Member

R. R. Spurrier
R. R. SPURRIER, Secretary

STATE OF NEW MEXICO OIL CONSERVATION COMMISSION

Guy Shepard
GUY SHEPARD
Commissioner of Public Lands