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GEOLOGIC SUMMARY OF POTASH SAFETY CONCERNS RELATING TO OIL AND GAS ACTIVITY WITHIN THE POTASH AREA

In April of 1992, the New Mexico Potash Industry released a statement concerning safety issues related to oil and gas wells located inside the "potash area". The potash industry has voiced these same concerns in the past and they center around the possible migration of petroleum gases into the active mine workings. In their April statement, they listed five major concerns:

1. It is not known how close to mine workings an oil or gas well can be drilled with assurance of safety. The petroleum and potash industries have jointly agreed to use one-half mile as a standard for deep oil and gas wells and one-quarter mile for oil wells less than 5000 feet deep. Much research is needed to permit defining the "safe" distance more closely, particularly since ground conditions and the efficiency of casing can be expected to vary widely among individual wells. To drill more closely at present, would be to place human life at risk unnecessarily and could be interpreted as violating the intent of federal mine safety and health laws.

2. Casing programs cannot provide protection in the event of accidents. At least seventeen blowouts or oil-well fires have occurred in the area around the Potash Basin. It is a virtual certainty that others will occur from time to time.

3. Examples of oil migration into potash workings have already been documented. In the most serious of these, oil migrated 700 feet along mud seams from an improperly plugged well into the Eddy Potash Mine. It should be clear that petroleum gases potentially can migrate much greater distances and in greater quantity than oil. Had the well been a high pressure gas well, the consequences could have been disastrous.

4. Practical experience has shown that it is unlikely that a casing and cementing program can give completely adequate assurance of protection against gas migration considering the enormity of the potential consequences. The occurrence of fractures and voids makes it difficult, at best, to seal off formation fluids, particularly in salt or heavily fractured zones.

5. The occurrence of hydrogen sulfide can be predicted to have a highly corrosive effect on casing, which can lead to casing failure and leakage of both flammable and toxic gases long after the well has been abandoned.

The third, fourth, and fifth concerns will be addressed in this geologic discussion while the first two concerns can be better addressed by engineering testimony. Through the need to address these concerns geologically, it would be best to discuss the fourth concern first and then proceed to the third and end with the fifth.

Fourth Safety Concern

The last sentence of the fourth concern states that there are fractures and voids in salt, thus creating paths of migration for fluids (Engineering will discuss the first sentence concerning casing programs). It will be shown that the salt in the Salado Formation has very little porosity and is virtually impermeable.

A brief description of the general geology is needed before proceeding. The potash zones occur within the Permian Salado Formation which is stratigraphically above the Permian Castile Formation and below the Permian Rustler Formation (refer to stratigraphic column). The Salado is composed of mostly halite with minor amounts of anhydrite, potash minerals (McNutt member), and mudstone. The thickness of the Salado in the Livingston Ridge area is approximately 2000 feet. The McNutt member has approximately 600 feet of salt above and 1000 feet of salt below.

The Salado is formed mainly of halite which is incapable of transmitting any appreciable amount of fluid. George Griswold concurs with this statement in his paper submitted to Charles High on March, 1982. His paper titled Geology of the Carlsbad Potash Mining District, which is in Appendix 2 of the "Miner's Bible", states (page 18): "Halite has the well known behavior of behaving plastically under pressure. Petrofabric analysis along with modern day observation of halite being deposited in evaporation basins indicate that loosely packed crystals form within saturated brine pools. Continued burial forces the brine upward so that closer packing is achieved. On continued burial the halite crystals become completely plastic and all brine is ejected. The only exception being those fluids trapped in negative crystals at the time of crystallization. Thus halite becomes a true solid and possesses no porosity (except for brine filled negative crystals) and therefore no permeability. Permeability tests performed on salt cores either yield results that are beneath the measurement capability of the test apparatus or if measureable can be accounted for by fractures induced into the sample."

Generally, the halite itself has very little porosity and no permeability, but it is not completely homogeneous. Thin mud or clay seams, fractures, and breccia pipes occur within the Salado halite. The potash industry claims that these are paths of fluid migration. Upon examination of the facts, it is found that this is not entirely the case.

Gas, of an inert nature has been associated with the clay seams. In fact, several in-mine explosions (nonflammable) have been attributed to gas that has collected at the interface of the halite and clay seams. The Environmental Evaluation Group of the

New Mexico Health and Environment Department state in their March, 1984 paper (page 24) titled Occurrence of Gases in the Salado Formation (Appendix 3 of the "Miner's Bible"): "All salt deposits contain some fluids (brine and gas) and the Salado Formation is no exception. Within halite crystals, gas can often be seen as a bubble within a fluid inclusion. To estimate the percentage of fluids in the halite crystals of the Salado Formation, 35 selected core samples from ERDA-9 borehole (WIPP related borehole) were heated to 500 degrees C and weighted before and after the expulsion of gas and brine. The results showed that more than half the specimens showed only 0.5% weight-loss. The maximum weight-loss recorded by one sample was 3.5%. Since most of the fluid in the inclusions consists of brine, total amount of gas trapped within the crystals is negligible." The report goes on to say (page 24): "Almost every reported encounter of gas in the potash mines as well as near the WIPP repository is associated with either clay seams or clay-enriched zone of salt. The composition of the gas shows that it was mostly derived from the original atmospheric air at the time of deposition of the Salado. The gas is depleted in oxygen most likely due to the high chemical activity of oxygen which allows it to react with a variety of elements to form oxides. Methane must have originated from decomposition of marine organic life during times when clays were deposited in the Salado sea. The presence of gas near the clay layers is probably due to the contrast in the mechanical properties of clay and salt. Gas originally trapped must have migrated along crystal boundaries until it reached the impermeable clay layer."

There are "pockets" of porosity at the clay-salt interface and gas has accumulated at these "pockets". The gas migrated probably over a period of thousands of years, from the fluid inclusions within the salt. The clay itself is impermeable and the porosity "pockets" are limited in size and are not connected to each other. When mining occurs near an enclosed pocket containing confined pressurized gas an explosion can occur. The nature of the explosions in the mines can be explained by the limited nature of the porosity "pockets" and the lack of permeability between the "pockets". If the "pockets" were permeable and interconnected and not limited then gas would continue to blow strongly after the explosion, but this is not the case. Only small blows continue after the explosions, which is characteristic of limited cavities.

The Environmental Evalution Group report has a 1964 Department of the Interior report within its Appendix A. This report studied gas "blows" in the potash mines and the drilling of vertical boreholes into the back and at drift intersections to relieve gas pressure. Some of the boreholes produced "blows" and it seemed that holes drilled in the intersections were more likely to blow than holes located elsewhere. In one intersection the report states (page 64): "Gas pressure in one hole in the center of an intersection was sealed in, by means of the packer and gage, and pressure built up to 50 psi. A second hole drilled 20 feet from the original, and 6 feet outside of the intersection, did not reduce the pressure in the original hole. Another hole drilled in the intersection, 7 feet from the original hole, relieved the pressure in the original hole." Thus, permeability carried 7 feet at least, but not more than 20 feet. Looking at the data from this report it can concluded that the permeability between the two holes was artifically enhanced by mining. The report states that the intersections were more likely to have "blows" and at the tested intersection the hole outside the intersection

was not permeable with the holes in the intersection. Conclusions drawn from this data are that when the intersections are mined the support underneath the back is removed and the back can start sagging, thus creating space above the back and thus artificially enhancing porosity and permeability. This explains why the two holes within the intersection were connected and the hole outside the intersection was not. Even if the porosity and permeability are not artificially enhanced, the permeability only had a maximum extent of less than 20 feet.

The same report notes that some of the holes have pulsating blows. This can be explained by low permeability. If a cavity is limited in size and the surrounding rock has low permeabilities, gas will bleed slowly into the cavity. At some point the pressure will build up enough to bleed into a nearby relief borehole. When this happens the pressure in the cavity drops and it will take some time for gas in the surrounding rock to bleed into the cavity to build the pressure up again. Thus, low permeability can explain these pulsating blows.

Another example of the limited nature of the porosity pockets is seen when wells are drilled in the Livingston Ridge area. Three wells that Yates operated encountered gas "pockets" while drilling through the Salado. In most cases when these encounters occurred drilling activity stopped and the blow died in a few hours. If the pockets had any extent they would have blown for far longer periods of time.

Fractures within the halite are another possible path of fluid migration. Fractures induced in halite should naturally "heal" themselves. Griswold (1982) talks about the plastic nature of halite and how, under pressure from overburden, porosity is destroyed. The same thing will happen to fractures unless a fluid inside the fracture has a greater pressure than the overburden. The Environmental Evaluation Group report (1984) questions whether fractures present, at one explosion site, were containing gases or if the fractures were induced by the explosion. That point is moot in the context of this discussion; what is important are the findings on how extensive the fractures are. The report states (page 25): "The fractures associated with gas blowouts are, however, not continuous for more than a few tens of feet -- they are not intercepted in parallel drifts." Thus, fractures in halite will tend to close up because of overburden and if they remain open they are limited in area (refer to figure 3, page 8) as are the porosity pockets associated with clay seams.

The last possible path of fluid migration would be breccia pipes, also known as breccia chimneys and collapse chimneys. Snyder and Gard (1982) in their U.S.G.S. report titled Evaluation of Breccia Pipes in Southeastern New Mexico and Their Relation to the WIPP Site (Appendix 20 of the "Miner's Bible") state (page 1): "Breccia pipes (also called breccia chimneys) as they occur in evaporites are vertical cylindrical pipes or chimneys that may or may not involve more than one geologic formation. The chimneys are filled with downward-displaced brecciated rock. In this context, the rock is brecciated by having collapsed into a void at depth that was probably created by ground-water solution and removal of deep-lying evaporite or carbonate rocks in an underlying aquifer system." This describes the Capitan Reef: it is a major aquifer system in this area and it is composed of carbonate rock. Snyder and Gard (1982) go on to say (page 21): "Because the Tansill and Yates do not contain water-soluble evaporites, they are probably not the cause of the collapse of the

overlying rocks. Below these formations is the Capitan Limestone, a somewhat soluble rock known to contain large caverns (Carlsbad Caverns). The most reasonable explanation for collapse of the rocks cored in WIPP 31 is that a large cavern formed in the Capitan, and overlying rocks, as young as the Triassic Dockum Group, collapsed into the void" (refer to figure 32, page 60). One suspected and three known breccia pipes were identified by Snyder and Gard (1982): Hills A,B, and C, plus the suspected Wills Weaver (refer to figure 1, page 2 and table 2, page10). Snyder and Gard (1982) concluded that breccia pipes only formed over the Capitan Reef. The Livingston Ridge area is not over the Capitan Reef, it is located basinward of the reef approximately 5-6 miles to the south (refer to breccia pipe and oil seep location map). Thus, no breccia pipes are present in the area of Livingston Ridge. Some minor solution features occur in the Rustler Formation, above the Salado, but they do not extend through the Salado. Snyder and Gard (1982) place the age of the breccia pipes at approximately 400,000-500,000 years.

One borehole (WIPP 31) was emplaced in a breccia pipe (refer to figure 10, page 20), with continuous core being taken. Drill-stem tests were also taken in this borehole. Concerning the drill-stem tests, Snyder and Gard (1982) concluded (page 64): "Hydrologic tests (see section on Drill-Stem Tests, WIPP 31, this report) show that the pipe material is not capable of transmitting ground water. The clay matrix surrounding the rock fragments acts as an impermeable barrier, and so there is probably no additional dissolution of evaporitic rocks in the pipe; at least in the upper 549 m (1800 ft) above the massive anhydrite found at the bottom of drill hole WIPP 31." Thus, Snyder and Gard feel there will be no fluid movement through the breccia pipe down to the massive anhydrite which is probably the Fletcher Anhydrite (basal Salado).

The data presented by the potash industry shows that halite, in general, has very little porosity and no permeability. The possible exceptions to this (clay seams, fractures, and breccia pipes) have been shown to have some porosity, but lack the properties to transmit fluids over any distance. Clay seams are limited and not interconnected, fractures are present, but are only tens of feet in length, and breccia pipes occur in the Salado, but only over the Capitan Reef which is not present in the Livingston Ridge area. It is true, fractures and voids do occur (as stated in concern #4), but this is the exception and not the rule. Even if a well bore penetrated some fractures and voids they would be sealed off easily with casing and cement due to their limited extent.

Third Safety Concern

Safety concern #3 refers to examples of oil migration into mine workings and specifically refers to a serious case in 1965 where oil migrated 700 feet along clay seams from a well into the Eddy Potash mine. There have been documented cases of oil seeps in mine workings, but there is no published evidence that any of these seeps are resulting from a leaking oil or gas well.

The case mentioned above is a part of Appendix 21 of the "Miner's Bible". The only documents pertaining to this incident are a memorandum on National Potash

Company stationary, an accompanying map, a letter on file with the BLM to Tidewater Oil Company (operator of nearby oil wells), and a memorandum on a meeting between the U.S.G.S. and Tidewater.

The National Potash memorandum refers to a oil seep located in the NW1/4 of section 25 of Township 20 South - Range 29 East. The U.S.G.S. was notified and everyone involved assumed the oil was coming from one of Tidewater's oil wells. No study was performed to determine the origins of the oil and no evidence showing that the oil was from the Tidewater wells has ever been published. The U.S.G.S. did ask Tidewater to perform tests on their wells to determine if they were leaking, but due to the poor economic status of the wells and the costs of the tests, Tidewater opted to plug the wells in question. Whether the seep stopped before, during, or after plugging operations is unknown, there is no information available.

Included in Appendix 21, along with the National Potash memorandum, is a memorandum from Potash Company of America refering to two other oil seeps in 1965 (refer to breccia pipe and oil seep location map). One is located in the SW1/4 of section 24 of Township 20 South - Range 29 East, not too far away from the seep reported in the National Potash mine (mentioned above). This seep was associated with a fine vertical fracture extending above and below the ore body. Again, all parties involved assumed the oil was coming from nearby leaking oil wells and again no study was performed nor any evidence offered that this was the case. Included with the memorandum was a map showing the location of the seeps, the oil wells, and the mine workings. Note that the PCA seep has mine workings in between the seep and the suspected oil wells, yet there is no mention of seeps in the workings nearest to the suspected wells. If the oil had seeped from the wells it would seem that there should be more seeps or stains in the workings closest to the wells. The other seep mentioned was in the PCA workings in the NW1/4 of section 9 of Township 20 South - Range 30 East, along with reported oil stains from a nearby potash core. Again, no evidence was presented nor was a study conducted to prove if the oil actually came from a nearby well.

As stated above there is no available evidence supporting the idea that sources for oil seeps in mine workings are oil wells. But there is a U.S.G.S. open-file report suggesting that some of the oil seeps are naturally occurring. Open-file report 82-421, titled Geochemical Analysis of Potash Mine Seep Oils, Collasped Breccia Pipe Oil Shows and Selected Crude Oils, Eddy County, New Mexico and authored by Palacas, Snyder, Baysinger, and Threlkeld, suggest that the oils in the studied seeps were naturally emplaced and did not leak from present oil wells. This study examined oil samples from coreholes in two breccia pipes (Hills A and C), an oil seep associated with a breccia pipe (Hill C) in the Mississippi Chemical potash mine (SW1/4 of section 5 of Township 21 South - Range 30 East), and oil samples from different wells completed in different formations to determine the origins of the seep oils (refer to figure 1, page 19).

The samples from the cores and seeps were compared chemically with the samples from the different wells to determine which geologic formation the oils were derived. The samples were found to be most similar to the oils from the Yates Formation. This also fits geologically, as previously stated breccia pipes form over the

Capitan Reef. When the Capitan Reef collapsed forming breccia pipes, strata in the Seven Rivers, Yates, Tansill, Dewey Lake, and Dockum caved into the void created in the Capitan Reef. The U.S.G.S. report concludes (page 14): "The breccia pipe and mine seep oils were probably emplaced during or sometime after the brecciation, fracturing, and faulting of rocks in response to the dissolution of the Capitan Limestone, a reef facies, and subsequent caving of the overlying rocks. Partial leakage from disrupted Yates oil reservoirs probably accounts for the above oil shows." Thus, the oil leaked out of the breached Yates Formation and made its way into the Salado via the breccia pipe. Snyder and Gard (1982) conclude (page 65 of Snyder and Gard): "It is possible that oil from this formatiom (Yates) migrated toward the area of the breccia pipes and either entered the rocks before collapse occurred or it was forcefully emplaced during collapse, being pushed stratigraphically upward by hydrostatic pressure as the water in the underlying void was forced upward by the infalling rocks." The possibility exists that there is some communication within the breccia pipe and the oil could have leaked upward after the pipe was formed, but the key point made is that the oil found in the Salado was emplaced naturally.

To the knowledge of this author, all of the reported oil seeps have occurred in an area which overlies the Capitan Reef. Knowing that breccia pipes only form in the same area and that breccia pipes are associated with oil seeps, it can be concluded that the reported oil seeps in mine workings are naturally occurring and are not from oil and gas wells. There is no available proof that any oil seep is related to oil and gas wells.

Fifth Safety Concern

Safety concern #5 discusses the problems encountered when hydrogen sulfide is present. This is not a problem when drilling oil wells in the Delaware Mountain Group such as the ones located in the Livingston Ridge area. Oil produced from the Delaware is "sweet"; this means there is no sulfur or hydrogen sulfide present. It is common knowledge throughout the petroleum industry in southeastern New Mexico that the Delaware oil is "sweet". It is also stated in publications such as an article titled Oil and Geology in the Permian Basin of Texas and New Mexico and authored by John Galley (page 432).

In Livingston Ridge, the only time hydrogen sulfide has been encountered was when drilling through the upper Castile Formation (in just a few wells). A water flow was encountered along with small amounts of hydrogen sulfide. Water and hydrogen sulfide were detected coming up with the circulating drilling mud. This hydrogen sulfide was natural from the Castile Formation; commercial sulfur deposits occur in the Castile in Texas. Griswold (1982) even mentions hydrogen sulfide occurring naturally in the Salado.

The Delaware produces "sweet" oil, so no hydrogen sulfide will come from this formation. The only time hydrogen sulfide might be encountered is when drilling through the Castile or Salado. An intermediate casing string is set through the Castile and Salado and drilling resumes into the Delaware. Thus, any hydrogen sulfide is behind casing. Even if any hydrogen sulfide did reach the level of the Salado, which is highly unlikely, then it would have to penetrate back into the Salado which would not

happen for reasons discussed earlier. It should be noted that only four of twenty nine Yates operated wells, in the Livingston Ridge area, have encountered any hydrogen sulfide.

Summary

In summary, the potash industry has stated several safety concerns involving oil and gas activity within the potash enclave. It is stated that there are voids and fractures in the salt that will allow migration of fluids into the mines. It is true that there are voids and fractures within the Salado, but this is the exception, not the rule. These voids and fractures are very limited in area and are not interconnected and will not allow fluids to freely migrate any distance through the Salado. The potash industry correctly states that there are documented examples of oil migration into the mine workings, but then they go on to state that the oil has migrated from an improperly plugged well. There is no documentation of this, nor is there any published proof backing this statement. There is a published U.S.G.S. report showing that many of the oil seeps are natural and not caused by oil and gas activity. Also, all of the published reports of oil seeps state that these seeps are located over the Capitan Reef and breccia pipes are associated with oil seeps and the reef. The Livingston Ridge area is several miles south of the reef and out of the breccia pipe area. Hydrogen sulfide is a concern to both the potash and oil and gas industries. The Delaware oil is "sweet" it contains no sulfur, the only hydrogen sulfide encountered when drilling Delaware wells is in the Castile and that has only been a few wells in Livingston Ridge.

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STATEMENT OF ISSUE AND AGENCY ACTION REQUESTED

Prepared by the New Mexico Potash Industry
April 15, 1992

I. Statement of Issue

Recent decisions of the Bureau of Land Management ("BLM") approving the drilling of oil and gas wells in the "Potash Area" near Carlsbad, New Mexico have increased significantly the safety hazards faced by underground miners in the Potash Area and have resulted in the unnecessary waste of over $450 million dollars in potash. In approving these oil and gas wells, the BLM has ignored, entirely, the provisions of an agreement reached by the Oil and Gas Industry and the Potash Industry on November 23, 1987 - almost five years ago - setting forth an agreed upon basis for the orderly and safe development of each industry's mineral resources despite the fact that this Industry Agreement, in significant respects, has been incorporated by BLM into a revised Secretarial Order signed on January 8, 1992, but not yet published in the Federal Register.

II. Impact on Potash Industry

Existing BLM policies and rules on the drilling of oil and gas wells in the Potash Area, which are set forth in the 1986 Order of the Secretary, 51 Fed. Reg. 39425 (October 28, 1986), do not reflect current knowledge of the hazards of methane gas to underground miners or the impact on mine operators of a release of methane gas into underground mine workings under the Federal Mine Safety and Health Act. Further delay, therefore, in the issuance of the revised Secretarial Order will adversely impact miner safety, result in the further wasting of valuable potash deposits, and expose mine operators to the possibility of having to implement more stringent - and prohibitively costly - safety requirements in the event methane gas is released into mine workings by oil and gas wells.

III. Agency Action Requested

Immediately publish the revised Secretarial Order in the Federal Register or adopt its provisions as a matter of policy until it can be published.

IV. Additional Information

For additional information please contact one of the following:

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YATES PETROLEUM CORP.
BEFORE THE COMMISSION
NMOCD CASE NOS. 10446-10449
DATE: 09/09/92 DE NOVO
EXHIBIT NO. 18

Comments of the New Mexico Potash Industry on Rules for Oil and Gas Drilling in the Potash Basin Eddy County and Lea County, New Mexico

EXECUTIVE SUMMARY

Introduction

The New Mexico Potash Industry welcomes this opportunity to comment on the 1991 proposed Order of the Secretary of the Interior regarding drilling for oil and gas within the Potash Basin of southeastern New Mexico.

These comments present the views of Eddy Potash Corporation, Horizon Potash Corporation, IMC Fertilizer, Inc., Mississippi Chemical Corporation, New Mexico Potash Corporation, Noranda Minerals, Inc. and Western Ag-Minerals Company, which together represent 85 percent of U.S. potash production. Collectively, these companies produce 100 percent of the potash mined in New Mexico and control 98.9 percent of the potash leases in the Basin. Accordingly, the views expressed in these comments reflect the position of the entire potash industry.

The potash industry strongly urges the implementation of the proposed Order of the Secretary of the Interior regarding "Oil, Gas and Potash Leasing and Development within the Designated Potash Area of Eddy and Lea Counties, New Mexico" (Federal Register, February 21, 1991). The Secretarial Order is crucial to establishing an orderly means of resolving conflicts arising from the occurrence of multiple natural resources within the Potash Area. It is vital to assuring safe working conditions for the underground mine work force and preventing undue waste of the potash resource. In the absence of the Order, needless waste of the potash resource has already occurred. If the Order is not implemented expeditiously, additional resources will be lost. Much more seriously, the entire potash industry could be jeopardized by the occurrence of even a single incidence of methane leakage into mine workings, as this event would force the implementation of unaffordable, stringent new safety regulations at least, or result in an underground mine disaster at worst. These regulations would require expenditures to retrofit mine electrical, mechanical and ventilation systems which would double the operating cost of mining potash. The encroachment of oil and gas drilling into the Potash Area could result in an underground explosion or hydrogen sulfide poisoning causing senseless loss of life.

Potash Industry Overview

Potash is an essential plant nutrient for which there is no substitute. The Potash Area of southeastern New Mexico contains the only potash deposits in the United States which can be produced by conventional mining methods. It accounts for approximately 85 percent of all domestic potash production.

Potash in the Basin is mined underground from bedded potash and salt deposits of the Salado Formation (Permian). Two ore minerals are produced. Sylvite (potassium chloride) is the more common mineral and is widely used as a source of agricultural potash, in drilling and fracturing fluids, and as a feed stock for other

potassium chemicals. Langbeinite (potassium-magnesium sulfate) is a rare ore of potash which occurs commercially only in the Carlsbad area. It is a premium product which provides multiple nutrients and can be applied to soils which are chloride intolerant.

Conventional room and pillar and continuous mining methods are used in the Basin. A network of openings is made in the first stage of mining, leaving large pillars of ore for support. Toward the end of mining, earlier mined areas are re-entered and the pillars are removed, which leads to gradual subsidence of the ground over the ore deposit.

Ventilation of the underground working areas is supplied by large main fans which either push or pull surface air into the mine, where it is disbursed through the workings by booster fans. Air quality is obviously of high importance underground. Consequently, ventilation is strictly regulated by the Mine Safety and Health Administration.

In order to prevent explosion hazards, the methane concentration in each mine is carefully monitored. MSHA must be notified in the event air sample results indicate 0.25 percent or more methane in the mine atmosphere. The ventilation regulations are written such that if one mine in an area is found to have unacceptable concentrations of methane, all mines in the area will be regulated under the assumption that they, too, are potentially gassy. If methane concentrations were to exceed this amount, underground electrical, mechanical and ventilation systems would be required to be replaced with explosion proof systems. The industry simply does not have the resources to absorb such a capital outlay, nor can it recover the increased operating costs which would result.

Effects of Oil and Gas Activity on Potash Mining

The danger posed by oil and gas activity within the Potash Area is the potential for escape of methane or other petroleum gases into the mine workings. This could cause an explosion or, at a minimum, force abandonment of the workings owing to unsafe conditions.

The Salado Formation in the area of the nearby Hobbs Pool has been found to be charged with methane because of leakage from oil and gas wells. New Mexico subsequently established casing requirements designed to prevent recurrence of leakage. Unfortunately, casing alone cannot assure prevention of gas leakage into mine workings:

1. It is not known how closely to mine workings an oil or gas well can be drilled with assurance of safety. The petroleum and potash industry have jointly agreed to use one-half mile as a standard for deep oil and gas wells and one-quarter mile for oil wells less than 5,000 feet deep. Much research is needed to permit defining the "safe" distance more closely, particularly since ground conditions and the efficiency of casing can be expected to vary widely among individual wells. To drill more closely at present, would be to place human life at risk unnecessarily and could be interpreted as violating the intent of federal mine safety and health laws.

2. Casing programs cannot provide protection in the event of accidents. At least seventeen blowouts or oil-well fires have occurred in the area around the Potash Basin. It is a virtual certainty that others will occur from time to time.

3. Examples of oil migration into potash workings have already been documented. In the most serious of these, oil migrated 700 feet along mud seems from an improperly plugged well into the Eddy Potash mine. It should be clear that petroleum gases potentially can migrate much greater distances and in greater quantity than oil. Had the well been a high pressure gas well, the consequences could have been disastrous.

4. Practical experience has shown that it is unlikely that a casing and cementing program can give completely adequate assurance of protection against gas migration considering the enormity of the potential consequences. The occurrence of fractures and voids makes it difficult, at best to seal off formation fluids, particularly in salt or heavily fractured zones.

5. The occurrence of hydrogen sulfide can be predicted to have a highly corrosive effect on casing, which can lead to casing failure and leakage of both flammable and toxic gases long after the well has been abandoned.

Potential Effects on the Potash Industry

The potential effects of oil and gas hazards on the potash industry are significantly greater than they were when concurrent development of the two industries first began. In the 1950's, there were few safety requirements addressing flammable gases which were of economic consequence. Because of several mine disasters caused by flammable gases, significant changes in mine safety and health laws were made in 1959, 1969 and 1977. Each time the regulations became more stringent and the consequences of the presence of gas became more severe. Today, the consequences are such that a single release of flammable gas into any one mine could destroy the industry.

Under regulations promulgated pursuant to the federal Mine Safety and Health Act, non-coal mines will be regulated as gassy upon the finding of a single air sample containing 0.25 percent methane or some other flammable gas.

The direct consequence of such a finding would be that all mines in the Basin would be required to install supplemental ventilation; replace or modify equipment with explosion-preventing types; and replace most if not all electrical systems. In 1982, it was estimated that the capital cost of compliance with gassy mine regulations would be greater than $80 million and the operating cost would be doubled.

The economic consequences of oil and gas drilling have already been experienced through loss of reserves. The assets of the potash mining industry are contained mainly in its mineable reserves. Each encroachment of oil and gas drilling into the Potash Area measurably decreases the accessible potash resource. For example, recent drilling has advanced into the Potash Area along the eastern margin of the WIPP Site. The cumulative effect of seven wells during the last 2 years has been the loss of approximately 29 million tons of potash reserves with a gross value of about $450 million in the three ore zones present.

The financial effect of any single well proposal cannot be predicted with sufficient certainty. Owing to changes in market conditions and demand for products, mine plans change frequently. It is entirely within likelihood that what is a fringe zone today could be an important ore target in the near future. Using lower height mining techniques, one mine is now mining ores that were considered waste 5 years ago. Historically, the potash industry has mined ores that have ever decreasing potash grades.

Recommendations

The discussion above summarizes the hazards associated with oil and gas drilling in the Potash Basin. We, as an industry, firmly believe that the provisions of the 1986 Secretarial Order do not adequately protect our mines and miners from the hazards associated with oil and gas drilling in the Potash Basin. Several actions are available which, if taken, will promote the safety and well-being of the potash industry and lead to greater cooperation among all parties. Among these are:

1. **Implement Proposed Secretarial Order.** While not perfect in all respects, the proposed 1991 Secretarial order is the best vehicle available to protect the interests and orderly development of both industries. It is essential to protecting the safety of potash mines and miners. It has the advantage of reflecting the good faith effort of both industries to reach a mutually beneficial accord regarding drilling and mine development. We strongly urge that the new Secretarial Order be placed in effect without delay.

2. **Well Spacing and Studies of Gas Migration.** A spacing requirement (buffer zone) between oil and gas activities and ore deposits must be developed and implemented to ensure the safety of miners. The hazards involved are too great to rely solely on a casing and cementing program. The spacing requirement should consider the possible migration of gases as well as the spacing required to avoid damage from mining subsidence. The one-half mile buffer established by industry agreement is a current "best guess" regarding an appropriate spacing. Technical studies to better define the buffer requirements would serve to protect the valid interests of both industries.

3. **Responsibility for Actions.** There should be a clear recognition of liability for any damage caused by one industry to the other. For example, if a well is damaged by mining activity, the mine operator should be liable for any losses. Similarly, if a well releases hazardous gases which migrate into mine workings, the oil or gas operator should be liable for additional costs or loss of assets stemming from that release.

4. **Definition of Potash Resource.** Current procedures for identifying ore bodies and barren areas need to be improved to provide more guidance to both industries. In many instances commercial grade ore exists well beyond the boundaries of any existing potash leases or Life of Mine Reserves (LMR's). We believe the identification of these areas should be the shared responsibility of both industries. The BLM also has a major responsibility under federal law to conserve mineral resources.

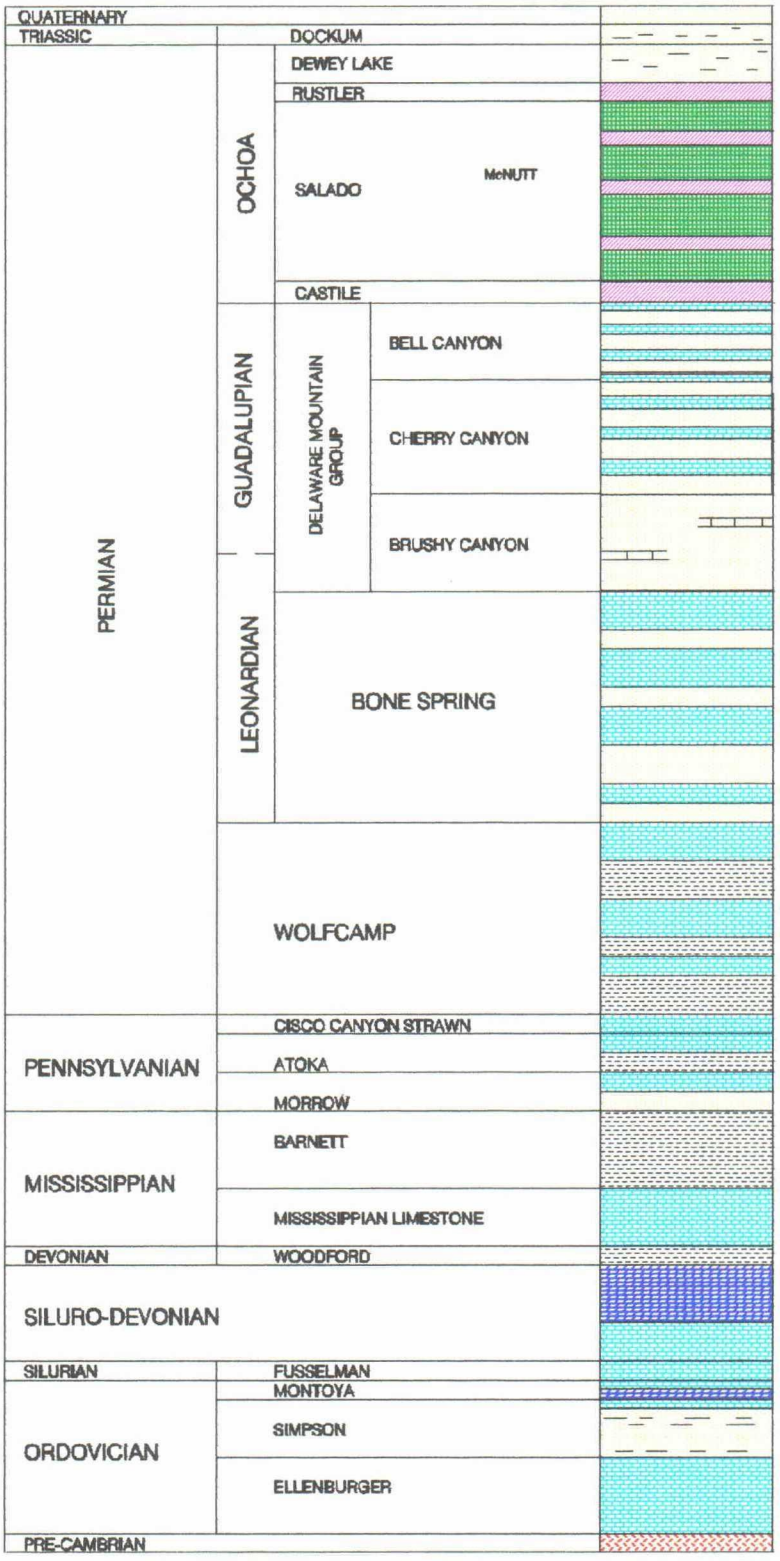
5. **Directional Drilling Technology.** Increased use of directional and horizontal drilling should be promoted. The drilling technology available today virtually eliminates any technical limits on bottom hole displacement. Using this

capability, wells could be drilled from locations sufficiently removed from ore deposits that the attendant hazards would be reduced greatly. Any increase in costs, we believe, would be justified by the increased safety to miners. At the very least, the amount of potash known to exist should justify the additional cost of directional drilling.

6. Increased Cooperation Between the New Mexico Oil Conservation Division and the BLM. We believe that any real effort to address the hazards involved in oil, gas and potash production will require increased cooperation between the OCD and BLM. Because of the nature of the hazards involved, it is essential that whatever safety practices are adopted are applied equally on federal and state administered lands.

7. Cooperation Between Industries. It is in the best interests of both the petroleum and potash industries to work together to achieve orderly development of our resources and to protect each of our valid interests. The potash industry wishes to promote mutual trust and cooperation. We will work ability to establish mutual trust and good-faith relationships with the petroleum industry and the affected regulatory agencies.

GENERALIZED SECTION
DELAWARE BASIN



(Modified after Roswell Geological Society, *A Symposium of Oil & Gas Fields, 1988*)

YATES PETROLEUM CORP.
BEFORE THE COMMISSION
NMOCD CASE NOS. 10446-10449
DATE: 09/09/92 DE NOVO
EXHIBIT NO. 19