STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION

IN THE MATTER OF THE APPLICATION	:	
OF YATES PETROLEUM CORPORATION	:	
FOR AUTHORIZATION TO DRILL,	:	CASE NO. 10449
EDDY COUNTY, NEW MEXICO	:	

APPLICANT YATES PETROLEUM CORPORATION'S
REQUESTED FINDINGS OF FACT

BY THE COMMISSION:

FINDS:

1. Due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

2. Commission Case Nos. 10446, 10447, 10448 and 10449 were consolidated at the time of the hearing for the purpose of presenting testimony.

3. The Applicant in this matter, Yates Petroleum Corporation ("Yates"), seeks approval to drill its Flora "AKF" State Well No. 2 within the "Designated Potash Area" pursuant to all applicable rules and procedures governing said area, as promulgated by Division Order No. R-111-P. The proposed well is to be located at a standard oil well location 1,980' from the South line and 2,310' from the West line (Unit K) of Section 2, Township 22 South, Range 31 East, N.M.P.M., Eddy County, New Mexico, to test the Delaware formation at an approximate depth of 8,500'. The NE/4 SW/4 of said Section 2 is to be dedicated to said well forming a standard 40-acre oil spacing and proration unit for either the Undesignated Lost Tank-Delaware Pool or Undesignated Livingston Ridge-Delaware Pool.

4. New Mexico Potash Corporation ("NM Potash"), owner of the state potash lease underlying all of Section 2 appeared at the hearing through counsel and opposed the application on the basis that there is a Life of Mine Reserve designation ("LMR") covering Section 2 and that oil and gas operations are prohibited within LMR areas under the provisions of Oil Conservation Commission Order R-111-P, and further that commercial potash would be wasted unduly as a result of the drilling of the well.

5. Order R-111-P prohibits drilling operations within an LMR or its attendant buffer zone unless the oil and gas operator and the mine operator mutually agree to permit drilling or the Oil Conservation Commission grants an exception to Order R-111-P upon a showing that commercial potash will not be wasted unduly as a result of the drilling of the well.

6. Under R-111-P, mine operators file LMR designation maps with the New Mexico State Land Office ("SLO") and with the U. S. Bureau of Land Management ("BLM"). Section 2 is on State Lands, thus involving only the SLO.

7. Yates in its application challenges NM Potash's designation of Section 2 as part of its LMR or buffer zone thereto, argues that an LMR is not established on State Land until approved by the SLO nor does it have retroactive effect once approved, and contends notwithstanding an LMR designation that the Oil Conservation Commission is obligated to grant exceptions to Order R-111-P unless commercial potash will be unduly wasted as a result of drilling the well.

8. Order R-111-P does not specify the process by which the BLM or SLO approve the LMR designation. NM Potash argues that the filing of the map creates the LMR, and that the SLO does not approve the LMR designation. There is no provision in Order R-111-P for any person, other than the SLO, to challenge the basis for designating an LMR, and the designation of an LMR, without the right to seek an exception thereto, effectively deprives the owner of oil and gas interests the right to develop those interests without any forum or opportunity to be heard. The interpretation argued by NM Potash raises constitutional questions about the validity of Order R-111-P.

9. Testimony from Ernest Szabo of the SLO established:

(a) an LMR designation by NM Potash effective 01/01/91 exists which includes most of Section 35, Township 21 South, Range 31 East, N.M.P.M., Eddy County, New Mexico, (the section immediately north of Section 2). **Szabo, Vol. 1 p. 109, lines 7 - 14**

(b) NM Potash filed with the SLO by letter dated 01/14/92 an amendment to its LMR designation, pursuant to paragraph G(a) of Order R-111-P, which amendment includes most of Section 2. **Szabo, Vol. 1 p. 109, lines 15 - 24**

(c) By letter dated 02/10/92 to NM Potash, the SLO acknowledged receipt of the updated LMR, gave notification that the updated LMR could not be approved with the information received and requested additional supporting data to show that sufficient mineral deposits exist within the amended LMR area to support the designation. **NM Potash Exhibit 10A**

(d) By letter dated 03/27/92, to NM Potash, the SLO acknowledged receipt of additional data and as of that date approved the designation of the SE/4 of Section 2 as an LMR. The SLO further advised that chronology would control and that all wells permitted prior to 03/27/92 were approved by the Commissioner. **NM Potash Exhibit 11; Szabo, Vol 1, p. 111, line 24 through p. 114, line 23; p. 130, lines 12 - 16**

10. Prior to 03/27/92 NM Potash's LMR did not extend into Section 2, but an LMR designation had been submitted under Order R-111-P to include Section 35. **NM Potash Exhibit 11; Szabo, Vol. 1 p. 111, line 24 through p. 114, line 23, p. 130, lines 12 - 16, p. 127, lines 15 - 18**

11. As of 01/01/91, the northern half of Section 2 was designated as a buffer zone because of the LMR designation in Section 35. **Szabo, Vol. 1, p. 127, lines 13 - 18**

12. Since the proposed Flora "AKF" State Well No. 2 is not within an LMR, including a buffer zone as defined in Paragraph G(e)(3) of Order R-111-P, Yates' application follows the guidelines of Paragraph G(e)(3) which states, in part, "Applications to drill outside the lMR will be approved...; provided there is no protest from potash lessee withn 20 days of his receipt of a copy of the notice...". NM Potash filed a timely objection.

13. Yates in its application contends that the total quantity of commercial deposits of potash which may reasonably be recovered in commercial quantities would not be unduly reduced by the drilling of the subject well, nor would its operations interfere unduly with the orderly development of commercial potash deposits in Section 2. **Patterson, Vol. I, p. 33, line 25 - 25; p. 34, line 1 - 23.**

14. Yates submitted its applications to drill the Graham "AKB" State Well No. 3 and No. 4 and the Flora "AKF" State Well No. 1 in November of 1991. The application for the Flora "AKF" State Well No. 2 was submitted in January of 1992. **Yates Exh. No. 2; Patterson, Vol. I, p. 15, lines 12 - 15; p. 17, lines 2 - 6; p. 44, lines 1 - 3.**

15. No objection was raised by NM Potash to the Graham "AKB" State Well No. 3 and No. 4 and the Flora "AKF" State Well No. 1 and No. 2 until January of 1992. **Patterson, Vol. I, p. 17, lines 7 - 17.**

16. In January of 1992, NM Potash personnel indicated to Yates that NM Potash had no plans for at least ten years for development of potash reserves located in Section 2. **Patterson, Vol. I, p. 34, lines 23 - 25; p. 35, lines 1 - 25; p. 36, lines 1 - 7.**

17. The proposed well is a Delaware test, from which similar wells in the area produce approximately 125,000 barrels of primary oil during their lifetime, resulting in approximately $417,000 in royalties for the State of New Mexico, an additional $230,000 in revenue to the State as taxes and $1 million in net

profits for the operator. **Patterson, Vol. I, p. 36, lines 23 - 25; p. 37, lines 1 - 14.**

18. The projected depth of the proposed well is 8,500' to test the hydrocarbon potential of the Delaware Mountain Group. **See Application.**

19. The primary objective is to test the basal Cherry Canyon formation and to extend the western limits of the Lost Tank and Livingston Ridge Pools. Secondary objectives include the Brushy Canyon and Bell Canyon formations. **May, Vol. I, p. 138, lines 19 - 25.**

20. Evidence was presented through the use of cross-sections indicating that the targeted reservoir should extend west from the existing pools into Section 2. **Yates Exh. No. 12, May, Vol.1, p. 138, lines 15 - 18.**

21. A structure map was presented showing east dip in the Livingston Ridge area, establishing that the proposed location is situated up-dip from already established production in Section 2, avoiding the oil/water contact. **Yates Exh. No. 13, May, Vol. I, p. 139, lines 5 - 8; Vol. I, p. 139, lines 17 - 19.**

22. A net porosity map was presented showing sufficient porosity to establish commercial oil production. **Yates Exh. No. 15; May, Vol. I, p. 140, lines 13 - 21; p. 141, lines 1 - 11.**

23. The location requested is one location away from being a direct offset of current production, and a well drilled thereon should encounter the main pay zone, along with several secondary pay zones. The well should be updip from producing wells in the same field and the amount and quality of reservoir encountered

should be sufficient to produce an economic well. **Yates Exh. No. 16; May, Vol. I, p. 147, lines 25 through p. 148, line 7.**

24. NM Potash presented no evidence to contradict the geologic evidence and interpretations presented by Yates concerning the oilfield development potential.

25. Five concerns previously voiced by the Potash Industry were addressed through testimony elicited by Yates. Those concerns voiced by the Potash Industry are:

1) It is not known how close to mine workings an oil and gas well can be drilled with assurance of safety. **May, Vol. I, p. 149, line 25; p. 150, lines 1 - 3.**

2) Casing programs cannot provide protection in the event of accidents. **May, Vol. I, p. 151, lines 8 - 9.**

3) Examples of oil migration into potash workings have already been documented. **May, Vol. I, p. 151, lines 14 - 15.**

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 to seal off formation fluids, particularly in salt or heavily fractured zones. **May, Vol. I, p. 151, lines 24 - 25; p. 152, lines 1 - 6.**

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. **May, Vol. I, p. 152, lines 7 - 12.**

26. The potash zones occur within the Permian Salado formation, which is stratigraphically above the Permian Castile formation and below the Permian Rustler formation. The Salado is composed of mostly halite with minor amounts of anhydrite, potash minerals concentrated in the McNutt member and mudstone. The thickness of the Salado in the Livingston Ridge area is approximately 2000 feet. The potash mineral bearing McNutt member has approximately 600 feet of salt above the potash and 1000 feet of salt below the potash zones. **May, Vol. I, p. 153, lines 19 through p. 154, line 4.**

27. Halite is incapable of transmitting any appreciable amount of fluid as documented by studies relied upon by the Potash Industry, which state that halite becomes a true solid and possesses no porosity 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 measurable, can be accounted for by fractures induced into the sample. **May, Vol. I, p. 154, lines 17 - 24; p. 155, line 23 through p. 156, line 6.**

28. The halite itself has very little porosity and no permeability, but it is not completely homogeneous. Thus mud or clay seams, fractures and breccia pipes occur within the Salado halite. **May, Vol. I, p. 156, lines 6 - 10.**

29. Gas of an inert nature has been associated with clay seams. Several in-mine explosions (nonflammable) have been

attributed to gas that has collected at the interface of halite and clay seams. **May, Vol. I, p. 156, lines 15 - 20.**

30. Reports relied upon by the Potash Industry indicate the composition of the gas shows that it was derived from the original atmospheric air at the time of deposition of the Salado. **May, Vol. I, p. 157, lines 19 - 25.**

31. Any methane in the gas originated from decomposition of marine organic life during the periods when the clays were deposited in the Salado sea. **May, Vol. I, p. 158, lines 4 - 6.**

32. There are pockets of porosity at the clay-salt interface and gas has been trapped in these pockets over a period of thousands of years. **May, Vol. I, p. 158,. lines 12 - 16.**

33. The clay itself is impermeable and the porosity pockets are limited in size and are not connected to each other. **May, Vol. I, p. 158, lines 16 - 18.**

34. When mining occurs near an enclosed pocket containing gas under confined pressures an explosion (nonflammable) can and has occurred. **May, Vol. I, p. 158, lines 18 - 21.**

35. The nature of the explosions 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 for a long time after the explosion, but this is not the case. Only small blows continue after the explosions, which is characteristic of limited cavities. **May, Vol. I, p. 158, line 22 through p. 159, line 5.**

36. Fractures within the halite can be a possible path of fluid migration. **May, Vol. I, p. 161, lines 20 - 21.**

37. Fractures induced in halite should naturally heal themselves. **May, Vol. I, p. 161, lines 21 - 23.**

38. Fractures in halite will close up or heal because of the overburden, and if they remain open are limited in area as are the porosity pockets associated with clay seams. **May, Vol. I, p. 162, lines 15 - 19.**

39. The only other possible naturally occurring path of fluid migration would be breccia pipes, also known as breccia chimneys or collapse chimneys. **May, Vol. I, p. 162, lines 20 - 22.**

40. Studies relied upon by the Potash Industry indicate that known breccia pipes only formed over the Capitan Reef and developed as a result of voids created in the reef. **May, Vol. I, p. 164, lines 6 - 7.**

41. The Livingston Ridge area is not over the Capitan Reef, which is located 5 to 6 miles north of Livingston Ridge. Thus, no breccia pipes can be expected in the area of the proposed location. **Yates Exh. No. 20, May, Vol. I, p. 164, lines 8 - 12, lines 20 - 25.**

42. Hydrologic tests show that the breccia pipe material is not capable of transmitting groundwater. The clay matrix surrounding the rock fragments act as an impermeable barrier. **May, Vol. I, p. 165, lines 12 - 22.**

43. With respect to Safety Concern No. 4 of the Potash Industry, 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 or permeability to transmit fluids over any distances. **May, Vol. I, p. 166, lines 3 - 9.**

44. There have been documented cases of oil seeps in mine workings, but there is no published evidence that any of these seeps were caused by a leaking oil or gas well. **May, Vol. I, p. 167, line 22 through p. 168, line 2.**

45. In at least one of the reported instances of an oil seep, mine workings in between the seep and the suspected oil wells evidenced no seeps. **May, Vol. I, p. 171, lines 6 - 17.**

46. USGS Open File Report 82 - 421 suggests that at least some of the reported oil seeps are naturally occurring. The report concluded that 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. **May, Vol. I, p. 172, lines 9 - 15; p. 173, lines 18 - 25.**

47. Evidence was presented indicating that the reported oil seeps have all occurred in an area which overlies the Capitan Reef. **May, Vol. I, p. 174, lines 20 - 22.**

48. With respect to Safety Concern No. 3 of the Potash Industry, no documented evidence exists to date indicating that oil seeps found in any potash mine were the result of a leaking oil or gas well. **May, Vol. I, p. 174, lines 23 through p. 175, line 4.**

49. Hydrogen sulfide is not a problem when drilling oil wells in the Delaware Mountain Group in the Livingston Ridge area. Oil produced from the Delaware is sweet, containing no sulfur or hydrogen sulfide. **May, Vol. I, p. 175, lines 17 - 21.**

50. Hydrogen sulfide has been encountered only a few times in water flows while wells were being drilled through the Castile formation, which is located below the Salado formation. **Yates Exh. 19, May, Vol., 1, p. 176, lines 3 - 11.**

51. With respect to Safety Concern No. 5 of the Potash Industry, any hydrogen sulfide, if encountered in the Castile formation, would be behind the cemented intermediate casing, thus eliminating the possibility of contact of hydrogen sulfide with either the intermediate casing or the 5 1/2" production casing cemented within the intermediate casing. **May, Vol. I, p. 176, lines 14 - 24.**

52. Evidence presented by Yates indicated that the average Delaware oil well in the Livingston Ridge area should have reserves on the order of 130,000 barrels of oil. **Yates Exh. 22, Boneau, Vol. I, p. 218, lines 2 - 11.**

53. Example economics for a Delaware well having producible reserves of 89,000 barrels of oil and of 130,000 barrels of oil were presented showing respectively a profit of $517,000 (a return of 35%) and a profit of $1.1 million (a return of 90%). **Yates Exhs. 23 & 24; Boneau Vol. I, p. 220, lines 1 - 12; p. 221, lines 2 - 10.**

54. A Delaware well in Section 2, having 130,000 barrels of producible oil reserves would generate $230,000 in production

taxes and $420,000 in royalty revenue for the State of New Mexico. **Boneau, Vol. I, p. 221, lines 11 - 16.**

55. A Delaware well drilled at the proposed location is expected to have good reserves and good economics. **Yates Exhs. 22, 23, & 24; Boneau, Vol. I, p. 218, line 2 through p. 221, line 16.**

56. Evidence was presented showing how the casing requirements under Order R-111-P would provide multiple barriers of steel and cement which would more than adequately protect the entire Salado formation from the oil and gas to be produced from the proposed well. **Yates Exh. 25 and 68; Boneau, Vol. I, p. 222, lines 24 - 25; p. 223, line 1 through p. 224, line 5; O'Brien, Vol. IV, p. 839, line 21 through p. 851, line 19.**

57. Evidence of an additional safety factor, that being the proposed well would be pumped through tubing, was presented. Pumping the well would result in essentially no pressure or a very low pressure in the wellbore. Because of the pressure differential between the wellbore and the Salado formation, all fluids would move in the direction of the formation to the wellbore and not vice versa. **Boneau, Vol. I, p. 224, line 6 through p. 225, line 14.**

58. With respect to Safety Concern No. 4 of the Potash Industry, the evidence indicates that no leaks would occur in the casing program required by R-111-P and further, if a leak were to occur, it would be from the formation back into the casing rather than into the Salado formation from the casing. **Boneau, Vol. I, p. 225, line 19 through p. 226, line 11; O'Brien, Vol. IV, p.**

868, line 15 through p. 870, line 12; p. 941, line 1 through p. 943, line 18; p. 995, line 25 through p. 997, line 6; p. 942, line 4 through p. 943, line 18; p. 1006, line 18 through p. 1007, line 1; Hutchinson, Vol. III, p. 723, line 9 through p. 724, line 6.

59. Yates is unaware of any evidence of a casing failure in the Livingston Ridge area. No evidence of such a failure was presented by NM Potash. **Boneau, Vol. I, p. 226, lines 3 - 11; O'Brien, Vol. IV, p. 1015, lines 6 - 9.**

60. With respect to Safety Concern No. 2 of the Potash Industry, NM Potash's evidence of seventeen blowouts or oil well fires confirms the fact that casing programs can provide protection in the event of accidents, as in each of the cases referred to the casing had performed its function and transmitted the explosive forces and oil and gas to the surface, protecting intermediate formations from damage or intrusions. **Boneau, Vol. I, p. 228, line 1 through p. 230, line 3; O'Brien, Vol. IV, p. 997, line 7 through p. 999, line 23.**

61. It was the opinion of experts testifying on behalf of Yates that once a well was plugged and abandoned, it would be possible to mine right up to the abandoned wellbore or even through it without any danger of hydrocarbons leaking into the potash zones. **Boneau, Vol. I, p. 230, lines 24 through p. 231, line 23; Hutchinson, Vol. III, p. 691, line 7 through p. 692, line 2; O'Brien, Vol. IV, p. 863, line 25 through p. 874, line 22; p. 931, lines 11 - 17; p. 1009, line 20 through p. 1010, line 5.**

62. Evidence was presented estimating that primary production from a Delaware well in the Livingston Ridge area should end within 15 years and a waterflood, if such should prove successful, would add an extra fifteen to twenty years to the life of the well. **Yates Exh. 27, Boneau, Vol. I, p. 233, line 19 through p. 234, line 2; p. 235, lines 3 - 7.**

63. A waterflood would start five years before the end of primary production, thus, the time required to produce both primary and secondary oil would be 30 years. **Boneau, Vol. I, p. 235, lines 7 - 15.**

64. A waterflood generally doubles the amount of primary production from a well. **Boneau, Vol. I, p. 235, line 25 through p. 236, line 1.**

65. The proposed well should produce oil and gas for 30 years and after plugging and abandonment, the same wellbore could be safely mined through. **Boneau, Vol. I, p. 235, lines 7 - 15; O'Brien, Vol. IV, p. 862, line 2 through p. 864, line 9; p. 931, line 11 through p. 932, line 2.**

66. Evidence was presented which showed that it was not feasible to drill a directional Delaware well any further than a diagonal offset, because the costs of drilling and compliance with Order R-111-P on a directional hole would make the well uneconomic. **Boneau, Vol. I, p. 239, line 1 through p. 240, line 20; O'Brien, Vol. IV, p. 917, line 15 through p. 929, line 23; p. 980, lines 2 - 23.**

67. Ore is defined in the Society of Mining Engineers Handbook, the accepted handbook of the mining industry, as a

mineral that can presently be acquired, mined, milled and marketed for a profit. **Muncy, Vol. II, p. 328, lines 19 - 24.**

68. After 70 years of mining, only 10% of the KPLA has been either first or second mined, yet large areas are mapped by the BLM as "measured ore". **Yates Exh. No. 34, Muncy, Vol. II, p. 349, lines 3 - 8.**

69. At least 16 oil wells are located in and around the Amax, now Horizon, potash mine. Seven of the wells were located within the area that had been first mined, four wells were located in the second mined area and five more wells were located in close proximity to the mine. Yates was unaware of any problems caused by these wells or by the wells located in and around the other potash mines. Evidence was presented that Amax will mine within 100 feet of the plugged and abandoned Culbertson and Irwin Federal No. 1 Well. **Muncy, Vol. II, p. 350, lines 15 through p. 351, line 4; p. 363, line 1 through p. 366, line 18.**

70. The BLM uses different terminology from that used in the Society of Mining Engineers Handbook to describe the degree to which available evidence indicates the existence of ore. The Society of Mining Engineers Handbook utilizes the following terminology: proven, indicated and inferred; while the BLM uses: measured, probable and possible. The difference in terminology used by the BLM appears to be the result of the lessening of the criteria necessary to establish ore within each category. This lessening of criteria is the result of the BLM's original usage of the criteria as a leasing standard and an attendant relaxation of the data point requirements described in the Society of Mining

Engineers Handbook. **Yates Exh. 35; Muncy, Vol. II, p. 347, lines 16 - 22; p. 352, lines 19 through p. 354, line 23.**

71. The examples of mine disasters referred to by the Potash Industry have all occurred in areas with significant differences in geologic conditions from that of Southeastern New Mexico, thus failing to form any real basis for comparison. **Muncy, Vol. II, p. 356, lines 3 - 16.**

72. The one example repeatedly cited by the Potash Industry of the unreliability of the cementing of casing was discussed by Nelson Muncy, who had been the engineer in charge of that cementing job which was performed upon the Westside Amax Electrical Hole. Mr. Muncy testified that the failure of the cement to circulate to the surface was a result of the failure of the potash company directing the cementing to follow recommendations and use sufficient amounts of cement to accomplish circulation. **Muncy, Vol. II, p. 360, line 20 through p. 362, line 10.**

73. Evidence was received through a letter dated 12/27/91, from IMC, that IMC and NM Potash had an agreement to transfer the potash lease on Section 2 from NM Potash to IMC. The letter was dated approximately 10 days prior to the inclusion of Section 2 into NM Potash's amended LMR. **Muncy, Vol. II, p. 372, lines 21 through p. 380 line 19.**

74. There is no evidence of any oil or gas well that has been affected by subsidence within the KPLA. **Muncy, Vol. II, P. 380, line 23 through p. 381, line 16.**

75. Evidence was presented that, when the plugging procedures established under Order R-111-P were followed, plugged and

abandoned deep gas wells did not pose safety concerns any different from that of a shallow oil well. **Muncy, Vol. II, p. 417, lines 1 - 20; O'Brien, Vol. IV, p. 862, line 2 through p. 870, line 12.**

76. Potash companies regularly drill coreholes through the potash bearing zones of the Salado formation without setting protective casing. Corehole K-162, drilled by NM Potash in Section 2, was drilled and plugged with cement without the use of protective casing. As such drilling and plugging procedures regularly result in coreholes from the surface through the mining areas in all mines, areas that are subjected to the most significant amounts of subsidence, the safety of drilling and plugging procedures has been demonstrated and accepted by the Potash Industry. **NM Potash Exh. No. 6; Muncy, Vol. II, p. 444, line 15 through p. 447, line 15; O'Brien, Vol. IV, p. 854, line 17 through p. 861, line 14; p. 999, line 24 through p. 1001, line 16.**

77. Evidence was received which indicated that the oil and gas reserves in Section 2 could be drilled, developed, produced and wells plugged before active mining would occur in Section 2, if, in fact, such mining ever occurred. **Muncy, Vol. II, p. 455, lines 6 - 19; Hutchinson, Vol. III, p. 697, lines 12 - 18; O'Brien, Vol. IV, p. 930, lines 7 - 11.**

78. Oil and gas logs can be used to predict barren and, to some degree, mineralized zones of potash. **Yates Exh. No. 40; Lammers, Vol. II, p. 473, lines 17 - 19; Grosvenor, Vol. VII, p. 1623, lines 14 - 17.**

79. On the basis of well log information and core data, both from within and without Section 2, the potash zones underlying Section 2 were confirmed to be very erratic in their mineralization and in the thickness of that mineralization. **Yates Exh. No. 41, Lammers, Vol. II, p. 483, lines 12 - 18; p. 513, line 6 through p. 514, line 6; Grosvenor, Vol. VII, p. 1625, line 11 through p. 1626, line 2.**

80. Four wells have been drilled along the eastern side of Section 2 in units A, H, I and P. Logs from the three southernmost wells show the area to be barren of potash mineralization. **Lammers, Vol. II, p. 479, lines 9 through p. 481, line 6.**

81. Yates presented evidence that NM Potash's extension of its LMR to cover all of Section 2 was unfair in that it gave too broad an area of influence to Corehole K-162, while ignoring negative data from Corehole ERDA-6, located just to the north in Section 35. Furthermore, it was elicited from NM Potash that in arriving at their conclusion that Section 2 contained a commercial grade of sylvinite through the triangulation method, NM Potash had relied on data from Corehole F-65, of which only one-third of the reported K_2O value was sylvinite. The remaining two-thirds K_2O value was carnalite, a non-commercial mineral that can only be processed in limited quantities. NM Potash did not include carnalite in determining the K_2O value of any of their other coreholes. **Yates Exh. 41; Lammers, Vol. II, p. 483, line 19 through p. 484, line 14; Lane Vol. VI, p. 1488, lines 1 - 22; Hutchinson, Vol. III, p. 794, line 10 - p. 795, line 6.**

82. Past experience shows that on the average, potash mines in southeast New Mexico drill four to five coreholes per section to establish minable concentrations of sylvinite. More than the four to five coreholes are used in establishing minable concentrations of langbeinite, which is more erratic in its deposition. **Muncy, Vol. II, p. 394, line 13 through p. 395, line 16; Lammers, Vol. II, p. 486, line 20 through p. 487, line 22; Hutchinson, Vol. III, p. 684, line 1 through p. 687, line 13.**

83. Yates presented evidence that data from one corehole was insufficient to conclude that all of Section 2 contains commercial potash ore. **Yates Exh. No. 41; Lammers, Vol. II, p. 488, lines 3 - 7; p. 509, line 9 through p. 510, line 24; Szabo, Vol. I, p. 125, line 22 through p. 126, line 7; Grosvenor, Vol. VII, p. 1621, line 25 through p. 1622, line 24; Hutchinson, Vol. III, p. 685 line 5 through p. 687, line 20.**

84. Yates presented evidence that there were no commercial reserves of potash in Section 2. **Hutchinson, Vol. II, p. 527, lines 2 - 7; Vol. III p. 791, line 19 through p. 792, line 22.**

85. The determination of whether there are commercial potash reserves underlying any particular tract is handicapped by the fact that potash companies are not required to furnish the information used to determine the boundaries of their LMR's. **Hutchinson, Vol. II, p. 527, lines 10 - 22.**

86. The determination of whether there are commercial potash reserves underlying any particular tract is further handicapped by the fact that the potash companies have maintained the position that the BLM and SLO do not have the authority to

question a designation of an LMR. **Hutchinson, Vol. II, p. 527, line 10 through p. 528, line 4.**

87. Potash is basically a product used in agriculture and its demand depends upon farm consumption. **Yates Exh. No. 43, Hutchinson, Vol. II, p. 533, lines 14 - 22.**

88. Potash from New Mexico supplies less than 30% of the total United States' demand for potash. **Yates Exh. No. 44, Hutchinson, Vol. II, p. 535, lines 18 - 24.**

89. Evidence was presented of the fact that the U. S. Bureau of Mines did not consider potash to be critical to this country's security because the United States' biggest trading partner in the world, Canada, supplies almost all of the potash which is imported and used by U. S. farmers. **Yates Exh. Nos. 45 and 46; Hutchinson, Vol. II, p. 537, lines 9 - 18; p. 558, lines 7 - 13.**

90. Key price determining factors of potash in the United States are: transportation costs, strength of the farm dollar, and Canadian production advantages due to higher quality and greater thickness of the Canadian potash deposits. **Yates Exh. Nos. 43 -50; Hutchinson, Vol. II, p. 531, line 19 through p. 561, line 12.**

91. The two kinds of potash produced in New Mexico are sylvinite and langbeinite. Sylvinite, the most common form, is the predominant mineral found in Section 2. **Yates Exh. No. 46; Hutchinson, Vol. II, p. 538, lines 9-16; p. 544, lines 11 - 17.**

92. New Mexico's average ore quality per ton is approximately one-half of that of Canada's, and the thickness of the ore

bodies in Canada are from two to four times thicker than those in New Mexico. **Hutchinson, Vol. II, p. 544, line 18 through p. 548, line 12.**

93. Because of the natural competitive advantage that Canada has over the United States, Canada is in a position whereby it can dictate the price of potash and set their production at the point where they reach their marginal revenue, and only so long as the New Mexico mine operators realize a positive cash flow at that price will they be able to continue to produce. **Hutchinson, Vol. II, p. 548, line 13 through p. 550, line 12.**

94. Yates presented testimony that indicated Canadian producers are operating only between 45% to 60% of their already built and paid for mine capacity. **Hutchinson, Vol. II, p. 561, lines 4 - 12; p. 563, lines 7 - 21.**

95. Using actual statistics given to Yates' mining engineer during the hearing process, it was determined that New Mexico Potash was mining on the average for the last three years approximately 240 gross acres per year. **Hutchinson, Vol. VIII, p. 1876, lines 11 - 15.**

96. Yates' mining engineer prepared a detailed mine plan which he used to predict when Section 2 would be mined. At the present rate of mining, using the concept of mining closest to the shaft first, first mining would reach Section 2 in approximately 36 years. That 36 years could be reduced to 23 years if the ore in the northern part of the mine property, though closer than Section 2, were left to be mined after Section 2. The 23 years could be further reduced to 20 years if certain Federal

acreage that adjoins NM Potash lease holdings was not leased and developed and was bypassed on the way to Section 2. **Hutchinson, Vol. VIII, pp. 1881, line 7 through p. 1882, line 15.**

97. New Mexico Potash presented evidence that they have at current mining rates an estimated 35 years of remaining ore reserves. **Case, Vol. IV, p. 1108, lines 15 - 19.**

98. NM Potash presented evidence that the earliest that they could possibly reach Section 2 would be in 7 to 8 years with mining spread over a period of 10 to 12 years. Reaching Section 2 within 10 years was suggested as a reasonable mine plan. **Case, Vol. V, p. 1156, lines 16 - 23; Lane, Vol 6, p. 1476, lines 10 - 11.**

99. Prior to the drilling of Corehole K-162 in December of 1991, NM Potash had no plans to mine Section 2. **Lane, Vol. VI, p. 1449, lines 13 - 25, p. 1470, lines 3 - 9.**

100. NM Potash's testimony that they would be down to Section 2 within 10 years was based upon a mine plan prepared by outside consultants. This plan was not prepared until 1992, and the preparation of mine plans by outside third parties is not a normal occurrence. **Case, Vol. V, pp. 1235, line 7 through p. 1236, line 5.**

101. Evidence was presented by NM Potash that it now intends to drive to the south end of Section 2, its lease line, or the end of the ore body and work back toward the mine shaft. **Lane, Vol. VI, p. 1476, lines 18 - 23.**

102. Evidence was presented by NM Potash that mine plans change regularly and are not definitive. The prediction of

reaching Section 2 in 7 to 10 years was basically a guess. **Case, Vol. V, p. 1233, line 21 through p. 1234, line 16; p. 1235, lines 3 - 6.**

103. Evidence was elicited from NM Potash that the criteria used in determining a mine plan was optimum extraction of reserves and economics with the grade of the actual ore itself dictating where you mine. NM Potash would drive to the end of Section 2 only if economics would permit it. **Case, Vol. V, p. 1231, line 2, through p. 1234, line 15; p. 1206, line 15 through p. 1208, line 19; Lane, Vol. VI, p. 1501, line 7, through p. 1503, line 24; Grosvenor, Vol. VII, p. 1622, line 19 through p. 1623, line 8.**

104. Yates presented evidence that NM Potash had in several instances avoided mining certain tracts of land, all of which were owned by the State of New Mexico. Yates' mining engineer offered that the only explanation he could reasonably come up with was that the acreage was not mined because the royalty was higher on state-owned tracts. **Hutchinson, Vol. III, p. 608, line 17, through p. 612, line 13.**

105. Evidence was elicited from NM Potash that if mining occurred in Section 2, that would be the farthest point NM Potash had ever mined from its mine shaft. Furthermore, NM Potash has in the past not mined all the way to its lease line before stopping. **Lane, Vol. VI, p. 1504, lines 14 - 17, p. 1509, lines 13 through p. 1510, line 9; Case Vol. V, p. 1206, line 15 through p. 1208, line 19, p. 1211, line 3 through p. 1222, line 21.**

106. Evidence was elicited from NM Potash that no new coreholes are planned for Section 2, and without additional corehole testing it is not known if it is even feasible to drive down to Section 2. **Case, Vol. V, p. 1241, line 2 - 18; Grosvenor, Vol. VII, p. 1622, line 19 through p. 1623, line 8.**

107. Yates presented evidence that even if mining did reach Section 2, the development of the potash reserves would not be materially affected by the oil and gas development, as the two could be simultaneously developed. **Hutchinson, Vol. III, p. 627, line 7 through p. 629 line 5; p. 691, line 7, through p. 692, line 2.**

108. Evidence was presented of a phenomenon called subsidence which is the natural tendency of an underground opening to close over time and the formations above to deform, eventually affecting the surface. **Hutchinson, Vol. III, p. 635, lines 3 through p. 638, line 1; Grosvenor, Vol. VII, p. 1587, line 9 through p. 1588, line 7.**

109. The best information concerning subsidence prediction in an area is the use of site specific data because rock characteristics vary from place to place, and it is those characteristics that largely influence when and how much subsidence will occur at the surface. **Hutchinson, Vol. III, p. 659, line 24 through p. 669, line 15; p. 775, lines 1 - 22.**

110. Empirical data obtained from measuring subsidence can be used to predict subsidence if and when mining occurs in that area. **Hutchinson, Vol. III, p. 659, lines 2 - 8; Grosvenor, Vol. VII, p. 1592, lines 4 - 10.**

111. Evidence was elicited from NM Potash that several studies on subsidence had been performed under the direction of the U. S. Bureau of Mines in Southeastern New Mexico and that NM Potash generally accepted those findings as being applicable to its operation and consequently had not found the need to develop specific studies for the NM Potash mine. **Case, Vol. V, p. 1191, lines 14 - 21.**

112. Evidence was presented that the angle out from the edge of the mine workings which includes the total area that is affected by subsidence is called the angle of draw. The angle of draw is more or less of academic interest. Because the subsidence profile levels off and subsidence becomes very small far before it reaches the edges of the subsidence basin and from surface structural damages point of view, it is in practice meaningless. In this respect, the angle of critical deformation and angle of break are more useful. **Hutchinson, Vol. III, p. 641, lines 4 - 20; O'Brien, Vol. IV, p. 887, line 6 through p. 888, line 23.**

113. Evidence was presented that within the angle of draw there is the angle of critical deformation which is determined not by measured subsidence above but by the structure to be affected by the subsidence. This angle can vary from a very small angle to a very large angle depending upon the structure affected. **Hutchinson, Vol. III, p. 641, line 10 through p. 642, line 18.**

114. Evidence was presented that the angle of draw is of academic interest only, as it is a function of man's ability to

measure extremely small amounts of subsidence such that the amount of rock movement being measured is so insignificant that no damage to a wellbore and casing could occur within the angle of draw. **Hutchinson, Vol. III, p. 642, lines 3 through 7; O'Brien, Vol. IV, p. 887, line 6 through p. 889, line 14.**

115. Evidence was presented that it was the angle of critical deformation that had any significance and that considerable science is available to determine the angle of critical deformation from a mined opening to oil well casing. One application of science is the actual measurement of tension at the surface near mined areas. The point of maximum tension for studies done in the potash basin show angles of negative degrees (over the mined opening) to 13° (outside the mined opening). **Yates Exh. 56 - 59; Hutchinson, Vol. III, p. 642, line 6 through p. 653, line 2.**

116. Evidence was presented by Yates that the buffer zone distances incorporated in Order R-111-P were not based on any scientific studies performed in the potash enclave and that the area of critical influence affecting oil wells as advocated by the potash industry was not as large as espoused. **Hutchinson, Vol. III, p. 658, line 20 through p. 659, line 4; p. 751, line 25 through p. 752, line 20; Case, Vol. V, p. 1257, line 3 through, p. 1259, line 10.**

117. Evidence was elicited from the NM Potash expert on subsidence that the amount of subsidence that would be experienced in the potash basin would be very small. **Grosvenor,**

Vol. VII, p. 1628, line 22 through p. 1629, line 10; Hutchinson, Vol. III, p. 652, line 3 - 24.

118. Evidence was elicited from the NM Potash expert on subsidence that the chief concern surrounding subsidence would be the creation of pathways for liquids or gas to migrate through. **Grosvenor, Vol. VII, p. 1607, lines 18 - 24; p. 1631, lines 2 - 23.**

119. Evidence was elicited from the NM Potash expert on subsidence that a pathway, if opened in the salt, would close and be sealed off by the salt. **Grosvenor, Vol. VII, p. 1631, line 24 through p. 1632, line 12; O'Brien, Vol. IV, p. 1005, line 19 through p. 1006, line 7.**

120. Evidence was elicited from the NM Potash expert on subsidence that he had no expertise with respect to oilfield casing and its ability to withstand stress. **Grosvenor, Vol. VII, p. 1644, lines 17 - 22.**

121. Evidence was elicited from the NM Potash expert on subsidence that he had performed no studies with respect to pillar size around the three holes drilled by oil companies in and around the NM Potash mine. **Grosvenor, Vol. VII, p. 1634, lines 9 - 16.**

122. Evidence was presented that one of the reports authorized by the Bureau of Mines had reported with respect to the Wills-Weaver Potash Mine as follows:

> The three producing oil wells currently located on the Wills-Weaver mine site are protected by salt pillars with radii of approximately 150 feet. Surrounding these pillars, the average ratio of extraction is about 70% to 75% and some closure of the mining horizons would probably have occurred within these areas. These closures at the mine horizon level would have impacted

> the oil wells because of the limited pillar size, but the level of disturbance has evidently not been sufficient to cause problems.

Hutchinson, Vol. III, p. 668, line 22 through p. 669, line 13.

123. Evidence was elicited from NM Potash that they did not case coreholes they drilled and that they had mined through a number of their coreholes without encountering any problems. **Lane, Vol. VI, p. 1497, line 6 through p. 1498, line 18; O'Brien, Vol. IV, p. 856, line 8 through p. 857, line 10.**

124. Evidence was presented by Yates and confirmed by statements from NM Potash witnesses that there are many techniques known to the mining industry to delay or protect against subsidence, and that such techniques are in use at the NM Potash mine. **Hutchinson, Vol. III, p. 669, line 16 through p. 671, line 11; p. 796, line 4 through p. 797, line 9; Case, Vol. V, p. 1187, line 9 through p. 1189, line 7; Grosvenor, Vol. VII, p. 1599, line 3 through p. 1601, line 21.**

125. Evidence was received that subsidence was a problem that all mines dealt with successfully on a daily basis, as some of the mines had been open since the 1930's, and that one of the Mississippi Chemical mines had been closed to active mining for 10 years without destroying the shafts and mine or preventing entry into it. **Hutchinson, Vol. III, p. 635, line 3 through p. 636, line 6; p. 669, line 16 through p. 671, line 11.**

126. Evidence was presented that a chief safety concern of the potash industry is personnel safety as a result of the potential for life-threatening accidents by the incursion of methane into a mine. **Case, Vol. V, p. 1158, lines 18 - 24.**

127. Evidence was elicited from NM Potash that if methane were to enter the mine, it would be diluted very quickly below the explosive range. NM Potash had done no studies on the volume of methane that would be required to reach the explosive point, giving consideration to the dilutive effect of NM Potash's ventilation system. **Case, Vol. V, p. 1159, line 24 through p. 1160, line 11; p. 1201, line 5 through p. 1202, line 22; Hutchinson, Vol. III, p. 729, line 21 through p. 730, line 8.**

128. Evidence was presented that the explosions that had occurred at the NM Potash mine had not been detonated explosions, but rather gas trapped within the potash expanding out with sufficient force to cause destruction. NM Potash concluded that such a phenomenon was localized. **Case, Vol. V, p. 1192, line 4 through p. 1194, line 22; p. 1195, lines 19 - 21.**

129. Evidence was presented by Yates that when studying the explosions that have occurred in the NM Potash mine and the limited extent of the fractures caused by them, the fact that salt was plastic, and that because of its plastic nature would heal itself and not be subject to fracturing, confirmed their conclusions that the salt would not allow the migration of methane over any appreciable distance. **Hutchinson, Vol. III, p. 630, lines 7 - 13; p. 635, lines 12 - 21; p. 636, line 21 through p. 637, line 12; p. 674, line 12 through p. 681, line 2.**

130. Evidence of explosions that have occurred in other salt mines within the United States was received, and it was elicited from NM Potash's expert on mine safety that neither the Belle Isle explosion nor the Cane Creek explosion was caused or con-

tributed to by oil and gas drilling, but that they were the result of naturally occurring methane gas. **Traweek, Vol. VII, p. 1806, lines 1 - 19; p. 1809, lines 6 - 17.**

131. Evidence was elicited from NM Potash's expert on mine safety that with respect to the Belle Isle explosion the naturally occurring concentration of methane gas in the mine was sufficiently high enough for mine engineers to consider it as a source of fuel in making a soda-ash by-product. The fatal explosion was a result of the mine's management and mine safety regulators ignoring the indications and potential dangers of such known concentrations of methane existing in the mining area. **Traweek, Vol. VII, p. 1806, line 20 through p. 1809, line 1.**

132. Evidence was elicited from NM Potash that federal regulations require monitoring each working face for methane gas at the beginning of each eight hour shift. **Case, Vol. V, p. 1197, line 8 through p. 1198, line 24.**

133. Evidence was elicited from NM Potash that the drilling of boreholes into the working faces of mines to determine if there were pockets of trapped methane, such as the ones that had caused previous explosions in the NM Potash mine resulting in the death of at least one miner had been discontinued because of the cost and time constraints. **Case, Vol. V, p. 1196, line 13 through p. 1197, line 7.**

134. Yates presented evidence that the only way potash ore (putting aside any consideration as to whether the mineralization in Section 2 was commercial) could ultimately be wasted by the drilling of the proposed well would be by the abandonment of a

pillar left around an oil and gas well. **Hutchinson, Vol. III, p. 687, line 21 through p. 688, line 12; O'Brien Vol. IV, p. 990, line 23 through p. 993, line 3.**

135. With respect to Safety Concern No. 1 expressed by the Potash industry, Yates presented evidence that, based on information gained through studies authorized by the U. S. Bureau of Mines in the potash enclave and actual experience from various mines, a reasonable protective pillar to be left around a well would be 125 feet in diameter. **Hutchinson, Vol. III, p. 694, lines 3 - 23; p. 787, line 4 through p. 789, line 23; O'Brien, Vol. IV, p. 1002, lines 4 - 14; p. 1018, line 25 through p. 1025, line 15.**

136. It was elicited from NM Potash's chief mine engineer that one of his duties prior to his employment with NM Potash was the checking of old oil and gas wells to insure that they were properly plugged and abandoned prior to the mining of coal right up to or through the oil or gas wells. It was learned that the proper plugging and abandonment was necessary because explosions could still occur even if you have permissible equipment. **Woomer; Vol. VII, p. 1695, line 3 through p. 1696, line 11.**

137. It was elicited from NM Potash's chief mine engineer that NM Potash had mined within approximately 300 feet of the Williamson No. 1 Well and that well had a show of oil from the Delaware formation. **Woomer, Vol. VII, p. 1697, line 8 through p. 1698, line 17.**

138. Yates presented evidence that a 125 foot diameter pillar would contain on the average 14,000 tons of potash which

would generate for a potash mine $154,000.00 in operating cash flow profit. A 2% royalty on 14,000 tons would amount potentially to $20,000 in royalty to the State of New Mexico. Each of the proposed oil wells potentially could produce $.4 million in royalty for a total of $1.6 million for the four wells. **Patterson, Vol. I, p. 36, line 19 through p. 37, line 7; Hutchinson, Vol. III, p. 687, line 21 through p. 689, line 10; p. 694, lines 3 - 23.**

139. Yates' mining and petroleum engineers offered the opinion that the drilling of the subject well would prevent waste and protect correlative rights and would not result in the waste of any potash, much less any commercial potash. They further testified that the orderly commercial development of the potash deposits would not be interfered with. **Hutchinson, Vol. III, p. 696, line 20 through p. 697, line 18; O'Brien, Vol. IV, p. 931, line 11 through p. 932, line 8.**

140. Yates presented evidence that subsidence is a problem commonly dealt with in the design of oil and gas well casing programs. **O'Brien, Vol. IV, p. 839, lines 13 - 19; p. 875, lines 1 - 21.**

141. The three strings of casing projected to be used in the subject well are 13 3/8" surface, 8 5/8" intermediate and 5 1/2" production. Each string would be cemented according to Order R-111-P requirements. **O'Brien, Vol. IV, p. 840, line 19 through p. 846, line 9.**

142. J-55 casing will be used in the subject well. Such casing is designed to withstand stresses of 55,000 pounds per

square inch to 80,000 pounds per square inch. **O'Brien, Vol. IV, p. 845, line 18 through p. 846, line 15; p. 967, line 14 through p. 968, line 22.**

143. Cementing of the well casing will provide an impermeable seal isolating each zone encountered throughout the depth of the well. **O'Brien, Vol. IV, p. 847, line 21 through p. 849, line 8.**

144. Yates presented evidence that in the opinion of its petroleum engineer specializing in the drilling and completion of wells that the casing alone would prevent any leakage of oil or gas into the potash zones and that the addition of the cement assured that the oil and gas being produced through the casing would be sealed completely from all zones other than those from which it was produced. **O'Brien, Vol. IV, p. 849, line 9 through p. 851 line 19; p. 946, line 24 through p. 948, line 13; Hutchinson, Vol. III, p. 731, line 25 through p. 733, line 6.**

145. Evidence was also presented by Yates' petroleum engineer that the impermeable seal formed by the cementing of the casing would be enhanced by the plastic and impermeable nature of the salt. These characteristics would ensure that the cemented casing would be completely sealed off. **O'Brien, Vol. IV, p. 851, line 20 through p. 852, line 7.**

146. Evidence was presented that at the formation level, where potash would be encountered in Section 2, the formation pressure would be in the approximate range of 2,000 pounds per square inch. In order for oil or gas to penetrate the potash zone, pressures in excess of 3,000 pounds per square inch would

be required. Pressures of that magnitude are not encountered in the Delaware formation in the Livingston Ridge area of Southeastern New Mexico. **O'Brien, Vol. IV, p. 852, line 8 through p. 854, line 9; p. 879, line 2 through p. 881, line 4.**

147. Evidence was presented that the plugging methods that would be utilized to plug this well pursuant to Order R-111-P would provide a better seal than the plugging methods utilized by the potash companies for plugging their coreholes. As the potash company's experience with plugging their coreholes had been satisfactory, even when subjected to the most severe conditions of subsidence that could be expected, no safety risks to the mine or miners should be encountered. **O'Brien, Vol. IV, p. 856, line 8 through p. 861, line 14; p. 931, lines 11 -17; p. 932, line 18, p. 933, line 10.**

148. Evidence was presented by Yates' petroleum engineer that subsidence in the salt formation would be unlikely to cause fracturing of the cement because of salt's plastic nature. Furthermore, even in the unlikely event that fracturing did occur, no oil or gas would penetrate the potash zones because of the high formation pressure of the impermeable salt zone and the low pressure within the production string, thus causing any such oil or gas to migrate to the surface rather than into the potash zones. **O'Brien, Vol. IV, p. 862, line 24 through p. 870, line 12; p. 1005, line 19 through p. 1006, line 17; p. 1011, line 15 through p. 1012, line 6.**

149. Evidence was presented that the mining through of oil wells in coal mines had been studied and it had been determined

that the plugging of oil and gas wells did provide an impermeable seal of those wells, allowing the wellbores themselves to be safely mined through. **O'Brien, Vol. IV, p. 870, line 13 through p. 874, line 22.**

150. Evidence was presented that the stresses caused by subsidence could be calculated and that the maximum stresses that could be expected to be encountered at 2,000' would be in the order of 12,000 to 16,000 pounds per square inch. Such stresses would be considerably less than those for which J-55 pipe was designed to withstand. A single string of J-55 pipe would give a safety factor of almost 4 to 1. **O'Brien, Vol. IV, p. 882, line 22 through p. 884, line 8; Hutchinson, Vol. III, p. 779, lines 1 - 22.**

151. Evidence was presented that when 2 strings of casing were cemented together, their combined strengths would become the sum of the two strings ratings plus 25%. **O'Brien, Vol. IV, p. 885, lines 2 - 10.**

152. Evidence was presented that the only formations that would be affected by subsidence are those that are above a mine, the area in which a well has multiple strings of casing and cement, giving the wellbore a combined strength of all the casing which would yield a strength many times over the stresses that would occur in the event of subsidence. **O'Brien, Vol. IV, p. 885, line 11 through p. 887, line 5.**

153. Evidence was presented that the most feared effect of subsidence was that of sheer, but that the magnitude of sub-

sidence which would be caused by potash mining would not cause sheering to occur. **O'Brien, Vol. IV, p. 890, lines 2 - 17.**

154. Evidence was presented of various phenomenons that could account for gas getting outside of an oil well's casing. Those phenomenons were given as: 1) casing coupling leaks; 2) micro-annuli development; 3) gas flow through cement; 4) gas channeling; 5) swapping out; and 6) gas percolation. **See Mitchell testimony, Generally Vol. V; Vol. V, p. 1365, line 14 through 1366, line 17.**

155. With respect to phenomenon number one, casing coupling leaks, Yates presented evidence that J-55 casing couplings were manufactured according to API standards which required the couplings to withstand at least 3,500 pounds per square inch pressure without leakage. Further evidence was presented that it would be impossible to hypothesize casing coupling leaks allowing oil and gas to get into the potash bearing zones. Evidence was elicited from NM Potash's petroleum engineer to support that conclusion. **O'Brien, Vol. IV, p. 894, line 14 through p. 897, line 6; Mitchell, Vol. V, p. 1369, line 3 through p. 1374, line 17.**

156. Evidence was elicited from NM Potash's petroleum engineer that he had no empirical data to support his hypothesis that gas got outside of wells' casing in three to four wells out of every one hundred wells drilled. **Mitchell, Vol. V, pp. 1374, line 18 through p. 1376, line 19.**

157. With respect to phenomenon number two, the occurrence of micro-annuli, Yates presented evidence that the concept of micro-annuli was more of an explanation of a phenomenon en-

countered when running bond logs, rather than a real occurrence. The American Petroleum Institute's 1992 volume on Worldwide Cementing Practices does not even mention micro-annuli as it is not recognized as a problem. Further, testimony was given that the industry was not sure they exist because tests had been run on micro-annuli indicated by bond logs and no leakage occurred. It was elicited from NM Potash's petroleum engineer that he had never measured a micro-annuli. **O'Brien, Vol. IV, p. 897, line 20 through p. 903, line 17; Mitchell, Vol. V, p. 1379, line 25 through p. 1380, line 18.**

158. With respect to phenomenon number three, gas flow through cement, Yates presented evidence that such was not a problem, because of the low pressures in oil wells, such as the subject Delaware well. It was elicited from NM Potash's petroleum engineer that the phenomenon probably was not a problem. **O'Brien, Vol. IV, p. 903, line 18 through p. 906, line 3; Mitchell, Vol. V, p. 1382, line 5 through p. 1384, line 10.**

159. With respect to phenomenon number four, gas channeling, Yates presented evidence that there were several procedures commonly used by the industry to prevent it from happening. Testimony was given that channeling of the magnitude necessary to cause a problem for an 8,000' Delaware well had never been encountered. Also, there was no reasonable likelihood that channeling would occur in connection with the cementing of each string of casing and for each channel to be connected. Furthermore, each string of casing after cementing was pressured up and if a loss of pressure occurred because of channeling, the problem

could be detected and corrected. Evidence was elicited from NM Potash's petroleum engineer that he had never measured such a channel long enough to cause a problem in a well drilled to the depth projected for the subject well. **O'Brien, Vol. IV, p. 906, line 4 through p. 910, line 9; Mitchell, Vol. V, p. 1388, lines 10 - 13.**

160. With respect to phenomenon number five, swapping out, Yates presented evidence that swapping out could only occur if casing were not set to within one or two feet of the bottom of the hole. The casing design for the subject hole calls for casing to be set within one or two feet of the bottom of the hole, thus there would be no problem from swapping out. Evidence was elicited from NM Potash's petroleum engineer that swapping out would not cause a problem for the subject well. **O'Brien, Vol. IV, p. 910 line 10 through p. 914, line 4; Mitchell, Vol. V, p. 1389, lines 18 - 25.**

161. With respect to phenomenon number six, gas percolation, Yates presented evidence that it only occurs when the weight of the cement is less than the pressure being exerted by the oil or gas bearing formation, and thus could happen only in conjunction with the setting of the production or 5 1/2" string of casing, and with any resultant channels occurring within the intermediate string of casing at the level of the potash zone. Evidence was elicited from NM Potash's petroleum engineer that he had never measured gas percolating as far as 6,000', which would be necessary for a problem to occur in the subject well. **O'Brien,**

Vol. IV, p. 914, line 5 through p. 915, line 23; Mitchell, Vol. V, p. 1393, lines 15 - 23; p. 1395, lines 16 - 20.

162. Evidence was elicited from NM Potash's petroleum engineer that his calculations of how much gas that could be produced through a channel or annulus .75 inch in diameter resulted in a figure that he recognized was beyond the capability of the subject well to produce. **Mitchell, Vol. V, p. 1395, line 21 through p. 1396, line 25.**

163. Yates presented evidence that directionally drilling the subject well would be more expensive and risky with the expense and risk increasing the further the distance that you had to drill laterally from the vertical. **O'Brien, Vol. IV, p. 916, lines 15 - 25; p. 980, lines 2 - 23.**

164. Yates presented evidence that it had drilled a directional well, the Bonneville "AKK" Federal Well No. 3, the cost of which was 35% over that of a straight hole. The Bonneville well was deviated only 750' from the vertical. NM Potash proposed that all four wells for which applications had been made to drill be drilled from existing locations which would require deviation some 2 to 4 times farther than the Bonneville well. **O'Brien, Vol. IV, p. 917, lines 1 - 12.**

165. Yates presented evidence using the proposed Flora wells as an example which would require drilling 2660' from the vertical under NM Potash's suggestion. Cost to drill the well was projected to increase by a total of $300,000. Because of the "higher costs" involved in producing a directional well the economic life of the well would be shortened resulting in ap-

proximately 5,000 barrels of oil not being produced and therefore wasted. **O'Brien, Vol. IV, p. 919, lines 5 - 19; p. 980, lines 15 - 23.**

166. Yates presented evidence that over the life of a straight hole the cost of operating the Flora well would be in the area of $255,000, whereas if it were drilled as a directional hole, the cost would rise to $876,000, a difference of $621,000. **O'Brien, Vol. IV, p. 924, line 13 through p. 926, line 3.**

167. Yates presented evidence that because of the additional costs incurred in drilling a directional Delaware well that the present value of such a well would only be $240,000. Evidence was further presented that a return of $240,000 on a well costing $900,000 to drill would not justify the drilling of such a well, and such a well would not be drilled. **O'Brien, Vol. IV, p. 926, line 4 through p. 927, line 7; p. 1014, lines 18 - 24.**

168. Evidence was elicited from NM Potash's petroleum engineer that in his calculations of the cost of a directional well he did not take into account the increased cost of operating directional wells. It was further elicited that he had no experience or expertise with respect to operational expenses or production of wells. **Mitchell, Vol. V, p. 1415, lines 7 - 23; p. 1419, lines 15 - 18.**

169. Yates presented evidence that it had and was continuing to make a large commitment of manpower and resources to the development of the Livingston Ridge area and was committed to drilling the subject well upon the issuing of the application to drill. **Patterson, Vol. 1, p. 37, line 22 through p. 40, line 4.**

1. **FINDING:** Presently under Order R-111-P, the NMOCC does not have the authority to review LMR designations and determine if they are supported by geologic and economic data.

2. **FINDING:** The determination of whether specific State lands are within an LMR is within the exclusive authority of the SLO, and such a determination by the SLO shall be binding upon the Commission.

3. **FINDING:** Pursuant to § 70-2-6, N.M.S.A., 1978, the Commission has the jurisdiction and authority over all matters relating to the conservation of oil and gas and the prevention of waste of potash as a result of oil or gas operations.

4. **FINDING:** Pursuant to § 70-2-11, N.M.S.A., 1978, the Commission is empowered and it is its duty to prevent waste prohibited by the "Oil and Gas Act" and to protect correlative rights.

5. **FINDING:** Pursuant to § 70-2-12(B)(16), N.M.S.A., 1978, the Commission has the jurisdiction and authority to determine the limits of any area containing commercial potash deposits and from time to time redetermine those limits.

6. **FINDING:** The evidence presented clearly established that insufficient geologic, economic or proven ore reserve data from coreholes exists to determine that all or some definable part of Section 2 contains commercial potash deposits.

7. **FINDING:** The evidence presented clearly established that due to the uncertainty as to whether the potash deposits would actually be mined in Section 2, it is impossible with the

record before the Commission to determine whether Section 2 contains commercial potash reserves.

8. **FINDING:** The evidence presented clearly established that due to the uncertainty as to <u>when</u> the potash deposits would actually be mined in Section 2, it is impossible with the record before the Commission to determine whether Section 2 contains commercial potash reserves.

9. **FINDING:** The evidence presented clearly established that, should all or part of Section 2 be found to contain a commercial deposit of potash at some time in the future, the drilling of the proposed well will not have the effect of unduly reducing the total quantity of commercial deposits of potash which may reasonably be recovered in commercial quantities.

10. **FINDING:** The evidence presented clearly established that should all or part of Section 2 be found to contain a commercial deposit of potash at some time in the future, the drilling of the proposed well will not have the effect of unduly interfering with the orderly commercial development of the potash deposit.

11. **FINDING:** The SLO had not designated an amended LMR covering Section 2 as of the time of the filing of Yates' application for authorization to drill, however, an LMR designation did exist for Section 35. The proposed well location is not within the 1/2 mile buffer zone of the existing LMR as specified in Order R-111-P.

12. **FINDING:** Pursuant to § 70-2-11, N.M.S.A., 1978, the Commission has the jurisdiction and authority to grant exceptions to Order R-111-P, thus allowing the proposed well to be drilled.

13. **FINDING:** The subject Application for Permit to Drill should be approved as an exception to Order R-111-P.

IT IS THEREFORE ORDERED THAT:

1) The application of Yates Petroleum Corporation to drill its Flora "AKF" State Well No. 2 at a standard oil well location 1,980' from the South line and 2,310' from the West Line (Unit K) of Section 2, Township 22 South, Range 31 East, N.M.P.M., Undesignated Lost Tank-Delaware Pool or Undesignated Livingston Ridge-Delaware Poo, Eddy County, New Mexico, is hereby approved.

2) All provisions of Division Order No. R-111-P applicable to the casing, actual drilling, cementing, and plugging of a deep well within the "Designated Potash Area" shall be strictly adhered to.

3) Jurisdiction of this cause is retained for the entry of such further orders as the Division may deem necessary.

Respectfully submitted,

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