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May 31, 1991

HAND-DELIVERED

William J. LeMay, Director
Oil Conservation Division
New Mexico Department of Energy,
Minerals and Natural Resources
State Land Office Building
Santa Fe, New Mexico 87503

Re Oil Conservation Division Case No. 10226; Order No. R-9501 (**De Novo**):
Application of Bird Creek Resources for Special Pool Rules, Eddy County, New Mexico

Dear Mr. LeMay:

Bird Creek Resources hereby requests that the above-referenced case be continued from the June Commission docket to the Commission's July docket.

Your attention to this request is appreciated.

Very truly yours,

WILLIAM F. CARR

WFC:mlh
cc: Mr. Brad Burks
W. Thomas Kellahin, Esq.

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June 7, 1991

HAND-DELIVERED

RECEIVED
JUN 7 1991
OIL CONSERVATION DIVISION

William J LeMay, Director
Oil Conservation Division
New Mexico Department of Energy,
Minerals and Natural Resources
State Land Office Building
Santa Fe, New Mexico 87503

Re: Oil Conservation Division Case No. 10226; Order No. R-9501 (**De Novo**): Application of Bird Creek Resources for Special Pool Rules, Eddy County, New Mexico

Dear Mr. LeMay:

Bird Creek Resources hereby requests that the above-referenced case be continued from the June Commission docket to the Commission's August docket.

Your attention to this request is appreciated.

Very truly yours,

WILLIAM F. CARR

WFC:mlh
cc: Mr Brad Burks
W. Thomas Kellahin, Esq.
Jim Bruce, Esq.

KELLAHIN, KELLAHIN AND AUBREY
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W THOMAS KELLAHIN
KAREN AUBREY

JASON KELLAHIN
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TELEPHONE (505) 982-4285
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September 11, 1991

William Weiss
Socorro Petroleum Company
310 West Wall, Suite 915
Midland, TX 79702

VIA FEDERAL EXPRESS

RECEIVED
SEP 11 1991
OIL CONSERVATION DIVISION

Gary Carlson
State Land Office
310 Old Santa Fe Trail
Santa Fe, NM 87503

HAND DELIVERED

Mr. William J. LeMay
Oil Conservation Commission
State Land Office Building
310 Old Santa Fe Trail, Room 206
Santa Fe, NM 87503

HAND DELIVERED

RE: Application of Bird Creek Resources, for increase GOR in East Loving-Delaware Pool, NMOCD Case No. 10266 (DeNovo)

Gentlemen:

On behalf of Oryx Energy Company, I am submitting the enclosed written argument of Oryx in the format of an order denying the Bird Creek Application.

In addition, I have enclosed for reference the Examiner order which also denied the Bird Creek Application.

Very truly yours,

W. Thomas Kellahin

WTK/jcl
Enclosures
cc: Charles Gray - Oryx Energy - Dallas (w/encl.)
Bonnie Wilson - Oryx Energy - Oklahoma City (w/encl.)
William F. Carr, Esq. - (Hand Delivered, w/encl.)
ltrk910.042

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

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION FOR THE PURPOSE OF
CONSIDERING:

CASE NO. 10266 (DENOVO)
ORDER NO R-9501-A

APPLICATION OF BIRD CREEK
RESOURCES FOR SPECIAL POOL
RULES, EDDY COUNTY, NEW
MEXICO

ORYX ENERGY COMPANY'S
PROPOSED ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9:00 a.m. on August 29, 1991, at Santa Fe, New Mexico, before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission."

NOW, on this ___ day of September, 1991, the Commission, a quorum being present, having considered the testimony presented and exhibits received at said hearing, and being fully advised in the premises,

FINDS THAT:

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

(2) The applicant, Bird Creek Resources, seeks an order promulgating special rules and regulations for the East Loving-Delaware Pool, Eddy County, New Mexico, including a provision for a limiting gas-oil ratio of 5000 cubic feet of gas per barrel of oil.

(3) The applicant further seeks the requested increase in gas oil ratio for a temporary period of one year.

(4) The East Loving-Delaware Pool was created and defined by Division Order R-8562 dated December 4, 1987 and is currently governed by General Statewide Rules and Regulations including a top unit allowable of 142 barrels of oil and 284 MCF casinghead gas per day at a gas-oil ratio of 2000 cubic feet of gas per barrel of oil.

(5) On February 21, 1991 this case came on for hearing before Examiner David R. Catanach and the applicant's request was denied by Division Order R-9501 entered May 10, 1991.

(6) Bird Creek based its application substantially upon a one well reservoir model simulation and failed to supply any rate sensitivity test data to demonstrate what would actually happen to individual well GOR if produced at higher rates.

(7) Oryx Energy Company ("Oryx"), an operator in the subject pool, appeared at the hearing and presented evidence and testimony in opposition to the application.

(8) Both Bird Creek and Oryx presented engineering evidence and testimony to the Commission and, based upon such evidence and testimony, there is substantial evidence to support the following conclusions concerning the East Loving-Delaware Pool:

(a) As a result of increasing the GOR allowable from 2000/1 to 5000/1, the primary recovery of oil for the entire east Loving-Delaware Pool would be reduced by 763,000 barrels.

(b) In any solution gas drive reservoir primary recovery is inversely proportional to cumulative produced GOR. Material Balance calculations for this pool confirm that increased gas production relative to oil will result in lower oil recovery.

(c) There are large variations in producing GOR's across this pool. GOR's range from 900 to 10,000 SCF/BBL.

(d) Raising the GOR allowable results in significantly increased reservoir voidage in high GOR wells relative to wells of similar oil rate but lower GOR. This results in an inefficient use of the limited reservoir energy.

(e) Producing GOR in this pool is a function of four factors:

-STRUCTURE: Within a given area, wells higher in structure generally produce at a higher GOR than wells lower in structure.

-DEPLETION: Wells in more mature, lower pressured areas of the field tend to have a higher GOR.

-PERMEABILITY: Wells in a tighter, lower permeability area will produce at a higher GOR due to increased drawdown near the wellbore. Tighter areas could reduce gas migration and serve as flow barriers.

-PRODUCTION RATE: Tests indicate that increasing the production rate in a well increases the near wellbore drawdown and results in increased GOR's reflecting an inefficient use of reservoir energy.

(f) The reservoir description within the pool is complex. There are four distinct sands with vertical communication within each sand. Aerially, permeability will vary with sand thickness and porosity.

(g) Hydraulic fracture stimulation has placed all the sands in pressure communication. Propped fracture half lengths range from 30 to 100 feet.

(h) No initial reservoir fluid sample is available. Analysis of two subsequent samples indicate the reservoir was very near its bubble point pressure. Small, localized primary gas caps may have been present.

(9) Numerical simulation by Oryx indicates:

- STRUCTURE has a significant effect on well performance. Neglecting structural effects and free gas migration leads to the erroneous conclusion that the potential losses due to higher GOR production are negligible.

- SINCE a small gas cap was needed to history match the high GOR wells, either small primary or secondary gas caps are present in the reservoir.

- ONLY the higher structure, high GOR wells are capable of producing the proposed gas allowable of 710 MCFPD. Structurally lower wells will never be capable of producing at this rate.

(10) Bird Creek's simulation of a single well cannot predict the effect that one well's higher producing GOR will have on its offset wells. Bird Creek's assertion that there well be no significant loss in production pool wide cannot be proven using their own one well model.

(11) Pressure data indicates that 40 acre wells are being depleted by their offsets. This implies drainage areas greater than 40 acres. Bird Creek's witness indicated that he was concerned that if their high GOR wells continued to be curtailed, these wells would be drained by uncurtailed offsets. This contradicted his previous testimony that the wells drain less that 40 acres.

(12) Well test data for Oryx's Pardue Farms #1 as well as actual production from Bird Creek's Teledyne #2 indicate that the producing GOR is sensitive to production rate. A higher oil production rate resulted in higher GOR's. Lowering the oil rate resulted in lower GOR's. With less gas produced per barrel of oil, recovery is improved. Bird Creek presented no test data to prove otherwise. Enforcing the current 2000:1 GOR limit will improve oil recovery.

(13) Oryx presented detailed geology evidence and testimony from which the Commission find substantial evidence to support the following conclusions:

(a) Four main sand members within this Brushy Canyon pay section divided by 4-10' thick shale barriers.

(b) Each sand member has vertical and lateral variations in porosity and permeability.

(c) Stratigraphic trapping mechanism with structural influence. Sands appear to pinchout to the north and west, with decreasing porosity and permeability.

(d) All four sands are relatively continuous across the field, with the "A" (M1), "C" (L1) sands contributing approximately 90% of net pay and also show highest degree on continuity.

(e) Geologic interpretation supports production characteristics observed across the field.

(14) Bird Creek's contention of high degree of discontinuity contradicts their own testimony. They contend thin shales act as vertical permeability barriers between 1-2" sands. In order for these millimeter thick shales to be vertical barriers, they must extend laterally - which in turn implies lateral continuity.

(15) Continuity of the sands clearly supports the fact that production from one 40 acre location will affect its immediate offsetting wells.

(16) Bird Creek testified that their one-well reservoir simulation model projected that over a twenty year period each well at the requested GOR would recover 5000 to 8000 barrel of oil less than would be recovered at the current GOR for the pool.

(17) The evidence available at the present time demonstrates that approval of the application will only temporarily increase the rate of oil production from some wells in the pool.

(18) The evidence further demonstrated that approval of the application will cause excessive depletion of reservoir energy which in turn will decrease ultimate oil recovery, thereby causing waste, and may violate correlative rights by denying the operators in the pool the opportunity to maximize their ultimate oil recovery.

(19) The application should be DENIED.

IT IS THEREFORE ORDERED THAT:

(1) The application of Bird Creek Resources for the promulgation of special rules and regulations for the East Loving-Delaware Pool, Eddy County, New Mexico including a provision for a temporary limiting gas-oil ratio of 5000 cubic feet of gas per barrel of oil is hereby DENIED.

(2) Jurisdiction is hereby retained for the entry of such further orders as the Commission may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

WILLIAM W. WEISS, Member

GARY CARLSON, Member

WILLIAM J. LEMAY, Chairman
and Secretary.

seal

ordt910.042

CAMPBELL & BLACK, P.A.
LAWYERS

JACK M. CAMPBELL
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September 16, 1991

William Weiss — **FEDERAL EXPRESS**
New Mexico Petroleum Recovery Research Center
Socorro, New Mexico 87801

Gary Carlson — **HAND-DELIVERED**
State Land Office
310 Old Santa Fe Trail
Santa Fe, New Mexico 87503

RECEIVED
SEP 16 1991
OIL CONSERVATION DIVISION

William J LeMay, Director — **HAND-DELIVERED**
Oil Conservation Division
New Mexico Department of Energy,
Minerals and Natural Resources
State Land Office Building
Santa Fe, New Mexico 87503

Re: Case No. 10226 (**De Novo**)
Application of Bird Creek Resources for Increase GOR in East Loving-Delaware Pool, Eddy County, New Mexico

Dear Mr. LeMay:

On behalf of Bird Creek Resources, I am submitting the enclosed written argument of Bird Creek Resources in the above-captioned case.

Very truly yours,

WILLIAM F. CARR
WFC:mlh
Enclosure
cc w/enc.: W. Thomas Kellahin, Esq.
Mr. Brad Burks

BEFORE THE

OIL CONSERVATION COMMISSION

NEW MEXICO DEPARTMENT OF ENERGY, MINERALS AND NATURAL RESOURCES

RECEIVED
SEP 16 1991
OIL CONSERVATION DIVISION

IN THE MATTER OF THE APPLICATION OF BIRD CREEK RESOURCES FOR SPECIAL POOL RULES, EDDY COUNTY, NEW MEXICO.

CASE NO. 10226

CLOSING STATEMENT AND SUMMARY OF THE EVIDENCE

BIRD CREEK RESOURCES, seeks a special gas/oil ratio for the East Loving-Delaware Pool. At present the state wide gas/oil ratio of 2000/1 is substantially restricting production from a number of wells in this pool and, if this continues, the ultimate waste of hydrocarbons will result.

In February 1991, Bird Creek came before Examiner David Catanach seeking an increase in the gas/oil ratio for this pool. The application was denied. Following the Examiner hearing a number of operators in the pool retained J. Scott Hickman and Associates to simulate this reservoir to determine what impact the higher gas/oil ratio would have on ultimate recovery from this pool. The result of this simulation has caused Bird Creek to gain wide support from other operators in the pool for the proposed 5000/1 gas/oil ratio. Now, only ORYX opposes this application.

BIRD CREEK'S GEOLOGICAL INTERPRETATION

Brad Burks, a consulting petroleum engineer, testified for Bird Creek and explained the nature of the reservoir in the East Loving-Delaware Pool. Using log and core

information, it was demonstrated that this pool consists of four zones each with differing characteristics and separated from one another by thick layers of shale. (Bird Creek Exhibit 2). By using shallow resistivity measuring devices he was able to demonstrate that these zones were comprised of many thin lenticular sand stringers, that these "pancake" sands do not correlate from well to well and that they are stacked on one another - each separated from the next by thin impermeable shales. (Bird Creek Exhibit 4). This geological interpretation of the reservoir is consistent with respected geological treatises on the Delaware formation (Bird Creek Exhibit 4) and was used as the geologic basis for Bird Creek's reservoir simulation.

BIRD CREEK'S EVIDENCE ON GAS/OIL RATIOS:

A comparison of Bird Creek's isopach map (Bird Creek Exhibit 3) and production and gas/oil ratio data from this pool (Bird Creek Exhibit 5) shows that high gas/oil ratios exist randomly across this field and that no correlation exists between pay thickness and higher gas/oil ratios. From this, Mr. Burks concluded that gas/oil ratios in the pool are controlled by the gas/oil relative permeability in each of the four sands, not by structural considerations as contended by ORYX (Bird Creek Exhibit 6).

BIRD CREEK'S RESERVOIR SIMULATION

Mr. Vanorsdale presented the results of a one-well reservoir simulation undertaken at the request and with the cooperation of Pogo Producing Company, ORYX Energy Company, Bird Creek Resources, R.B. Operating Company and Amoco Production

Company. The purpose of this simulation was to model reservoir response by matching the production and pressure history of the Carrasco Well No. 1, a well representative of the producers in the field, and then to forecast the oil recovery as a function of gas withdrawal rates. Mr. Vanorsdale testified on the preparation of data for the model and the attainment of a match within 2% of the actual oil and gas cumulative production and a pressure match within approximately 60 psi or 4% of the actual bottomhole pressure. The simulation was performed using four sands separated by impermeable shale barriers and the results indicated that the oil recovery at the present gas/oil ratio was 3% more of the original oil in place than the recovery at a 5000/1 gas/oil ratio at the end of twenty years. (Bird Creek Exhibit 16). Although this represents about 6,000 barrels of oil, Mr. Vanorsdale testified that due to current operational problems involving corrosion and paraffin the ultimate recovery from this pool may be substantially reduced if the oil recovery is not accelerated through the adoption of a higher gas/oil ratio allowable for operators will have a better opportunity with the higher allowable to stay ahead of the potential operational problems.

Mr. Vanorsdale tilted his model 7° to incorporate regional depth and thereby assess the likelihood of the development of a secondary gas cap in this formation. He found that the minor gas migration which resulted from tipping the model was insufficient to form a gas cap, particularly given the low permeability of the formations involved. He testified that the low recovery factors with and without regional dip indicate a low efficiency solution gas drive reservoir and accordingly raising the gas withdrawal rate would have little impact on oil recovery.

EVIDENCE OF ORYX ENERGY COMPANY

ORYX'S RESERVOIR SIMULATION

Bonnie Wilson, an expert witness in petroleum engineering, prepared several reservoir simulations for ORYX to prove the existence of a secondary gas cap in this field. The matches for these simulations were presented in exhibit form and demonstrated very poor fits to the actual production in the gas/oil histories of the selected wells. Ms Wilson obtained what she termed "general matches". This terminology indicates that no specific data was matched. Input data to the ORYX simulator was limited to that obtained primarily from ORYX's wells. With these "matches" the simulation was run to predict the impact of GOR limitations on recovery.

Ms Wilson evaluated two alternatives - one assuming no regional dip and no gas cap and another with a regional dip and gas cap. The results of the first alternative were similar to those presented for Bird Creek by Mr. Vanorsdale. This, again, is indicative of a low efficiency solution gas drive reservoir. The second alternative, however, illustrated both a lower overall recovery and a more dramatically decreasing recovery with increasing gas/oil ratio allowables.

Ms Wilson did not incorporate a hydraulically fractured grid block pattern around the wellbores of her model. Mr. Vanorsdale, however, had incorporated these fractures and testified that this was absolutely essential in order to accurately handle rapid pressure and saturation distribution changes around a fracked wellbore. She also testified to using basic core analysis data from the RGA No. 3 and the Lewis Estate No. 1 Wells in her model, as did Mr. Vanorsdale with three wells in his Exhibit 12, yet Ms Wilson arrived at

an average permeability of 3.2 millidarcy - this permeability figure is almost twice the largest permeability value shown on Bird Creek's Exhibit No. 12. With this permeability magnitude, gas migration would be much more likely. Therefore, the migration ORYX found in its second alternative was a result of nothing more than the simulation method it used.

ORYX'S ENGINEERING INTERPRETATION

Ms Wilson used a material balance approach to estimate oil recovery as a function of GOR allowables, but she had to treat the individual zones as one common reservoir in order to do this. During cross examination, Ms Wilson agreed that it was possible that each zone contributed separately and that some zones may not yield much production until others diminish their reservoir energy.

Finally, Ms Wilson presented rate sensitivity data conducted for two 7-day periods on ORYX wells. Her conclusion was that oil production was sensitive to the gas withdrawal rate. On cross examination, however, she admitted that this sensitivity analysis does not have any impact on ultimate recovery.

ORYX also called Mr. Greg Jacobson who testified that pressure data supported the ORYX's three pod reservoir theory. He observed that the reservoir pressure in the ORYX-Pardue Farms No. 1 Well was below the bubble point pressure in the reservoir and, if plotted on Vanorsdale's Exhibit No. 18 (bottomhole pressure v. time), would track the pressure of the Carrasco No. 14-1 Well. Mr. Jacobson stated that this indicated communication and drainage. Upon cross examination, however, Mr. Jacobson admitted

that the build up time for the Pardue Farms Pressure Test was three days compared to the seven days duration of other tests shown on Bird Creek's Exhibit 18. The observation was also made that low permeability reservoirs, such as this field, require a longer time to reach pressure stabilization in order to estimate true reservoir pressure.

GEOLOGICAL TESTIMONY

ORYX called Bob Sidlowe, who presented a geologic interpretation which illustrated the continuity of the individual zones across this field. Although he testified to his inability to discern any shale laminations which could act as vertical permeability restrictions in the reservoir, on cross examination, he could not account for the permeability barriers which form the three pods that ORYX found in the reservoir in the absence of such laminations and sand continuity.

ORYX is concerned about its correlative rights, about drainage, about dissipation of reservoir energy because they contend their wells are unlike the typical or average well used in the Bird Creek model. The evidence, however, disclosed that data on gas production from ORYX wells has not been reported to the Division and when this production is considered the ORYX wells perform like the other wells in the pool.

Hickman and Associates modeled the reservoir using an average well. The model was structured carefully to honor the true geologic characteristics of the reservoir. The reservoir is comprised of a number of small sands of limited extent separated by shale stringers. This geological interpretation is consistent with that of respected treaties on this formation and with the evidence from logs and core analyses. The formation has been

fractured during completion practices on wells in the pool and this was also accurately incorporated into the Hickman and Associates simulation.

ORYX, on the other hand, modeled this reservoir as if it were one homogeneous zone. Given their lack of fieldwide data, "generic" simulation without a realistic match of actual performance significantly limits the validity of ORYX's computer modelling. Further, the forecasting of oil recovery with such models does not instill confidence that the conclusions represent anticipated reservoir response. Without this confidence, conclusions by ORYX as to oil recovery as a function of gas withdrawal rates are highly questionable.

The division of the field into pods does not address the contribution of individual zones. No proof was offered by ORYX to the discontinuity of the zones except by inference.

To accept ORYX's interpretation, the Commission would have to find sufficient vertical communication in the reservoir to permit the formation of a gas cap. This vertical communication would have occurred because of what ORYX estimates to be 30 foot fractures induced during well completion in zones that have continually produced from each of the major zones since the wells were initially completed.

If the Commission is to meet its duty to prevent waste, it must authorize more efficient production practices which Bird Creek seeks. If the Commission is to protect correlative rights in this pool, it should again grant this application for the best evidence demonstrates that each well can ultimately produce more oil at a 5000/1 gas/oil ratio.

Respectfully submitted,

CAMPBELL, CARR, BERGE & SHERIDAN, PA

By: _____
William F. Carr
Post Office Box 2208
Santa Fe, New Mexico 87504
Telephone: (505) 988-4421

Attorneys for Bird Creek Resources

CERTIFICATE OF MAILING

I hereby certify that I have caused to be mailed a true and correct copy of the foregoing Closing Statement and Summary of the Evidence to W. Thomas Kellahin, Esq., Kellahin, Kellahin & Aubrey, Post Office Box 2265, Santa Fe, New Mexico 87504 on this 16th day of September.

_____
William F. Carr

CAMPBELL, CARR, BERGE
& SHERIDAN, P.A.
LAWYERS

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October 2, 1991

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OIL CONSERVATION DIVISION

William Weiss
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HAND-DELIVERED

William J. LeMay, Director
Oil Conservation Division
New Mexico Department of Energy,
Minerals and Natural Resources
State Land Office Building
Santa Fe, New Mexico 87503

HAND-DELIVERED

Re: Case No. 10226 (**De Novo**)
Application of Bird Creek Resources for Increase GOR in East Loving-Delaware Pool, Eddy County, New Mexico

Gentlemen:

On September 16, 1991 I submitted a written argument in the above-referenced case on behalf of Bird Creek Resources.

It has been called to my attention that there is an error on page 3, line 8 of this argument. The phrase which reads "oil recovery at the present gas/oil ratio was 3% more" should read "oil recovery at the present gas/oil ratio was less than 0.3% more."

Your attention to this matter is appreciated.

Very truly yours,

WILLIAM F. CARR
WFC:mlh
cc: W. Thomas Kellahin, Esq.
Mr. Brad Burks

STATE OF NEW MEXICO

ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION

BRUCE KING
GOVERNOR

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October 30, 1991

CAMBELL & BLACK
Attorneys at Law
P. O. Box 2208
Santa Fe, New Mexico 87504

RE: CASE NO. 10226
ORDER NO. R-9501-A

Dear Sir:

Enclosed herewith are two copies of the above-referenced Division order recently entered in the subject case

Sincerely,

Florene Davidson

Florene Davidson
OC Staff Specialist

FD/sl

cc: BLM Carlsbad Office
Tom Kellahin
John Kulseth