

DHC RELEASE 9-27-93

MERIDIAN OIL

OIL CONSERVATION DIVISION
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August 31, 1993

New Mexico Oil Conservation Division
Attn: Mr. Bill LeMay
P.O. Box 2088
310 Old Santa Fe Trail
Santa Fe, New Mexico 87501

GOVERNADOR
RE: San Juan 28-5 Unit #227
Unit M, Section 11, T28N, R05W
Rio Arriba County, New Mexico
Downhole Commingling Request

Dear Mr. LeMay:

Meridian Oil Inc. is applying for an administrative downhole commingling order for the referenced well in the Pictured Cliffs and the Basin Fruitland Coal fields. The ownership of the zones to be commingled is common. All offsetting acreage in this case belongs to Meridian Oil Inc. A letter has been sent to the Bureau of Land Management notifying them.

The Fruitland Coal and Pictured Cliffs wells producing in this area operated by Meridian are marginally productive. Based on offset production in this area, drilling of separate wells and dual completions to produce the Fruitland Coal and Pictured Cliffs are not economically justified. The only economical way to recover the Fruitland Coal and Pictured Cliffs reserves in this drill block is to downhole commingle production from both zones in this well.

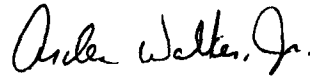
It is proposed to complete the Pictured Cliffs formation and test its production. It is then proposed to set a bridge plug above the Pictured Cliffs, perforate and stimulate the Fruitland Coal, and test its production. The bridge plug will then be removed, and both zones produced through a single string of tubing. The reservoir characteristics of each of the subject zones are such that underground waste will not be caused by the proposed commingling. Neither producing interval makes oil, and only minimal amounts of similar water are produced in the offset wells. The average shut-in pressures in the area for the Pictured Cliffs and Fruitland Coal are 1090 and 1070 psi, respectively.

The allocation of the commingled production will be calculated using the attached allocation formula. This formula is based on offset Pictured Cliffs production performance (material balance) and volumetrics, and uses accepted Reservoir Engineering methods to allocate the Pictured Cliffs reserves. This addresses the Fruitland Coal producing characteristics of early life inclining production rates.

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Approval of this commingling application will allow for the prevention of wasted resources and protection of correlative rights. Included with this letter are plats showing ownership of offsetting leases for both the Pictured Cliffs and Fruitland Coal, a copy of the letter to the BLM and an allocation formula.

Sincerely,



Arden L. Walker, Jr.
Regional Production Engineer

KS:tg
Attachments

cc: Frank T. Chavez - NMOCD/Aztec

MERIDIAN OIL

August 31, 1993

Bureau of Land Management
1235 La Plata Highway
Farmington, New Mexico 87401

RE: San Juan 28-5 Unit #227
Unit M, Section 11, T28N, R05W
Rio Arriba County, New Mexico
Downhole Commingling Request

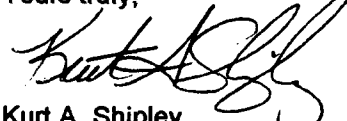
Gentlemen:

Meridian Oil, Inc. is in the process of applying for a downhole commingling order for the San Juan 28-5 Unit #227 well located in Unit M, Section 11, T28N, R05W, N.M.P.M., Rio Arriba County, New Mexico, in the Pictured Cliffs and the Basin Fruitland Coal fields.

The purpose of this letter is to notify you of such action. If you have no objections to the proposed commingling order, we would appreciate your signing this letter and returning it to this office.

Your prompt attention to this matter would be appreciated.

Yours truly,



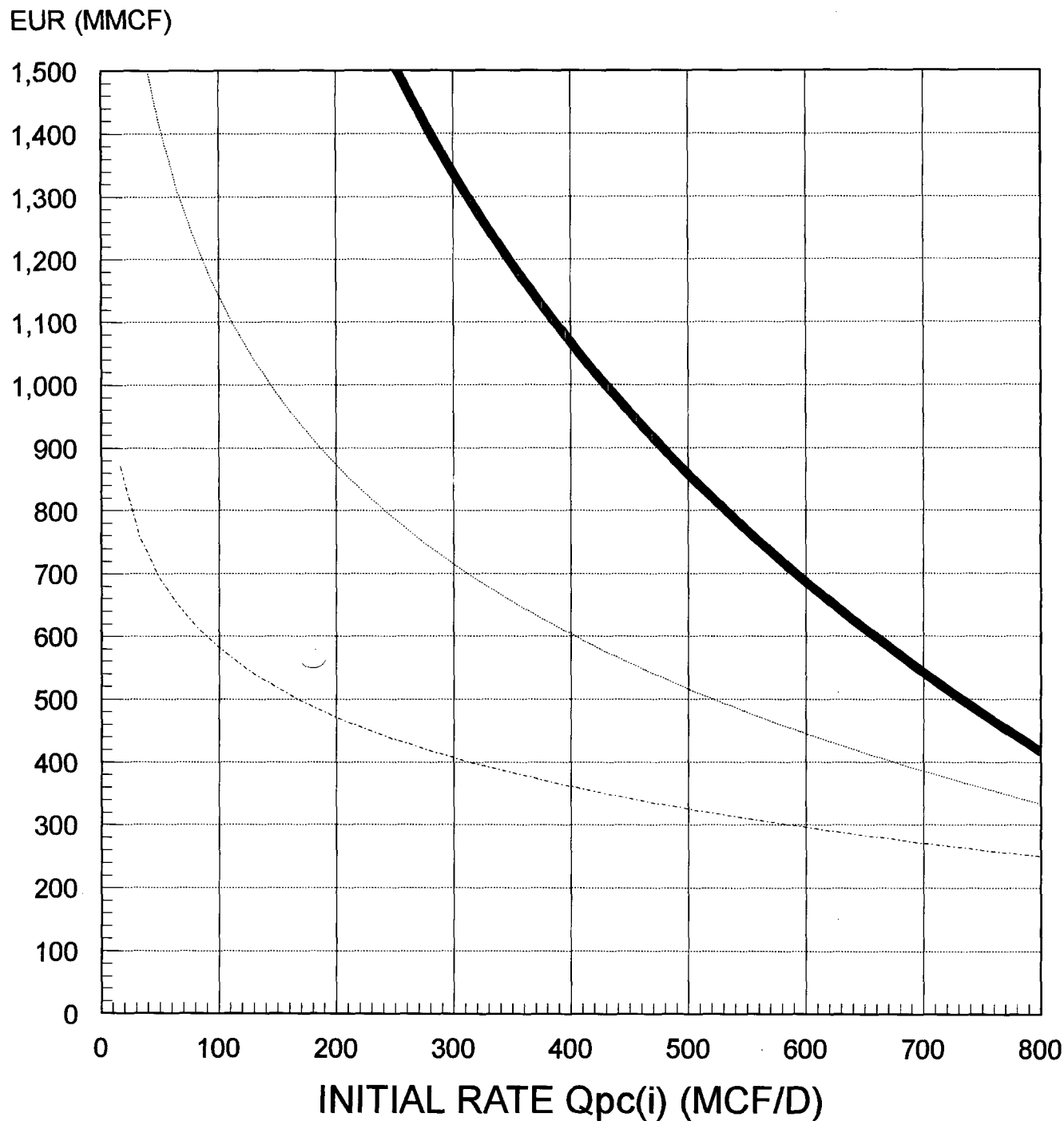
Kurt A. Shipley
Production Engineering

KS/tg

The above downhole commingling request is hereby approved:

Date: _____

SAN JUAN 28-5 UNIT #227 **FRUITLAND COAL/ PICTURED CLIFFS** **ECONOMIC EVALUATION: Qi vs EUR**



SINGLE DUAL COMMINGLE
 15% ROR 15% ROR 15% ROR

EST. FTC EUR: 571 MMCF EST. FTC QI: 175 MCFD
 EST. PC EUR: 834 MMCF EST. PC QI: 310 MCFD

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MONTHLY GAS PRODUCTION ALLOCATION FORMULA

GENERAL EQUATION

$$Q_t = Q_{ftc} + Q_{pc}$$

WHERE: Q_t = TOTAL MONTHLY PRODUCTION (MCF/MONTH)
 Q_{ftc} = FRUITLAND COAL (ftc) MONTHLY PRODUCTION
 Q_{pc} = PICTURED CLIFFS (pc) MONTHLY PRODUCTION (MCF/MONTH)

REARRANGING THE EQUATION TO SOLVE FOR Q_{ftc} :

$$Q_{ftc} = Q_t - Q_{pc}$$

ANY PRODUCTION RATE OVER WHAT IS CALCULATED FOR THE PICTURED CLIFFS (PC) USING THE APPLIED FORMULA IS FRUITLAND COAL (FTC) PRODUCTION.

PICTURED CLIFFS (PC) FORMATION PRODUCTION FORMULA IS:

$$Q_{pc} = Q_{pci} \times e^{-\{D_{pc}\} \times (t)}$$

WHERE: Q_{pci} = INITIAL PC MONTHLY FLOW RATE (CALCULATED FROM FLOW TEST)
 D_{pc} = PICTURED CLIFFS MONTHLY DECLINE RATE CALCULATED FROM:
 $D_{pc} = (Q_{pci} - Q_{pcabd}) / N_{p(pc)}$
See Determination of Q_{pci} and PC Estimated Ultimate Recovery ($N_{p(pc)}$)
 $Q_{pcabd} = 300$ MCF/M

WHERE: $N_{p(pc)}$ = PICTURED CLIFFS ESTIMATED ULTIMATE RECOVERY (EUR)
 $N_{p(pc)} = P \times 0.81 \text{ MMCF/PSI}^{**} \times R_f$
 P^* = INITIAL RESERVOIR PRESSURE (SIBHP)
 R_f = RECOVERY (FIELD ANALOGY): = 0.95
 $**$ DETERMINED FROM MATERIAL BALANCE (FIELD ANALOGY) AND VOLUMETRIC RESERVES (LOG ANALYSIS)

By calculating $N_{p(pc)}$ from SIBHP and determining Q_{pci} , D_{pc} can then be calculated utilizing the previously described parameters. See derivation of D_{pc} , item (c) on page 4.

THUS: $Q_{ftc} = Q_t - Q_{pci} \times e^{-\{D_{pc}\} \times (t)}$
WHERE: (t) IS IN MONTHS

REFERENCE: Thompson, R. S., and Wright, J. D., "Oil Property Evaluation", pages 5-2, 5-3, 5-4.

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In order to facilitate an economic Pictured Cliffs completion three requirements must be met. It is the combination of these three requirements that determines the economic status and completion method (PC single completion, PC-FTC Dual, PC-FTC commingle) utilized. In some cases the Pictured Cliffs formation may be economic as a stand alone or dual completion. The Fruitland Coal, however, fails to meet economic criteria in all cases except commingling. These three requirements are as follows:

RESERVES $N_p(pc)$

FLOW RATE (Q_{pci})

COSTS (Investment and Operating)

Shown in the following example are the parameters and calculations used to determine Pictured Cliffs initial rate (Q_{pci}), Pictured Cliffs Estimated Ultimate Recovery ($N_p(pc)$), and Pictured Cliffs decline rate (D_{pc}). Additionally, estimated costs associated with each completion method and economic sensitivities (figures 1-3) are attached to show the effects of PC reserves ($N_p(pc)$), initial PC rates (Q_{pci}), and completion method (costs).

The monthly gas production allocation formula presented is similar to the allocation formula presented by Meridian Oil in previous commingle hearings.

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DETERMINATION OF Q_{pci} : (INITIAL PICTURED CLIFFS MONTHLY PRODUCTION)

$$Q_{pci} = Q_t(1) \times Q_{pc}(p) / \{Q_{pc}(p) + Q_{ftc}(p)\}$$

WHERE:

$Q_t(1)$ = FIRST MONTH TOTAL PRODUCTION (MCF)

$Q_{pc}(p)$ = FINAL PICTURED CLIFFS FLOW TEST (MCFPD)

$Q_{ftc}(p)$ = FINAL FRUITLAND COAL FLOW TEST (MCFPD)

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EXAMPLE DETERMINATION OF:

- (a) $N_p(pc)$
- (b) Q_{pci}
- (c) D_{pc}

PC EUR
INITIAL PC MONTHLY FLOW RATE
PC MONTHLY DECLINE RATE

(a) DETERMINATION OF $N_p(pc)$

(see page 5 for $N_p(pc)$ derivation)

$$N_p(pc) = 0.81 \text{ (MMCF/PSI)} \times P^* \text{ (PSI)} \times R_f$$

$$P^* = 1090 \text{ PSI (FROM SIBHP)}$$

$$N_p(pc) = 0.81 \text{ MMCF/PSI} \times 1090 \text{ PSI} \times 0.95$$

$$\underline{N_p(pc) = 834 \text{ MMCF}}$$

(b) DETERMINATION OF Q_{pci}

$$Q_{pci} = Q_t(1) \times \{Q_{pc}(p)/(Q_{pc}(p) + Q_{ftc}(p))\}$$

$$\begin{aligned} Q_t(1) &= 15,000 \text{ MCF} \\ Q_{pc}(p) &= 500 \text{ MCF/D} \\ Q_{ftc}(p) &= 400 \text{ MCF/D} \end{aligned}$$

1ST MONTH TOTAL PRODUCTION
PC FLOW TEST
FTC FLOW TEST

$$Q_{pci} = 15,000 \text{ MCF/M} \times \{500 \text{ MCF/D}/(500 \text{ MCF/D} + 400 \text{ MCF/D})\}$$

$$\underline{Q_{pci} = 8,333 \text{ MCF/M}}$$

(c) DETERMINATION OF D_{pc}

$$D_{pc} = (Q_{pci} - Q_{pcabd})/N_p(pc)$$

$$Q_{pcabd} = 300 \text{ MCF/M}$$

$$D_{pc} = (8,333 \text{ MCF/M} - 300 \text{ MCF/M})/(834,000 \text{ MCF})$$

$$\underline{D_{pc} = 0.0096/\text{M}}$$

$$\underline{\text{THUS: } Q_{ftc} = Q_t(\text{MCF/M}) - 8,333(\text{MCF/M}) \times e^{\{-(0.0096(1/\text{M}))\}} \times t(\text{M})\}}$$

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A. DETERMINATION OF PC RESERVES		$N_p(pc) =$	$(HCPV \times B_g \times R_f)$
Volumetric Evaluation (averages are for subject 160 acre drill block)			
a.	(t)	thickness	= 23.0 ft
b.	(phi)	porosity	= 14.0 %
c.	(Sw)	H2O saturation	= 44.0 %
d.	(Rf)	Recovery Factor	= 95.0 %
e.	(rcf)	Reservoir Cubic Feet	@ reservoir conditions
f.	(scf)	Standard Cubic Feet	@ standard conditions

1. $HCPV =$ HYDROCARBON PORE VOLUME (rcf)

$$= t \text{ (ft)} \times a \text{ (ft}^2\text{)} \times \phi \times (1-S_w)$$

$$= 23 \text{ (ft)} \times 160 \text{ (acres)} \times 43,560 \text{ (ft}^2\text{/acre)} \times 0.14 \times (1-0.44)$$

$$= 12,328,800 \text{ ft}^3 \quad 1 \text{ mmrcf} = 1,000,000 \text{ ft}^3$$

$HCPV = 12.329 \text{ mmrcf}$

2. $B_g =$ FORMATION VOLUME FACTOR (scf/rcf)

UTILIZING THE REAL GAS LAW TO DETERMINE THE FORMATION VOLUME FACTOR (B_g):

REAL GAS LAW states:

$$P V = Z n R T$$

Rearranging to solve for n:

$$n = P V / Z R T$$

assuming:

$$n_r = n_s$$

WHERE: $n_r =$ NUMBER OF MOLES OF GAS AT RESERVOIR CONDITION

$n_s =$ NUMBER OF MOLES OF GAS AT SURFACE CONDITIONS

THUS: $\frac{P_r V_r}{Z_r T_r R} = \frac{P_s V_s}{Z_s T_s R}$

Rearranging: $\frac{V_s}{V_r} = \frac{B_g}{Z_s T_s P_r / Z_r T_r P_s}$

assuming:

$$\begin{aligned} Z_s &= 1.00 \\ Z_r &= 0.94 \\ T_s &= 60 \text{ } ^\circ\text{F} \quad \text{or } 520 \text{ } ^\circ\text{R} \\ T_r &= 100 \text{ } ^\circ\text{F} \quad \text{or } 560 \text{ } ^\circ\text{R} \\ P_s &= 15.025 \text{ psia} \\ P_r &= \text{Determined from build-up test} \end{aligned}$$

$$\begin{aligned} B_g &= \text{FORMATION VOLUME FACTOR (scf/rcf)} = \frac{Z_s T_s P_r}{Z_r T_r P_s} \\ &= (\text{scf/rcf}) \{1.00 \times 520 \text{ (} ^\circ\text{R)} \times P_r \text{ (psia)}\} / \{0.94 \times 560 \text{ (} ^\circ\text{R)} \times 15.025 \text{ (psia)}\} \end{aligned}$$

$B_g = 0.0657 \{ \text{scf/ (rcf psia)} \} \times P_r \text{ (psia)}$

3. $EUR =$ $HCPV \times B_g \times R_f$

$$= 12.329 \text{ (mmrcf)} \times 0.0657 \{ \text{scf/(rcf psia)} \} \times P_r \text{ (psia)} \times 0.95$$

$N_p(pc) = 0.81 \text{ (mmscf/psia)} \times P_r \text{ (psia)} \times 0.95$

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B. PICTURED CLIFFS DRILLING /COMPLETION COST SUMMARY

1. STAND ALONE SINGLE PC COMPLETION

ESTIMATED COSTS:	TANGIBLE	INTANGIBLE	TOTAL
	(M\$)	(M\$)	(M\$)
	115.00	209.75	324.75

2. FTC/PC DUAL COMPLETION*

ESTIMATED COSTS:	TANGIBLE	INTANGIBLE	TOTAL
	(M\$)	(M\$)	(M\$)
	127.20	144.34	271.54

3. FTC/PC COMMINGLE COMPLETION*

ESTIMATED COSTS:	TANGIBLE	INTANGIBLE	TOTAL
	(M\$)	(M\$)	(M\$)
	58.90	141.45	200.35

***PICTURED CLIFFS COSTS ONLY**

C. ECONOMIC SUMMARY

THE FIGURE INCLUDED DEPICTS RESERVES (EUR) VS INITIAL RATE (MC

THREE CASES PER FIGURE (FTC/PC COMMINGLE, FTC/PC DUAL, PC SINGLE) @ 15 % ROR

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Expected Reservoir Pressures

Pictured Cliffs - Average of the closest PC completions is 1090 psi SICP (pressures range from 1017 psi to 1065 psi). All of the completions are within 4 miles of the subject location. The initial pressure at the subject location is expected to be the offsetting PC average of 1090 psi.

Fruitland Coal - Average of the closest FTC completions is 1070 psi SICP (pressures range from 635 to 1459 psi). All of the completions are within 4-5 miles of the subject location. The pressure at the subject location is expected to be the offset FTC average of 1070 psi.

PC - 1090 psi, FTC - 1070 psi. Within limits of pressure requirements for commingling.

Fluid Compatibility

Neither producing formation makes oil or water in existing wells in the area. Both formations are very dry gas producers and no fluid production is anticipated in this well.

PC - dry gas production , FTC - dry gas production. Only natural gas will be produced so fluids are compatible.

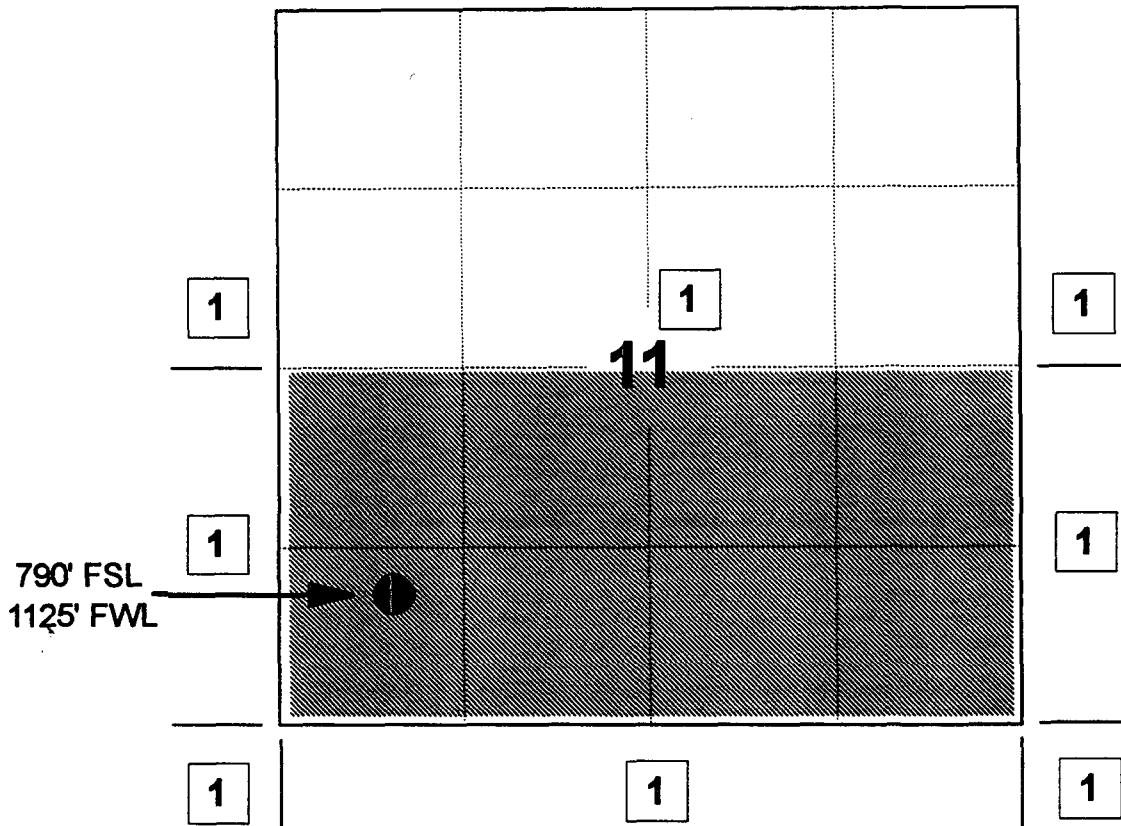
MERIDIAN OIL INC

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OFFSET OPERATOR \ OWNER PLAT

Fruitland Coal / Pictured Cliffs Formations Commingle

Township 28 North, Range 05 West



1) Meridian Oil Inc
