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June 20, 2011

Via E-Mail: richard.ezeanyim@state.nm.us
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and Via Federal Express

RECEIVED OCD
2011 JUN 21 P 12:18

Mr. Richard Ezeanyim
Mr. David K. Brooks
Oil Conservation Division
Energy, Minerals & Natural Resources Dept.
1220 S. St. Francis Drive
Santa Fe, New Mexico 87505

Re: New Mexico OCD Case Nos. 14613 and 14647 regarding various Yeso Pools, Lea and Eddy Counties, New Mexico

Dear Examiners Ezeanyim and Brooks:

Filed herewith are a 2-page written statement from Wayman Gore, a testifying expert witness on behalf of Burnett/Hudson, and its two attachments. We have submitted these in precisely the same form as was used by counsel for COG with its statement from Mr. Metcalf and its attachments. I trust this is in line with the ruling last week by Mr. Brooks, as announced in Mr. Ezeanyim's e-mail.

Thank you for your attention to these cases.

Very truly yours,

KELLY HART & HALLMAN LLP

Robert C. Grable

Attorneys for Burnett Oil Co., Inc. and Hudson Oil Company of Texas

RCG/gm
Enclosures

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PGH
ENGINEERS · CONSULTANTS

June 20, 2011

Production Rate vs. Ultimate Recovery in Heterogeneous, Low Permeability, Low Porosity Reservoirs with Large Volume Hydraulic Fracture Completions.

Mr. Ezeanyim,

In response to your statement and request, when I returned to Austin after the hearing I and others in my firm did an exhaustive search of the technical literature to try to find any papers or other authorities that would be useful to your consideration of whether the ultimate production from these Yeso reservoirs would be affected by the rates of production of oil or gas. While there are published papers on this topic in general, such as the two tendered with Mr. Metcalf's post-hearing submission on behalf of COG, none of them concerned heterogeneous, lenticular, low permeability and porosity reservoirs with properties similar to these Yeso reservoirs, nor did any consider the effects of the large, modern fracture stimulations that are now performed to make these reservoirs produce in commercial quantities.

Consequently, after concluding my research in the published literature, I went to Fort Worth and met with Bill Pollard, John Haiduk, Mark Jacoby, and Deacon Marek, a highly respected consulting engineer with William M. Cobb & Associates in Dallas ("Cobb") to discuss the situation and determine if Cobb could help us provide meaningful data to answer your questions. It was our conclusion that the only way to provide an answer based upon the actual reservoir data and conditions in this case was to commission Cobb to use its highly sophisticated reservoir modeling capability to construct a computer model of the Yeso reservoirs and test the model's response to production under several variables of well density, oil allowable, and with or without a producing GOR rule of 2000:1.

Burnett representatives and I supplied Mr. Marek data on the Yeso reservoir properties from the hearing, as well as the variables of 10 acre or 20 acre density, and oil allowables ranging in steps from 50 barrels per 40 acres to 300 barrels per 40 acres, both with and without a GOR rule of 2000:1. The model tested all of these different iterations of potential producing rules and allowables to determine if there were verifiable and consistent qualitative or directional trends that could be observed. The model runs demonstrated a definite trend that ultimate oil or recovery is higher for all cases with a 2000:1 GOR rule, rather than without a GOR rule, and that ultimate oil recovery decreases with higher oil allowables. The model also demonstrated that 10 acre development recovers very little, if any, additional oil above 20 acre development. In fact, some of the 20 acre density cases resulted in greater ultimate recoveries than 10 acre density. Specifically, the Burnett/Hudson recommendation of 187 BOD allowable with 2000:1 GOR and 20 acre density recovered more oil and gas than the COG/Apache recommendation of 300 BOD with no GOR and 10 acre density. Burnett's amended recommendation in its Closing Statement of 107 BOD with 2000:1 GOR recovered even more ultimate oil and gas.

I participated in the formulation of the model with Mr. Marek, and reviewed the results. I believe the model is an accurate representation of the Yeso reservoirs, that the data input to the model to characterize the reservoir is accurate from actual field data presented at the hearing, and that the ultimate recoveries predicted by the model are reasonably accurate predictions of how the reservoir will respond to production under various different rules on density, allowable and GOR.

I have also reviewed both Mr. Metcalf's 2-page submission, the SPE papers he included with it, and Mr. Marek's letter commenting on the differences between the Cobb Model and the early reservoir models

developed decades ago described in those papers, and the different reservoir characteristics that were input to those model runs. In my opinion, Mr. Marek's computer model at William J. Cobb & Associates is a much more refined, sophisticated and powerful tool than the early computer models utilized and described in the COG SPE papers; and that the reservoir data input to the Cobb Model represents the actual Yeso reservoir, while the reservoir characteristics utilized in the COG papers have much higher porosities and permeabilities and simply aren't representative of these Yeso reservoirs. Consequently, I believe the Cobb Model Study is a reasonably accurate prediction of how these Yeso reservoirs will respond in EURs to different field rules, while the SPE papers served by COG simply are not relevant to your question given (i) the vast differences in the reservoir qualities in the reservoirs modeled in those papers and (ii) the absence of study in those models of the effect of large fracture stimulations, which are used on all wells in these reservoirs.

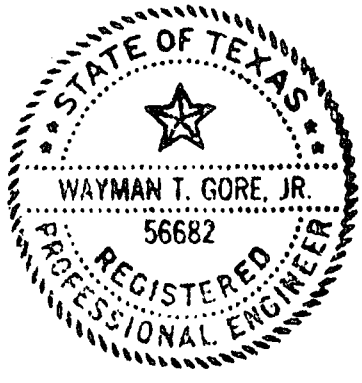
Finally, I have attached copies of the summary, description and results of Mr. Marek's Model, and his letter giving further comment on the distinctions between his model and the models used in the SPE papers furnished by COG.

Recommendation

Based on the Cobb Study, as well as my opinions expressed at the hearing that COG's increased density of drilling resulted in areas of the reservoir producing at lower pressures and substantially higher GORs, and that production of gas at high rates prematurely depletes reservoir energy and pressure, thereby lowering ultimate oil recoveries, it remains Burnett/Hudson's recommendation that the Examiner adopt 20 acre density, a 2000:1 GOR, and either a 107 or 187 BOD oil allowable (or anything in between), in order to maximize the oil recoveries from these Yeso reservoirs and prevent physical and economic waste. This recommendation is particularly applicable to the East portion of the Yeso pools involved in this case, as described in the Burnett/Hudson Closing Statement, due to the large areas there that are undeveloped or lightly developed compared with the Western part of the subject area.

Respectfully Submitted,

Wayman T. Gore, Jr., P.E. 6/20/11
President
PGH Petroleum & Environmental Engineers, L.L.C.



PGH PETROLEUM &
ENVIRONMENTAL
ENGINEERS, LLC
F-9137

Loco Hills Yeso

Simulation Model Study

June 2011

William M. Cobb & Associates, Inc.

New Mexico OCD
Consolidated Hearing Cases:
14613 & 14647
Burnett Oil Co., Inc./
Hudson Oil Company of Texas
Exhibit # 60

Summary and Conclusions

- ***Built 40 acre, 12 layer Yeso simulation model***
- ***Made primary depletion runs***
  - ***Varied oil rate allowable and GOR limit***
  - ***Studied 20 acre and 10 acre development***
- ***Main conclusions***
  - ***Oil recovery is sensitive to rate and GOR limit***
    - ***Oil recovery decreases with higher oil allowable***
    - ***Oil recovery is higher for limited GOR cases***
  - ***10 acre development recovers very little additional oil above 20 acre development***

Loco Hills Yeso Model

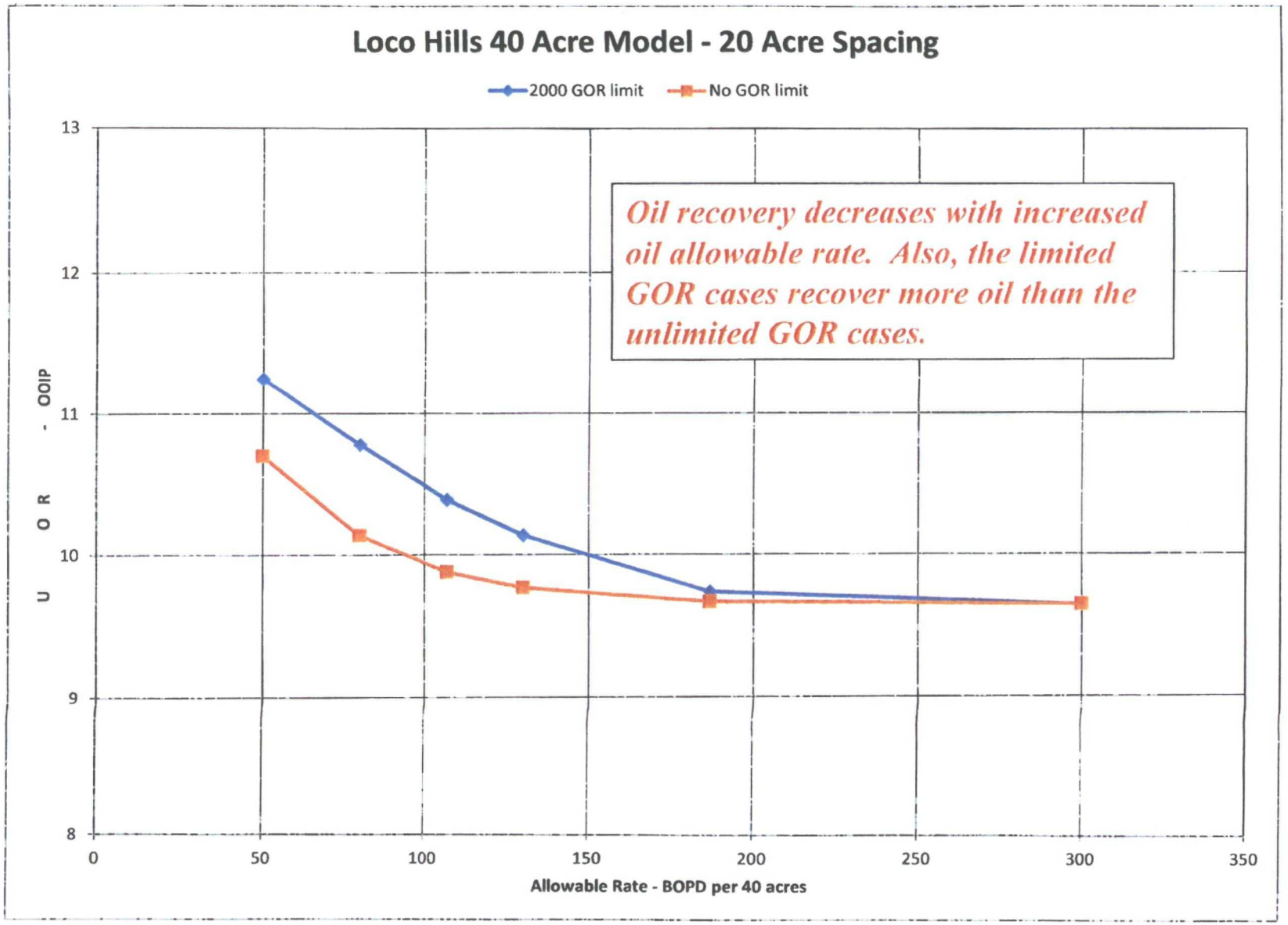
40 Acre - 12 Layer Model

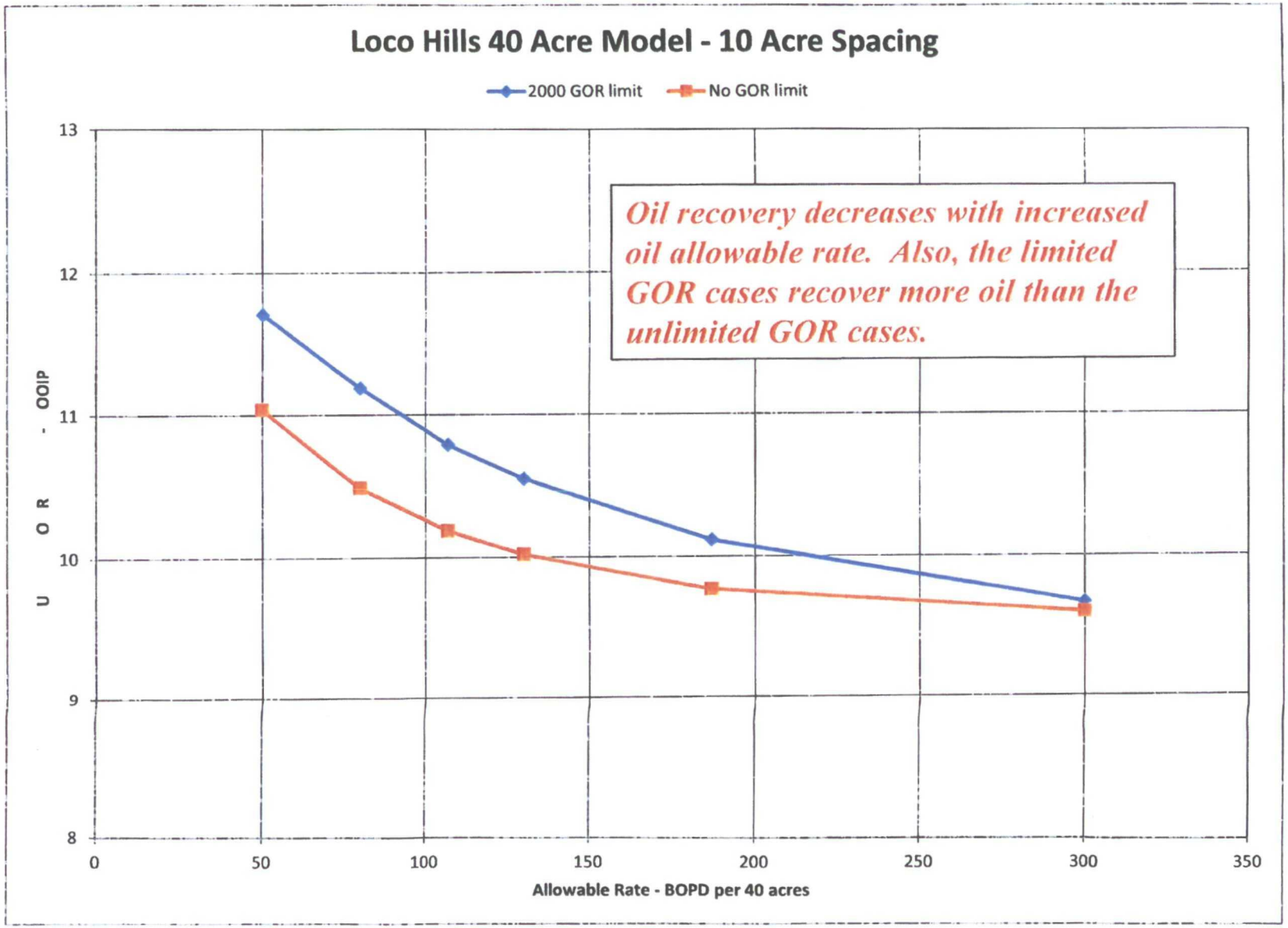
Development on 20 ac spacing:

		2000 GOR Limit			No GOR Limit		
allowable BOPD/40 ac.	allowable BOPD/well	EUR %OOIP	EUR %OGIP	40 Ac. EUR MSTB	EUR %OOIP	EUR %OGIP	40 Ac. EUR MSTB
50	25	11.25	87.81	201.9	10.70	86.16	192.1
80	40	10.78	86.65	193.5	10.14	86.18	182.0
107	53.5	10.39	86.40	186.5	9.88	86.40	177.3
130	65	10.14	86.36	182.0	9.77	86.49	175.4
187	93.5	9.74	86.45	174.8	9.67	86.60	173.6
300	150	9.65	86.64	173.2	9.65	86.62	173.2

Development on 10 ac spacing:

		2000 GOR Limit			No GOR Limit		
allowable BOPD/40 ac.	allowable BOPD/well	EUR %OOIP	EUR %OGIP	40 Ac. EUR MSTB	EUR %OOIP	EUR %OGIP	40 Ac. EUR MSTB
50	12.5	11.71	87.32	210.2	11.04	85.04	198.2
80	20	11.19	86.08	200.9	10.49	84.93	188.3
107	26.75	10.79	85.56	193.7	10.19	85.04	182.9
130	32.5	10.55	85.47	189.4	10.02	85.19	179.9
187	46.75	10.12	85.32	181.7	9.77	85.41	175.4
300	75	9.67	85.63	173.6	9.60	85.68	172.3


Loco Hills 40 Acre Model - 20 Acre Spacing
2000 GOR limit
No GOR limit
Oil recovery decreases with increased oil allowable rate. Also, the limited GOR cases recover more oil than the unlimited GOR cases.
U O R - OOIP
13
12
11
10
9
8
0
50
100
150
200
250
300
350
Allowable Rate - BOPD per 40 acres


Loco Hills 40 Acre Model - 10 Acre Spacing
2000 GOR limit
No GOR limit
Oil recovery decreases with increased oil allowable rate. Also, the limited GOR cases recover more oil than the unlimited GOR cases.
U O R - OOIP
13
12
11
10
9
8
0
50
100
150
200
250
300
350
Allowable Rate - BOPD per 40 acres


Loco Hills 40 Acre Model - 2000 GOR Limit
20 Ac. Devel.
10 Ac. Devel.
Oil recovery decreases with increased oil allowable rate for both 10 and 20 acre spacing. 10 Acre development recovers very little additional oil.
U O R - OOIP
13
12
11
10
9
8
0
50
100
150
200
250
300
350
Allowable Rate - BOPD per 40 acres

Scope of Study

- *Prepare model for "typical" 40 acre element*
  - *Rock and fluid saturations from log and core data*
  - *Fluid properties from correlations*
- *Model primary oil recovery 20 acre and 10 acre development*
  - *Include effects of hydraulic fracture treatments*
  - *Study sensitivity of oil recovery to allowable oil rate and GOR limits*

Model Description

- ***Software – Merlin black oil simulator marketed by Gemini Solutions Inc.***
- ***40 acre area***
  - ***2 wells for 20 acre spacing runs***
  - ***4 wells for 10 acre spacing runs***
- ***12 vertical layers***
  - ***From Paddock zone in Gissler B 44 well***
  - ***Used Gissler B 33 whole core for vertical perms***
  - ***Used rotary SWC data from all available wells for horizontal perm's***

Model Description – Cont.

- *Used correlations for relative permeability curves – no lab data available*
- *Used fluid correlations for PVT properties*
- *Hydraulic fracture geometry*
  - *20 acre cases*
    - *Cell width for frac = 1.81'*
    - *Frac length = 1027'*
    - *Frac perm = 100 md.*
  - *10 acre cases*
    - *Cell width for frac = 1.81'*
    - *Frac length = 440'*
    - *Frac perm = 100 md.*

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June 15, 2011

Via Hand Delivery and E-Mail
From Michael Campbell

Examiner Richard Ezeanyim, P.E.
Oil Conservation Division
Energy, Minerals, & Natural Resources Dept.
1220 S. St. Francis Drive
Santa Fe, New Mexico 87505

Re: New Mexico OCD Case Nos. 14613 and 14647 regarding various Yeso Pools, Lea and Eddy Counties, New Mexico

Dear Examiner Ezeanyim:

I am the author of the Affidavit which is Burnett/Hudson Exhibit 59 and the reservoir simulation model study that is now in evidence as Burnett/Hudson Exhibit 60. My model study is referred to as the "New Cobb Study" in the Burnett/Hudson Closing Statement. This study showed that ultimate oil recovery in the Yeso reservoir is sensitive to oil producing rate. Higher oil allowable rates were shown to result in lower ultimate oil recovery.

In their Closing Statement, COG submitted two technical papers in support of their contention that higher oil rates actually result in higher ultimate oil recovery. I have reviewed these papers and would like to comment on their relevance to this case.

SPE Paper #2696 by Richard A. Morse and Robert L. Whiting (May, 1970)

First, let me say that Dr. Morse and Mr. Whiting were professors of mine at Texas A&M University in the mid-1970's. Both were brilliant men with stellar reputations in the industry. Mr. Whiting was the Petroleum Engineering department head at A&M when I started and he is a co-author of the text book *Petroleum Engineering Fundamentals* which is a standard at many Petroleum Engineering schools. I was a TA for Mr. Whiting during my time at A&M and I hold him in the highest regard.

Dr. Morse was the professor who taught reservoir simulation at A&M. He was a pioneer in reservoir simulation, always at the forefront, developing and using the latest techniques.

The modeling work referenced in the subject paper was done with the latest computer tools available at the time. Also, the authors modeled simple, conventional reservoirs. However, today we have much more sophisticated computer simulation tools, and the Yeso reservoir is not very "conventional".

Comparing the Yeso reservoir to the reservoirs modeled in SPE 2696 is a bit like comparing conventional gas reservoirs in, say, the Gulf of Mexico, to the unconventional reservoirs such as the Barnett Shale. Reservoir properties and completion techniques are vastly different between the two, and performance prediction techniques are necessarily different as well.

Following is a comparison of various reservoir parameters used in SPE 2696 to the actual values for the Yeso reservoir:

Permeability – The Morse/Whiting model used a horizontal perm of 10,000 md. Our model, which utilized actual Yeso core data, has an average perm of 0.211 md.

Net thickness – Our model has 153' of net pay, which is the Paddock only (no Blineberry). The Morse/Whiting model has only 25' of net pay.

Vertical stratification – The Morse/Whiting model has 4 layers with equal perm values. Our model has 12 layers, based on actual Yeso properties, with variable perm and porosity by layer.

Model type – Morse and Whiting used 2D, two phase model, which was sophisticated for the time. It is not designed to model the near-wellbore pressure drawdown effects, which will be more significant and controlling in a low permeability system such as the Yeso. Our model is a 3D, 3-phase black oil simulation model. It is much more sophisticated, and similar to models built by Dr. Morse later in his career. It also does a much better job of modeling the near-wellbore pressure drawdown effects.

Well stimulation – The Morse/Whiting model had no well stimulation. Obviously, none is needed when the base permeability is 10,000 md! The Yeso, however, is very tight and requires large hydraulic fracture treatment to be economically productive. Our simulation model incorporates the hydraulic fracture as a very thin series of grid cells with very high permeability. Obviously, this is much better than no stimulation, and it is also a better way, technically, than using a model with a negative skin to represent a frac.

In summary, SPE 2696 was a fine piece of technical work, performed by very knowledgeable individuals. However, the Morse/Whiting model is just not applicable to the Yeso reservoir and completion techniques at issue in this proceeding.

Factors Affecting Solution Gas Drive Recovery (June 1975)
By Charles R. Connaughton and Paul B. Crawford

This paper was also published by two well-known industry experts. The model employed in this study was a 2D radial model with three layers of equal thickness (10 feet). Again, this is a very simplistic model, but was consistent with the computing capabilities of the time. The authors did cover a wider range of permeabilities , 25 to 500 md., all of which are much higher than the actual Yeso permeability of about 0.211 md. The authors also incorporated skin factors ranging from zero to -3.5. As I stated earlier, however, this is not an accurate way to model a hydraulic frac (which was not the intent of the authors).

The same list of comments and critiques from the Morse/Whiting model are generally applicable to the Connaughton/Crawford model. The model simply does not represent the more complex Yeso reservoir properties or the hydraulic fracture stimulation treatments necessary for production.

In the conclusion section of the subject paper, on page 5, conclusion number 3 states:

> 3. Depletion drive is rate sensitive in reservoirs with vertical permeability. Highest oil producing rates yield highest recoveries.

COG obviously likes this conclusion. However, conclusion number 2 is contradictory to the opposition's case, stating:

> **2. Processes or production schemes that result in rapid increases in GOR result in lower ultimate oil recoveries.**

It is my understanding that the producing GOR for the COG wells is increasing much more rapidly than at the BOC wells.

I sincerely hope that this analysis and my comments are of some help to you in reaching your decision in this case.

Very truly yours,

WILLIAM M. COBB & ASSOCIATES, INC.

Frank J. Marek, P.E.
Senior Vice President

FJM:mas