

**THE APPLICATION OF LANGHAM PETROLEUM EXPLORATION COMPANY, L.L.C.
TO CONSIDER PRODUCTIVE ACREAGE FOR THE TRI-CITIES (BACON LIME)
FIELD AND DETERMINATION REGARDING NATIVE GAS IN THE SUBJECT FIELD,
HENDERSON COUNTY, TEXAS**

Heard by: Margaret Allen, Technical Hearings Examiner
Mark Helmueller, Legal Examiner

Procedural history

Application received: August 14, 2000
Notice of hearing: September 1, 2000
Prehearings held: October 16, 2000, and February 13, 2001
Hearing held: March 7, 8, 9, 12, 14, and April 19, 2001
Proposal for decision issued: January 23, 2002

Appearances

<u>Applicant</u>	Representing
Glenn E. Johnson John D. White Wayman Gore John Pepper	Langham Petroleum Exploration Company
<u>Respondant</u> James Mann Phil Gamble Ann Coffin Charles R. Yarbrough III Terry Payne	TXU Lone Star

EXAMINERS' REPORT AND PROPOSAL FOR DECISION

STATEMENT OF THE CASE

Operating rules for the Tri-Cities (Bacon Lime) Field were approved when the field was approved as a gas storage reservoir April 9, 1956, under Oil & Gas Docket No. 5-33,231. Field rules were amended May 13, 1964, under Oil & Gas Docket No. 5-53,948, by the addition of the following rule:

Rule 8:

(a) No well completed in the Tri-Cities Bacon Lime Gas Storage Reservoir shall be permitted to produce any quantity of gas in excess of the amount of recoverable native gas originally in place in the Bacon Lime Formation underlying the acreage assigned to such well; provided however, that not more than six hundred forty (640) continuous and contiguous productive

acres shall be assigned to any well completed in the Bacon Lime Gas Storage Reservoir. No acreage assigned to a well shall be more than six thousand feet (6000') from such well and certified plats showing acreage assigned to each well shall be filed with the Commission, and if the acreage assigned to any well has been pooled, the operator shall furnish the Commission with such proof as it may require as evidence that interests in the assigned acreage have been pooled.

(b) The operator of a well which has produced an amount of gas equivalent to the recoverable native gas originally in place in the Bacon Lime Formation underlying the acreage assigned to such well may nevertheless produce additional gas provided the operator of such well has injected into the Bacon Lime Storage Reservoir an amount of gas equal to or greater than the amount of such additional gas produced.

(c) For the purpose of this rule, acreage assigned to each well shall be deemed to be underlain at original conditions with an amount of gas which would fill the total Bacon-Lime Reservoir under such acreage assigned to the well with native gas at original conditions. It is also provided that the Bacon Lime Gas Storage Reservoir is hereby defined to be any area which is in communication with any well presently classified in the Bacon Gas Storage Unit.

The Commission determined the productive limits of the field and amount of recoverable native gas under 26 tracts outside the Tri-Cities Gas Storage Unit on July 20, 1964. Two of these tracts, Nos. 16 and 25, are in the E.M. Day Estate Unit ("Day Unit") operated by Langham Petroleum Exploration Company, L.L.C. ("Langham"). Langham believes subsequent development shows its unit was originally underlain by more native gas than the allowable assigned in 1964. The instant hearing is the result of Langham's request that the Commission redetermine the productive limits of the field and the amount of recoverable native gas originally in place in the Tri-Cities Field.

The application is protested by TXU Lone Star Pipeline ("Lone Star"), the operator of the Tri-Cities Bacon Lime Gas Storage facility.

HISTORY

The Tri-Cities (Bacon Lime) Field was discovered in 1941, and produced until depletion in the mid-1950's. In 1956, the Commission approved the request of Lone Star to have the Tri-Cities (Bacon Lime) and Tri-Cities (Rodessa) Fields recognized as the Tri-Cities Bacon Lime Gas Storage Facility. Lone Star based its request partly on the prevention of waste, as the repressurization of the gas storage reservoir would allow for the recovery of significant incremental oil and condensate. Lone Star also noted that the removal of the oil and condensate would lead to enlargement of the storage reservoir.

Wells were subsequently completed in the Tri-Cities (Bacon Lime) Field outside of the gas storage facility established in 1956. These wells were in pressure communication with the storage reservoir, and Lone Star's requests for Commission action regarding these wells were denied. Lone Star then brought an action for conversion in the District Court, which ultimately led to the decision in *Lone Star Gas Company v. Murchison, et al.*, 353 S.W. 2d 870 (Tex. Civ. App. - Dallas 1962, writ ref'd n.r.e.). This decision held that an owner of natural gas does not lose title to the gas when it is injected into an underground reservoir for storage purposes.

Following this decision, Lone Star requested amendments to the special field rules approved by the Commission. At a hearing in October 1963, Lone Star proposed Rule 8 for the Tri-Cities Bacon Lime Storage Reservoir.

Geologic maps then adopted by the Commission established the areal extent of the field and thickness of the reservoir under 26 tracts on the northwest, west and southwest sides of the storage facility. Each of these tracts was assigned an allowable based on the recoverable gas-in-place originally under that tract. Tract Nos. 16 and 25, in which Langham has an interest, had 1071 productive acre-feet and were assigned a corresponding allowable of 1,189,881 MCF.

Two wells on Tract 16 (there has never been a well on Tract 25) have produced allowable gas from the Tri-Cities (Bacon Lime) Field. The Murchison-Day Estate Well No. 2 produced 970,022 MCF, along with 10,046 barrels of hydrocarbon liquids, between 1965 and 1969. The Langham E.M. Day Estate Unit Well No. 1 ("Day well") was drilled in 1979, and recompleted from the Travis Peak to the Tri-Cities (Bacon Lime) Field in January, 1996. The Day well has produced 214,060 MCF and 7535 barrels of liquids from the Tri-Cities (Bacon Lime) Field, and is still active. All but 5,799 MCF of the allowable assigned in 1964 has been produced.

Langham has 49.13289% interest in the Day Unit. This unit comprises 642 acres in four leases, and includes 59 acres of Tract 25 and all of Tract 16 as recognized in the 1964 final order. In 1995, Lone Star acquired approximately one half interest in the Day well. Both parties agree that there is no native gas left under the Day Unit. The only gas present has been injected by Lone Star.

POSITION OF THE PARTIES

LANGHAM

Langham's current analysis shows 4238 acre-feet were originally productive under its Day Unit, and that its cumulative allowable should have been 4,707,220 MCF of gas, based on the recovery factor used in 1964. Langham Ex. 25. Langham made structure and thickness (isopach) maps of the entire field but did not make an independent study of the productive limits or original gas reserves in the field.

Langham believes Rule 8 allows an operator to present a determination of productive acreage and original gas reserves under its tract alone. As an alternative, during its rebuttal case, Langham modified a Lone Star map, to recalculate the number of acre-feet underneath each of the 26 tracts, including its own. Langham thus claims that even using Lone Star's evidence, the Day Unit is entitled to a substantial, though smaller, increase in allowable.

In the 1956 and 1964, the Commission referred to the field as a gas/condensate reservoir, and Langham agrees with this determination. If true, the entire reservoir was gas-filled at original pressure, and all the originally-productive acre-feet under the Day Unit are entitled to a full gas allowable, under Rule 8. However, since Rule 8 requires that all productive acreage be assigned an allowable equal to the amount of gas which would fill the reservoir at original conditions, Langham argues that it would be irrelevant if the Day Unit were originally filled with oil instead of gas.

Langham introduced into evidence a large amount of data from Lone Star's files, kept over many years, on the Tri-Cities (Bacon Lime) storage facility. Langham believes the exhibits show Lone Star's

attempts to keep other operators and the Commission from knowing Lone Star's changing interpretations of the size of reservoir.

LONE STAR

Lone Star believes that Langham failed to meet the call of the hearing because it confined most of its analysis to its tracts alone. Lone Star believes its storage operations prove the total size of the reservoir if not its exact distribution. If Langham's tracts are entitled to more allowable, as Langham claims, then Langham should be required to show which other tracts are entitled to less¹. If the amended reservoir parameters presented by Langham for its Day Unit are extrapolated to the rest of the reservoir, the reservoir should contain much more gas than Lone Star's storage operations show to be there.

Lone Star objected to the characterization of any of its exhibits as either Lone Star's field limits map or its recoverable reserves interpretation. Except for its structure map, all of Lone Star's maps were based partially on Langham's interpretations. Lone Star used these interpretations without necessarily agreeing with them or adopting them as its own. Lone Star thus intended to show that even using Langham's interpretations, the Day Unit has already received more allowable than it was entitled to.

Lone Star believes an oil rim was present in the field at original conditions, invalidating Langham's volumetric gas calculations. Assigning Langham a gas allowable based on Langham's current map, would mean ignoring the original conditions in the reservoir. Lone Star presented evidence to show that, from 1980 until recently, representatives of Langham also recognized the presence of an oil rim.

Lone Star admitted that, over the years, it has recognized the reservoir extends under more area to the northeast and southwest than it thought in 1964. But its interpretation of the field capacity is unchanged, except for the increase in storage space previously occupied by now-produced oil. Lone Star argues that all of the gas now in the reservoir belongs to Lone Star.

DISCUSSION OF THE TECHNICAL EVIDENCE

INTERPRETATION OF THE RESERVOIR

OIL RIM

The presence or absence of an oil rim causes the greatest difference between Langham's and Lone Star's technical interpretations. Lone Star believes part of the reservoir, including the Day Unit, was originally oil-filled and not entitled to any more gas allowable. Considerable evidence shows the reservoir to be a crude oil field with an associated gas cap. The gas cap area, as mapped by Lone Star,

¹ Late in the hearing, during its rebuttal case, Langham redetermined the productive acre-feet under each of the 26 tracts. To make this interpretation Langham modified a Lone Star map, which it referred to Lone Star's productive limits map. Langham testified that Lone Star's productive limits and bulk volume were "a reasonable representation of this reservoir at original conditions." Tr. Vol. VI, p. 27.

was thought in 1956 to be the entire field. Attachment A. Lone Star's current map shows the gas cap now surrounded by an oil rim that was discovered after 1956. All ten wells drilled in Lone Star's oil rim area after 1956, were classified as oil wells by the Commission, at least initially, due to their gas/oil ratios and oil gravities². Several cores from various field wells reported the presence of oil, not condensate, and at least one core was bleeding oil when pulled from the ground. Lone Star used actual test and production data (open flow potentials, producing gas/oil ratios and oil gravities) from five oil rim wells to pick a gas/oil contact at an elevation of -7275' (feet below sea level).

Langham was, on the other hand, was able to present considerable contradicting evidence suggesting the field is a gas/condensate reservoir without crude oil. For example, Langham showed that most of the wells drilled in Lone Star's oil rim were eventually reclassified as gas wells. Langham pointed out that production of large amounts of hydrocarbon liquids does not necessarily mean crude oil, since true gas wells can produce significant amounts of liquid hydrocarbons (condensate) at the surface.

In spite of Langham's current opposition to an oil rim theory, Mr. Loren (a geologic witness for Langham and an interest owner in the Day well) apparently believed in the presence of an oil rim in 1980. A report he prepared for Langham identifies "... a fair probability that the Langham No. 1 Day Unit will be oil productive." Tr. Vol. II, p. 112; Lone Star Ex. 5. In 1995, Langham sent a letter to Lone Star, stating Langham still expected the Day well to be oil productive when recompleted to the Bacon Lime. In this letter, Langham predicted 300,000 barrels of oil which is "...certainly not part of Lone Star's storage gas, and was not accounted for in the 1964 RRC hearing order." Tr. Vol. I, p. 55; Lone Star Ex. 2.

The Day Well itself was initially classified as an oil well in 1996, despite Langham's requests to the Commission that it be considered a gas well. The well produced 6500 BO with 173 MMCF, before it was reclassified as a gas well in 1998. Liquid gravities reported from the Day well, however, have generally indicated condensate was being produced, not crude oil, and therefor that the well could have been classified as gas all along.³

PRODUCING HISTORY

Lone Star believes this field has always had a crude oil rim overlain by an associated gas cap. In most such fields, oil recovery is optimized by producing oil first with gas production restricted until the oil is depleted. The Bacon Lime field was produced in opposite order to this typical method. Essentially all of the recoverable gas in the gas cap was produced by 1956, before the oil rim was discovered. The bottom-hole pressure was thus depleted, at least in the gas cap, before the first wells were completed in the oil rim. Gas injection operations subsequently repressurized the oil column with injected gas that had a different gravity from the native gas. Because the oil rim went unrecognized, Lone Star considers it not surprising that wells, particularly those drilled on the flanks, were sometimes reclassified due to changes in gas/oil ratios or oil gravities over time.

In Langham's interpretation, the field contained only gas, at original conditions, and only gas

² Hydrocarbon liquid specific gravity is measured on a scale developed by API. Liquids with gravities under 50 degrees are usually considered crude oil while those with gravities over 50 degrees are usually considered condensate. Langham Ex. 54. Other properties of hydrocarbon liquids also influence their classification.

³ Distillation reports from 1996, 1997, 1999, and 2001 show liquid hydrocarbon gravities ranging from 54 to 59 degrees API; a liquid gravity of 42 degrees was reported in 1998. Langham Ex. 37.

and condensate now. The depletion of reservoir pressure by 1956, caused some of the gas to condense to a liquid which then flowed downstructure. Little condensate was produced before 1956 because all of the existing wells were upstructure. According to Langham, storage operations, with cycles of dry gas injection and withdrawal, created an 'accordion effect' where gas injection caused a dry gas cap to form at the top of the reservoir and push the condensate farther down the flanks of the reservoir. Withdrawal of storage gas then caused the condensate to be drawn up structure. Thus, later wells drilled on the flanks of the field encountered not crude oil, but rather condensate that had formed after the reservoir was discovered. In Langham's opinion, Rule 8 refers to original conditions, and Langham asserts that there was no crude oil present in the reservoir at original conditions.

STRUCTURE AND SIZE OF THE RESERVOIR

STRUCTURE

The parties agree on the general geologic framework of the Tri-Cities (Bacon Lime) Field. The Bacon Lime reservoir is located on a doubly-plunging anticline that formed over a salt-generated structural high. The reservoir rock is a carbonate that was deposited as sand-sized grains in various environments on a shallow-water platform. The anticline is on the west side of a significant fault that forms the eastern boundary of the field.

Langham's unit is on the northwest flank of the field. Both parties agree the field is limited on this side by increasing saltwater downdip. Langham used petrophysical⁴ analyses of fourteen well logs near its tract to determine the lowest producible hydrocarbons were at an elevation of -7463' (feet below sea level). Lone Star interprets the saltwater contact to be at -7400', over 50' shallower than Langham does, based on downdip wells that produced water⁵. In 2000, another operator, Ellis Exploration, Inc., filed a new field application with the Commission which said that the original saltwater contact in the Tri-Cities (Bacon Lime) Field was at -7365'. Lone Star Ex. 24.

Langham's structure map is on the top of the Bacon Lime formation. Lone Star made its structure map on the top of the Bacon Lime porosity, believing this top more correctly reflects the structure of the reservoir. Both agree the top of the Bacon Lime porosity that is productive in this field is not a consistent depth below the top of the Bacon Lime formation, however the structure maps of both parties are roughly similar.

THICKNESS

Langham created an isopach map of the field from net feet of pay, defining pay as the number of feet on a log with 8% or greater porosity. Well control to the west of the storage wells is very sparse. The net feet of pay Langham posted for these dry holes to the west include porosity in both the main storage pay of the field and in a second, occasionally-porous section about 40' deeper in the Bacon Lime. Langham believes this lower porous section is in communication with the main storage pay, and

⁴ Petrophysics is the detailed study of the physical properties of rock.

⁵ The Perryman-Parker Well No. 1 tested saltwater from the Bacon Lime at -7385', the Perryman-Stokes Well No. 1 tested oil and saltwater from the Bacon Lime at -7354', and the Hinton-Thompson Well No. 1 tested saltwater in the Bacon Lime at an elevation of -7431'.

could contribute reserves. Langham's attribution of pay to these western dry holes has expanded its isopach lines across the Day Unit causing the reservoir to appear thicker there than it would otherwise.

Lone Star believes the lower porous section is unconnected to the main storage unit as it does not meet Langham's pay criterion in any well in the field.⁶ Lone Star chose not to make its own isopach map, though its map shows the porosity pinching out on the western side of the field. Attachment A. Both Langham and Lone Star used Langham's isopach map in all their subsequent interpretations.

FIELD LIMITS

Neither party wanted to be accused of mapping the limits of the field. Lone Star's Exhibit 26 shows the edges of the gas cap and surrounding oil rim, but Lone Star was "not going to sponsor it to the Commission as the map for productive limit purposes." Tr. Vol. IV, p. 151. The downdip field limits on the northwest and northeast flanks in Exhibit 26 is at the saltwater contact chosen by Lone Star. The field's western edge, as mapped by Lone Star in Exhibit 26, is very close to the western field edge determined in the 1964 hearing, and to the western edge of the solid contour lines on Langham's net pay isopach. Only on the south side of the field, did Lone Star apparently rely partly on Langham's data to draw the limit of the field. Tr. Vol. IV, p. 152.

During its rebuttal case, Langham testified that Lone Star's Exhibit 26 map was a reasonable interpretation of the field limits, and that it used these field limits to create an alternate interpretation of the recoverable reserves in the field. Tr. Vol. VI, p. 27.

MATERIAL BALANCE CALCULATIONS

Since 1956, the Tri-Cities (Bacon Lime) reservoir has been filled, emptied and refilled with gas many times (over 440 BCF⁷ have been injected and 420 BCF have been withdrawn). Material balance calculations were made by Lone Star to connect reservoir pressure to the amount of gas in the pore space as they varied over time.

Prior to the field's conversion to storage, the 20 wells in the gas cap area of the Bacon Lime field reported production of 21.667 BCF of gas and 1,121,000 barrels of liquids. It took 22 BCF of extraneous gas to fill the storage facility back up. According to Lone Star, this shows the original gas-in-place was 25 BCF, assuming 2 to 3 of gas was unrecovered in 1956. In 2000, Lone Star tested the reservoir capacity at 26.5 BCF. Lone Star believes this increase is due to continuing net extraction of liquid hydrocarbons and water since 1956.

Langham claims the Day Unit contained as much as 4,710,307 MCF (Table 1), which is 15-20% of the gas in the field, an unusually large percentage for an edge tract, according to Lone Star. If

⁶ Langham's isopach indicates 1.5' of pay in the Perryman-Gentry Well No. 1, 1' in the Murchison-J.C. Kennedy Well No. 1, and 2' in the Munson-Carter G.U. Well No. 1, west of the field. These dry holes have porosity in the lower section only. Lone Star considers them outside the limits of the field as they have no porosity over 8% in the main storage pay interval. Only one dry hole on the western field edge, the Perryman-Royal Carson has pay in both sections--2' in the main pay and 4' in the lower section.

⁷ BCF stands for billion cubic feet (100,000 MCF).

Langham's assumptions on the oil rim and the water contact are correct, the reservoir should have contained over 50 BCF, twice as large as Lone Star believes its material balance calculations show.

Langham challenged Lone Star's material balance calculations, in part because as much as 6 BCF of gas may have been withdrawn but not reported prior to 1956. Langham believes it well known that material balance calculations, including a P/Z^8 curve, cannot be used to determine recoverable gas in an associated field (one with both gas and oil). Lone Star has used and continues to use P/Z analyses, indicating to Langham that Lone Star has known all along that this field is a gas/condensate reservoir. Recent storage capacity tests showed that only 74% of the reservoir was in good communication and could respond within a three-month period during a test. The total flank area where the Day Unit is located was not well represented in these tests or the material balance calculations, according to Langham. Langham Ex. 31.

In its rebuttal case, Langham showed that its alternate interpretation could be matched to the history of the storage facility. If the entire reservoir is assumed to have been gas-filled, and if the Z-factor used by Lone Star is 'corrected', the reservoir originally contained 27.974 BCF of recoverable gas which accords well with the most recent storage capacity study.

BULK VOLUME

Overlaying Langham's isopach map on its structure map of the Bacon Lime porosity, Lone Star calculated the bulk volume of the entire field to be 39,705 acre-feet (18,380 in the gas cap and 21,325 in the oil rim). Lone Star recalculated that the 26 tracts from 1964, contained 12,786 acre-feet of oil rim and 1213 acre-feet of gas cap, for a total of 13,999 originally productive acre-feet. There were 2402 acre-feet originally productive of oil in the Day Unit. Table 1.

In its direct case, Langham determined the volume of original gas-filled reservoir on its Day Unit by divided it into 57 small tracts of one to fifty acres, each of which it assigned a single elevation and uniform net pay. For each small tract, Langham derived a net pay value from its field-wide isopach map and then calculated the sum of the bulk volumes on the Day Unit to be 4238 acre-feet.

In Langham's rebuttal case, it agreed with Lone Star's determination of the acre-feet in the field but planimetered a total of 12,807 productive acre-feet in the 26 tracts from 1964. In this alternate interpretation, the Day Unit had at least 2369 productive acre-feet, even when Langham used some of Lone Star's methods.

GAS ALLOWABLES

POROSITY AND WATER SATURATION

Langham used its digitized petrophysical study of 14 wells only to assign water saturations to

⁸ P/Z refers to pressure divided by a Z-factor, which is based on the pressure, temperature and composition of the gas. Dry gas, such as that injected during storage operations, will have a different Z-factor than the original reservoir gas did.

each of its 57 small tracts. Even though this study was very comprehensive⁹, Langham did not use it for porosity but assigned only a generalized porosity value to each tract based on its net pay.

According to Lone Star, the gas cap and oil rim in this field exhibit different porosities, water saturations and permeabilities. For the entire oil rim, Lone Star established an average porosity of 14% and average water saturation of 35%, using only the average values from Langham's 57 small tracts in the Day Unit. For the gas cap, Lone Star used the 1964 hearing results wherein the average porosity was 15% and average water saturation was 20%. Lone Star admits there may be poor communication between the oil rim and gas cap in the short term, but believes the two areas are in full communication over time.

During rebuttal, Langham calculated porosity and water saturation numbers by averaging data from cores and from log analyses from two sources.¹⁰ In these alternate calculations, Langham found the average porosity was 12%, and the average water saturation was 26% in what it referred to as the flank area (oil rim), and 20% in what it referred to as the central area (gas cap).

RECOVERY FACTOR

In 1964, the Commission assumption of 15% porosity and 80% gas saturation, meant that each acre-foot of reservoir at original conditions could have produced 1111 MCF. However, Langham testified that a lower recovery factor--760.333 MCF per acre-foot--is probably more correct because of the lower porosity and higher water saturation it calculated for each of the 57 small tracts on its Day Unit.

Lone Star recommended using different recovery factors for the gas cap and for the oil rim. For the oil rim, Lone Star calculated 443 barrels of recoverable oil and 344 MCF of recoverable (solution) gas per acre-foot (using the average porosity and water saturation from Langham's 57 small tracts). For the gas cap, Lone Star 'corrected' the 1964 recovery factor for the composition of the injected gas, and determined that 918 MCF of injected gas could be recovered from an average acre-foot that originally contained native gas. Table 1. Thus, at original conditions the oil rim contained 9,450,500 barrels of oil and 7,337,488 MCF of recoverable solution gas, while the gas cap contained 16,879,524 MCF of recoverable gas. Lone Star Exs. 27 and 28. Because all of the Day Unit is within the oil rim, Lone Star's believes the unit should have been assigned an allowable of only 827,268 MCF (2404 acre-feet multiplied by 344 MCF per acre-foot). Lone Star Ex. 30.

In its alternate case, Langham determined the 2369 acre-feet on its Day Unit would have contained 2,634,181 MCF at original conditions, assuming the 1964 recovery factor. Even using a

⁹ This study included the following steps: the log data from the 14 wells was digitized, log curves were depth corrected to assure consistency, the SP curve was shifted to the shale baseline and normalized for mud filtrate resistivities, resistivity was corrected for invasion of wellbore fluids, porosity was calculated from neutron and density logs, porosity was also calculated from acoustic transit-time logs, petrophysical parameters were defined, water saturation calculated, and net pay, average porosity and average water saturation was defined using the selected cutoffs.

¹⁰ Langham's petrophysical expert calculated porosity and water saturation for 14 wells. Lone Star's experts had tried to replicate Langham's petrophysical methods on these and a few additional wells to see if Langham's results could be replicated. Lone Star did not adopt these methods nor use them further, but Langham added these efforts of Lone Star in with the results of its own experts.

recovery factor of 924 MCF per acre-foot¹¹, the original recoverable gas would have been 2,190,804 MCF. As the wells in the Day Unit have already produced 1,184,082 MCF, Langham believes its well is entitled to additional allowable of an absolute minimum of 1,004,874 MCF. Table 1 shows the remaining allowable Langham believes it is entitled to under the different scenarios it presented.

EXAMINERS' OPINION

TECHNICAL ANALYSIS

The examiners believe Langham's re-interpretation of the volume of hydrocarbon acre-feet under the Day Unit to be unsupported. Langham divided its unit into 57 small tracts and recorded specific parameters for each one. This gave its volumetric calculation the appearance of much more precision than is warranted. Several of the factors used in generating each tract's specific parameters were only generalized estimates, some without supporting data. Other parameters were incorrectly derived.

The net feet of pay for each well in the field was determined "kind of by eyeball." Tr. Vol I, p. 106. The isopach map created from these net pay numbers was used to assign net pay for each of the 57 small tracts on the Day Unit. This rather vaguely-determined pay value was not only an important number itself in the volumetric calculations but was also used to determine the porosity. Langham ignored the detailed porosity values generated in its petrophysical study, relying instead on its petrophysicist's assignment of a "reasonable value of porosity to that range of net feet of pay." He cited his experience in assigning reasonable values, but gave little justification specific to this field. Tr. Vol. II, p. 80. Even the elevation of each of the 57 tracts was "...an eyeball estimate of what the average subsea depth of that tract is." Vol. II, p. 90.

The only specific result of Langham's exhaustive petrophysical analysis was a single capillary pressure curve. This capillary pressure curve is based on actual evidence, however the specific well test and production data show Langham's saltwater contact at -7450' is too deep.

Langham incorrectly derived the structure of the reservoir by mapping on the top of the formation rather than the top of the porosity in the Bacon Lime. Langham's isopach map exaggerates the net pay in the Day Unit because the map included porous intervals unconnected to the reservoir pay.

Langham's interpretation depends heavily on the reservoir being gas-filled at original conditions. The classification of wells on Langham's unit has been ambiguous as has the classification of the field as a whole. However, the preponderance of the evidence supports an oil rim. Almost all of the wells ever completed in the area that Lone Star mapped as an oil rim have been classified as oil wells during part of their producing life.

The J.W. Murchison Gladney Unit Well No. 3, was drilled in 1961, as one of the first wells in the oil rim. Its initial potential was 472 BOPD (the oil gravity was 46.2° API) and 321 MCF per day, for a gas/oil ratio of 681 cubic feet per barrel. This is a statutory oil well and could not, under any common definition, have been producing condensate at that time. The producing history of this field, including the depletion of the gas cap prior to drilling in the oil rim, provides a reasonable explanation

¹¹ The recovery factor for the Day Unit was recalculated from 760.333 to 924 MCF per acre-foot because the acre-feet below -7400' were no longer included in the average. Structurally lower acre-feet have higher water saturations and therefore lower recoveries.

for the confusing producing characteristics of wells in this associated oil and gas field.

Evidence shows the Day Unit is within the field's oil rim, making it likely that the Day Unit has already produced all of the gas it is entitled to under Special Field Rule 8. When wells on the Day Unit were classified as oil, they received oil allowables and casinghead gas allowables. To allow the pore space that was filled with oil and received an oil allowable to now be treated as if it had been gas-filled and to give it a second allowable would invalidate the oil allowable.

Neither party wanted to define the field limits except on the Day Unit. Lone Star's Exhibit 26 really is a map of the field's limits even if Lone Star prefers not to be held accountable for every acre. Neither party made an independent assessment of the number of originally-productive acre-feet in the field or in the 26 tracts established in 1964. Both patched together interpretations using some but not all of the other side's data. Because of this, neither side presented their own consistent interpretations of such parameters as porosity, water saturation or recovery factors. Both parties sought only to impeach the other side's interpretation at the same time they tried to avoid making their own. As a result, Langham failed to meet its burden of proving that the productive acreage in the Tri-Cities (Bacon Lime) Field or in its Day Unit is significantly different from that established in 1964.

LEGAL ANALYSIS

This action revisits a 40 year old legal controversy between Lone Star and operators in the Tri-Cities (Bacon Lime) Field. Langham argues that Special Field Rule 8 was enacted to protect the correlative rights of the edge tract mineral interest owners to the native gas in place at original conditions. Langham admits that no native gas remains in the reservoir. However, Langham claims that Special Field Rule 8 gives it the right to produce gas injected by Lone Star in an amount equivalent to the native gas originally in place.

Langham's argument places too much importance on consideration of the correlative rights of the edge tract mineral interest owners in the Commission's adoption of Special Field Rule 8. It also de-emphasizes the explicit recognition in several decisions of the injector's ownership interest in the injected gas. Finally, it does not acknowledge the Legislature's determination of the public interest in the underground storage of natural gas, and the superiority of the injector's ownership interest over any correlative rights claim.

Langham believes that the goal of Special Field Rule 8 was to protect the correlative rights of the mineral interest owners in the edge tracts of the Tri-Cities Bacon Lime Gas Storage Reservoir. To support this argument, Langham relies on the language in subsection (c) which it claims allows the production of storage gas in an amount equivalent to the native gas originally in place. As legal support for its interpretation of Special Field Rule 8, Langham relies on the Texas Supreme Court's decision in *Railroad Commission of Texas v. Lone Star Gas Co.*, 844 S.W.2d 679 (Texas 1992). Langham argues that the Court "blessed, confirmed and upheld the validity and purpose of Rule 8."

Langham's argument that the primary purpose of Special Field Rule 8 was to protect the correlative rights of the edge owners is inaccurate. The Commission's intent in adopting Special Field Rule 8 is illustrated by the review of the record in Oil and Gas Docket No. 5-52,197: *Application of the Lone Star Gas Company for Amendment to Rules for the Tri-Cities (Bacon Lime) Field, Henderson County, Texas*. The record from the 1964 hearing confirms that Special Field Rule 8 was proposed by Lone Star, not by the operators of the edge wells in the Bacon Lime Gas Storage Reservoir. In support of the rule, Lone Star cited the decision in *Lone Star Gas Company v. Murchison, et al.*, 353 S.W. 2d 870 (Tex. Civ. App.

- Dallas 1962, writ ref'd n.r.e.) which held that gas injected into a formation for storage was not subject to the rule of capture. Finally, the record reveals that the protection of correlative rights was only one of the five reasons cited in support of adopting Special Field Rule 8.¹²

Additionally, contrary to Langham's position, review of the Texas Supreme Court's decision in *Railroad Commission v. Lone Star Gas Co.*, supra, does not support an argument that Special Field Rule 8 allows Langham to ignore Lone Star's ownership of the gas it proposes to produce. In *Railroad Commission v. Lone Star Gas Co.*, the Texas Supreme Court did not discuss: 1) the validity of Special Field Rule 8; 2) the rationale behind the Commission's adoption of the rule; or 3) the conflict between the correlative rights of the edge owners and Lone Star's ownership interests in the injected gas. Instead the dispute focused solely on the production method for any native gas attributable to the tract at issue. *Id.* at p. 113. To arrive at the position Langham asserts, one must ignore the merits of the case presented to the court and create an applicable precedent which extends beyond the issues actually addressed.

In addition to overstating both the intent of the Commission in adopting Special Field Rule 8 and the holding in *Railroad Commission v. Lone Star Gas Co.*, Langham's argument, by elevating the issue of correlative rights above all other issues considered, ignores subsequent legal decisions explicitly recognizing the ownership interest in the injected gas. Finally, it does not acknowledge the Legislature's recognition of the public interest in the underground storage of natural gas and the superiority of the property interest in injected gas over any correlative rights claim.

Subsequent to the *Murchison* decision, the Texas Courts repeatedly recognized that stored gas is not subject to the rule of capture if it is reinjected. In *Humble Oil and Refining Co. v. West*, 508 S.W.2d 812 (Tex. 1974), the Supreme Court adopted the *Murchison* holding that reinjected gas remains the property of the party who stores the gas. This holding was followed in *City of Brady v. Bennie*, 735 S.W.2d 275 (Tex.App. – Eastland 1987, no writ). The *Brady* court held that the owner of mineral interests in land overlying a storage reservoir was “entitled to recover only the native gas, not native gas and extraneous gas.” *Id.* at p. 281.

These cases, all decided after the enactment of Special Field Rule 8, further confirm Langham's myopic vision of the purpose of the rule and the competing legal principles it addresses. This nearsightedness is further illustrated when one considers the Legislative enactments concerning

¹² Lone Star also cited in its supporting brief, five grounds in support of the proposed rule:

It is now the duty of the Railroad Commission to formulate an order which will (1) protect the public interest of the citizens and gas consumers of the Dallas-Fort Worth area; (2) prevent the physical waste of casinghead gas which except for the storage project would otherwise be flared; (3) prevent the physical waste which would result from failure to recover the additional 2 to 2-1/2 million barrels of liquids which will be recovered from the Tri-Cities Field only as a result of the gas storage operations; (4) prevent the unlawful taking of the extraneous gas which is the exclusive property of Lone Star gas by Sanders and Murchison; and (5) protect the correlative rights of Sanders and Murchison by allowing production of an amount of gas equal to the volume of recoverable native gas which underlay their leases at original conditions.

Lone Star's five points are cited with approval in the memorandum recommending adoption of Special Field Rule 8.

underground gas storage reservoirs and the ownership of stored gas.

In 1977, the Texas Legislature passed the Underground Natural Gas Storage Act of 1977 (Texas Natural Resources Code §§ 91.171 - 91.184.) The Legislature's Declaration of Policy is outlined in Texas Natural Resources Code §91.172:

The underground storage of natural gas promotes the conservation of natural gas, permits the building of reserves for orderly withdrawal in periods of peak demand, makes more readily available natural gas resources to residential, commercial, and industrial customers of this state, provides a better year-round market to the various gas fields, and promotes the public interest and welfare of this state.

In addition to specifically addressing the Legislature's policy concerns, the act recognized the superiority of the ownership interests in the stored gas in Texas Natural Resources Code §91.182, which provides in pertinent part:

All natural gas in the stratum condemned which is not native gas, and which is subsequently injected into storage facilities is personal property and is the property of the injector or its assigns, and in no event is the gas subject to the right of the owner of the surface of the land or of any mineral or royalty owners interest under which the storage facilities lie, or of any person other than the injector to produce, take, reduce to possession, either by means of the law of capture or otherwise, waste, or otherwise interfere with or exercise any control over a storage facility (Emphasis added)

A plain reading of §91.182 leads to the inescapable conclusion that the property interests of the injector of gas into storage facilities extinguish any correlative rights claim of any interest owner to produce the injected gas.

It is uncontested that Langham seeks to produce injected gas which Lone Star obtained, processed, transported by pipeline and ultimately injected into the Tri-Cities Bacon Lime Storage Reservoir. In light of the issues considered by the Commission in adopting Special Field Rule 8, the subsequent legal decisions recognizing the ownership interest in stored gas, and finally, the Legislative determination of the superiority of that ownership interest over any correlative rights claim, any proposed interpretation of Special Field Rule 8 which would allow a party to produce injected gas while ignoring Lone Star's ownership interest must be rejected.

In summary, Langham failed to establish that the Day Unit productive acreage accepted in 1964 was wrong. It is undisputed that no native gas remains. Judicial decisions and statutes (§91.182) have established that injected gas is the property of the injector and that mineral interests have no correlative right to its production.

FINDINGS OF FACT

1. At least ten (10) days' notice of the application was issued to all persons entitled to notice under Statewide Rule (16 Tex Admin Code 1.46).

- a. Notice of this application by Langham Petroleum Exploration Company, L.L.C. (“Langham”) was mailed to all operators and affected persons in the Tri-Cities (Bacon Lime) Field on September 1, 2000.
 - b. Notice of the application was published in the Athens Daily Review, a newspaper of general circulation in Henderson County, on September 4, 11, 18 and 25, 2000.
 - c. Notice of the hearing was issued on October 6, 2000.
2. Tri-Cities (Bacon Lime) Field was discovered in 1941 and produced gas until depleted by 1956.
 3. In 1956, the Commission approved the request of TXU Lone Star Pipeline (“Lone Star”) to create the Tri-Cities (Bacon Lime) Gas Storage Facility to store injected gas.
 4. Subsequent wells drilled outside the storage facility were found to be in communication with wells in the storage facility.
 5. In 1964, at the request of Lone Star, the Commission adopted a rule to prevent operators from producing any amount of gas in excess of the amount of recoverable native gas originally in place in the Bacon Lime Formation underlying the acreage assigned to such well.
 6. The E.M. Day Estate Unit (“Day Unit”), operated by Langham, comprises the productive acres from two tracts, to which the Commission had assigned 1071 productive acres and a total gas allowable of 1,189,881 MCF in 1964.
 7. Langham believes that the allowable assigned in 1964 is less than the amount of recoverable native gas originally in place in the Bacon Lime Formation underlying the acreage assigned to the unit.
 8. Lone Star, the operator of the Tri-Cities (Bacon Lime) Gas Storage Facility, opposes this application.
 9. All gas currently in the subject field is gas that was produced from other fields and injected by Lone Star for storage purposes.
 10. The Day Unit is below the gas/oil contact, which is at an elevation of -7275' in the Tri-Cities (Bacon Lime) Field.
 - a. Cores taken from wells below -7275' were seeping oil when removed from the ground and have indicated oil saturations when tested in a laboratory.
 - b. All of the field wells drilled at elevations below -7275' were classified as oil wells at some time in their producing lives, based on their producing gas/oil ratios and oil gravities.
 - c. When the J.W. Murchison Gladney Unit Well No. 3, was completed in 1961, at an elevation of -7282', its initial potential was 472 BOPD (oil gravity was 46.2° API) and 321 MCF per day, for a GOR of 681 cubic feet per barrel.
 - c. When the Day Unit Well No. 1 was completed in the Bacon Lime at an elevation of -7350', it was first classified as an oil well.

11. The Day Unit Well No. 1 has received both oil and gas allowables and has produced a total of 214,060 MCF of gas and 7535 barrels of oil.
12. Dry holes to the north of the storage field show the downdip limit across the Day Unit is a saltwater contact at or above -7400'.
 - a. The Perryman-Parker Well No. 1 tested saltwater from the Bacon Lime at -7385'.
 - b. The Perryman-Stokes Well No. 1 tested oil and saltwater from the Bacon Lime at -7354'.
 - c. The Hinton-Thompson Well No. 1 tested saltwater in the Bacon Lime at an elevation of -7431'.
13. Langham has not demonstrated that there were more originally-productive acre-feet under the Day Unit than were assigned in 1964.
 - a. There were no recoverable reserves from elevations below the saltwater contact at -7400' on this unit.
 - b. Dry holes west of the storage field that have little or no porosity in the main pay show Langham's isopach map has overestimated the pay section in the Tri-Cities (Bacon Lime) Field on the Day Unit.
14. The Day Unit has produced all but 5800 MCF of the gas allowable assigned in 1964.

CONCLUSIONS OF LAW

1. Proper notice of hearing was issued by the Commission to the persons entitled to notice.
2. The Commission has jurisdiction over the subject matter and the parties in this hearing.
3. Lone Star possesses a legally recognized property interest in any natural gas injected into the Tri-Cities (Bacon Lime) Gas Storage Facility.
4. Natural gas injected into the Tri-Cities (Bacon Lime) Gas Storage Facility by Lone Star does not become subject to the rule of capture and remains the property of Lone Star under *Humble Oil and Refining Co. v. West*, 508 S.W.2d 812 (Tex. 1974) and Texas Natural Resources Code §91.182.
5. Special Field Rule 8 for the Tri-Cities (Bacon Lime) Field was not enacted solely to protect the correlative rights of the edge tract mineral interest owners in the field.
6. Langham has no correlative interest in any of the natural gas injected by Lone Star into the Tri-Cities (Bacon Lime) Gas Storage Facility and has no right to an allowable to produce that gas.

EXAMINERS' RECOMMENDATION

Based on the above findings and conclusions, the examiners recommend that the application of Langham Petroleum Exploration Company to be **denied**, as per the attached Final Order.

Respectfully submitted,

Mark Helmueller
Legal Examiner

Margaret Allen
Technical Hearings Examiner

Date of Commission Action _____

TABLE 1

Source	Total field (acre-feet)	26 tract-total (acre-feet)	Day Unit (acre-feet)	Recovery factors (MCF per acre-foot)	Cumulative allowable due (MCF)	Remaining allowable due (MCF)	Exhibit No.
Final Orders, 1964	No estimate	10,381	1071	1111	1,189,881	5,799	
Langham, based on 57-tract analysis			4240 4240	1111 760.333	4,710,307 3,383,430	3,526,225 2,199,348	25, 39
Langham, after adoption of Lone Star's productive limits	39,705	12,807	2369 2369	1111 924	2,634,181 2,190,804	1,450,099 1,006,722	74
Lone Star, using Langham's isopach map	39,705	13,999 (Oil rim: 12,786; gas cap: 1213)	2404	<u>gas in oil rim:</u> 344 <u>gas cap:</u> 918	827,268	0	27, 28, 30

Exhibit No. refers to the exhibits of the respective parties which show their interpretations of productive acre-feet and gas allowables due. The allowable numbers refer to the Day Unit which has already produced 1,184,082 MCF of gas.