ALBERTA ENERGY AND UTILITIES BOARD
Calgary Alberta

Decision 2003-049

VINTAGE PETROLEUM CANADA, INC.	**Applications No. 1257887, 1257896, 1257979,**
APPLICATIONS FOR SPECIAL	**1257980, 1257981, 1258046, 1258113,**
GAS WELL SPACING	**1258114, 1258115, 1258288, 1258293,**
STURGEON LAKE SOUTH FIELD	**1258295, 1258298, and 1258348**

DECISION

The Alberta Energy and Utilities Board has considered the findings and recommendations set out in the attached examiner report, adopts the recommendations and directs that Applications No. 1257887, 1257896, 1257979, 1257980, 1257981, 1258046, 1258113, 1258114, 1258115, 1258288, 1258293, 1258295, 1258298, and 1258348 be approved as provided in the report.

DATED at Calgary, Alberta, on June 23, 2003.

ALBERTA ENERGY AND UTILITIES BOARD

[Original signed by]

G. J. Miller
Acting Board Chairman

ALBERTA ENERGY AND UTILITIES BOARD
Calgary Alberta

EXAMINER REPORT RESPECTING	**Decision 2003-049**
VINTAGE PETROLEUM CANADA, INC.	**Applications No. 1257887, 1257896, 1257979,**
APPLICATIONS FOR SPECIAL	**1257980, 1257981, 1258046, 1258113,**
GAS WELL SPACING	**1258114, 1258115, 1258288, 1258293,**
STURGEON LAKE SOUTH FIELD	**1258295, 1258298, and 1258348**

1 RECOMMENDATION

Having carefully considered all of the evidence, the examiners recommend that Applications No. 1257887, 1257896, 1257979, 1257980, 1257981, 1258046, 1258113, 1258114, 1258115, 1258288, 1258293, 1258295, 1258298, and 1258348 be approved in part, subject to the conditions set out herein. Special gas well spacing of two wells per section is considered to be appropriate, and approval of this level of development would be in the public interest. Additional evidence is necessary before the need for and the potential impacts from the requested three wells per section can be properly assessed.

2 INTRODUCTION

2.1 Applications

During February 2002, Vintage Petroleum Canada, Inc. (Vintage) submitted applications to the EUB, pursuant to Section 5.190 of the Oil and Gas Conservation Regulations and Section 79(4) of the Oil and Gas Conservation Act, to establish 16 holdings for the production of gas from the Badheart Formation as indicated below.

Holdings	Application No.
Section 35-68-22W5M	1258113
Section 36-68-22W5M	1258298
Sections 19 and 30-69-21 and Section 25-69-22W5M	1258293
Section 2-69-22W5M	1258113
Section 3-69-22W5M	1258113
Section 4-69-22W5M	1257981
Section 9-69-22W5M	1257980
Sections 10, 11 and 14-69-22W5M	1258046
Section 12-69-22 W5M	1258348
Section 13-69-22W5M	1258288
Section 15-69-22W5M	1258115
Section 16-69-22W5M	1257979
Sections 17 and 20-69-22W5M	1257887
Section 21-69-22W5M	1257896
Section 22-69-22W5M	1258114
Section 24-69-22W5M	1258295

Separate holdings were requested due to differing mineral ownership between sections.

The applicant proposed that within each holding, a producing well would be 400 metres (m) from any other well producing from the same pool, a producing well would be at least 200 m from the boundaries of the holding, and up to three wells per section may be produced from the same pool.

2.2 Intervention

By letter dated February 15, 2002, Paramount Resources Ltd. (Paramount) filed an objection to the subject applications stating that inequities would result that would benefit Vintage if reduced spacing only occurred in certain portions of the pool as opposed to the entire pool. Paramount stated all owners in the Badheart A Pool should reach agreement on depletion plans for the pool before reduced spacing was approved.

2.3 Hearing

The applications and intervention were considered at a public hearing on April 1 and 2, 2003, in Calgary before an examiner panel consisting of R. J. Willard, P.Eng. (Chair), W. Elsner, P.Geol., and T. Pesta, P.Eng. Those who appeared at the hearing are listed in the following table.

THOSE WHO APPEARED AT THE HEARING

Principals and Representatives (Abbreviations Used in Report)	Witnesses
Vintage Petroleum Canada, Inc. (Vintage)	J. Tarnowsky, P.Eng.
B. K. O'Ferrall, Q.C.	B. McNamara, Ph.D., P.Geol.
D. Naffin	S. Wilhelm, P.Eng.
Paramount Resources Ltd. (Paramount)	C. Folden, P.Eng.
L. M. Sali, Q.C.	D. Bassi, P.Eng.
Alberta Energy and Utilities Board staff	
G. Perkins, Board Counsel	
A. Beken, P.Eng., P.Geol.	
S. Thomas, P.Eng.	
C. Lochhead	

3 BACKGROUND

Historically, numerous deep wells have been drilled within the area of application that penetrated the Badheart Formation. However, none of these wells specifically targeted or tested the zone.

The Sturgeon Lake South Badheart A Pool (the pool) is a sweet, shallow (approximately 600 m drilled depth), nonassociated gas pool located in northwestern Alberta. The pool was discovered with the drilling of the 00/13-14-069-22W5/0 well in May 2000. The 00/13-14-069-22W5/0 well was not placed on production until April 2001. Production from the pool commenced in March 2001 from the 02/11-34-068-22W5/2 and 03/09-10-059-22W5/0 wells. EUB pressure records show an initial pressure of 4580 kilopascals absolute (kPaa) for the pool. As shown in the figure, there are currently 29 wells capable of production from the pool and an additional 3 wells not yet tied in. The existing spacing for the pool is one section (i.e., one well per pool per section).

Vintage has an interest in all wells in the pool. Paramount has an interest in the 00/16-27-068-22W5/0, 02/11-34-068-22W5/2, 02/11-01-069-22W5/0, and 02/01-03-070-22W5/0 wells, which are outside the area of application, and in the 00/12-36-068-22W5/0 and 00/06-02-069-22W5/0 wells, which are within the area of application. Both Vintage and Paramount also have an interest in undrilled or unproductive acreage offset to the pool.

A preliminary appropriate dispute resolution meeting was held between Vintage and Paramount. However, efforts to resolve issues through this process were not successful.

4 ISSUES

The examiners consider the issues respecting these applications to be

- need for reduced well spacing,
- location of proposed infill wells,
- need for additional information on the pool, and
- equity.

5 NEED FOR REDUCED WELL SPACING

5.1 Views of the Applicant

Geology

Vintage described the geological setting of the pool as a northward extension of a northwest-southeast trending and areally extensive marine sand bar. The portion of the bar constituting the Badheart A Pool was interpreted to have a wet sand system to the southwest, with its northeastern limit being a shale basin. Thus, the pool was formed as a stratigraphic trap within marine sands. Vintage submitted that the pool had an average porosity of 20 per cent and pay thickness ranging from 0.4 to 4.0 m at a 15 per cent porosity cutoff. Vintage stated the pool was heterogeneous with an area of better quality reservoir in its northern portion, where the wells at 00/10-23-069-22W5/0, 00/12-27-069-22W5/0, 00/02-28-069-22W5/0, and 00/09-33-069-22W5/0 were believed to be capable of draining the reserves from a full section. This up-dip portion of the reservoir was considered to have better permeability compared to the rest of the pool. Based on well test analysis and core data, Vintage testified that the permeability ranges from 5 to 50 millidarcy (mD), with the permeabilities increasing towards the north-northwest.

Vintage considered the pool as a single and coarsening-upward sand body. However, it considered Paramount's interpretation of three sand units as being a more detailed and appropriate model for the pool. It described the two interpretations as being complementary.

Vintage stated that even in portions of the reservoir where porosity was higher than 15 per cent, there may be varying degrees of cleanliness (or shale content), resulting in significant lateral variation in permeability. Vintage submitted that a plot of initial production rate versus net pay and a plot of initial production rate versus porosity clearly indicated that permeability was not related to net pay or porosity thickness. Vintage stated that proof of lithological variability was provided by the gamma response and proof of lateral variability in permeability was provided by the lack of relationship between porosity thickness and initial production rates.

Vintage claimed that there was not enough core data to map permeability directly. Therefore lithological, pressure, and production evidence must be used as a proxy to infer the existence of the high and low permeability areas within the pool. Vintage testified that the pool geology in the area of application had resulted in insufficient drainage by the existing wells.

Aquifer

Vintage interpreted that the aquifer on the southern edge of the pool was inactive. Vintage added that its aquifer interpretation was inferred, since the exact position of a gas-water contact was uncertain. Further, it said that its interpretation was based on the lack of significant water production in wells in the southern portion of the pool. In addition, Vintage stated that its material balance work did not support the presence of an active aquifer.

Volumetric Analysis

Vintage stated that based on its geological mapping, the original gas-in-place (OGIP) was 31 billion cubic feet (bcf) (874 million cubic metres [10^6 m^3]) for the entire pool and 22.3 bcf (627 10^6 m^3) for the area of application. A summary of reserves is given in Attachment 1.

Vintage stated that the consistency of the volumetric estimates of the OGIP between itself and Paramount reflected agreement on the depositional model of the pool and average values for petrophysical parameters and porosity cutoffs. Further, Vintage stated that the agreement between the OGIP determined from volumetric analysis was the result of hard data that existed at the wellbores, which had little room for subjective interpretation.

Vintage identified the estimation of OGIP as the main issue of contention between itself and Paramount. Vintage suggested that Paramount had unfairly discounted the estimate of the OGIP determined from volumetric analysis in favour of a material balance calculation and a simplistic reservoir model.

Using volumetric information, Vintage calculated the area being drained by each well. Vintage used the petrophysical data at the wellbores, along with an assumption of a 75 per cent recovery factor, to back out a drainage area given the estimate of recoverable gas in place determined from production decline analysis. Vintage argued that the small drainage areas indicated the need for reduced well spacing.

Production Decline Analysis

Vintage submitted that cumulative gas production from the pool to February 22, 2003, was 6 bcf (169 10^6 m^3) and that daily production rates as of February 20, 2003, for all wells in the pool ranged from 0.8 10^3 m^3/d to 13.5 10^3 m^3/d.

Vintage calculated the recoverable gas from the entire pool to be 9.2 bcf (259 10^6 m^3) based on production decline analysis. The recoverable gas from the application area was determined to be 5.6 bcf (158 10^6 m^3) based on production decline analysis.

Although Vintage recognized that the subject pool was the only Badheart pool being produced in the province of Alberta, it believed that Cardium and Dunvegan pools would be reasonable analogs in determining the recovery factor. Vintage considered a recovery factor of 75 per cent to be appropriate for the pool. Because production decline analysis indicated a recovery factor of 30 per cent for the pool using the OGIP determined from volumetric analysis, Vintage believed that infill drilling would improve recovery.

Material Balance Analysis

Vintage stated that the OGIP determined from material balance analysis was prone to be inaccurate, considering the heterogeneous nature of the pool and the difficulty in obtaining a representative average reservoir pressure. Vintage submitted that there was a large variation in pressure data throughout the pool, which suggested a very complex reservoir with varying permeability. However, Vintage noted that the OGIP of 23 to 35 bcf (648 to 986 10^6 m^3) estimated from its material balance calculations supported the OGIP determined from volumetric analysis. Vintage stated that Paramount's material balance work omitted pressure data recorded in February 2002 and July 2002 at the 00/16-27-068-22W5/0, 02/11-34-068-22W5/2, 02/05-35-068-22W5/0, and 00/12-36-068-22W5/0 wells, which were at higher reservoir pressures. By not incorporating these data, Vintage believed that Paramount had underestimated the OGIP determined from material balance analysis.

Simulation Study

Vintage questioned the model simulation work performed by Paramount. Vintage did not believe the input data for the model to be representative of known pool parameters, such as net pay, and therefore questioned the model results with regard to the OGIP and anticipated incremental recovery. Vintage stated that the model had initially been structured to evaluate drainage impacts on Paramount lands if infill drilling were to occur within the area of application. Vintage stated that the OGIP used in the model seemed quite sporadic from section to section and did not appear to honour existing production characteristics or geological mapping. In addition, permeability inputs in the model were much higher than those obtained from well test analysis, with the greatest discrepancy seen for wells within the application area. Vintage questioned the simulation results because only one well configuration could be modelled at a time. Vintage also believed that because the model was matched to the existing well performance, it could only estimate the amount of reserves that the existing wells would drain. Therefore, Vintage did not believe the model to be appropriate for determining the OGIP and assessing the need for reduced well spacing.

Conclusion

Based on the expected recovery factor of 75 per cent and the estimated OGIP of 22.3 bcf ($627\ 10^6\ m^3$) within the application area determined from volumetric analysis, Vintage estimated that the recoverable gas reserves would be approximately 16.5 bcf ($465\ 10^6\ m^3$) within the application area. Because production decline analysis indicated recoverable gas reserves of 5.6 bcf ($158\ 10^6\ m^3$) within the application area, Vintage estimated that 11 bcf ($307\ 10^6\ m^3$) of incremental gas reserves could be obtained from infill drilling in the area of application.

Vintage concluded that additional wells were required within the area of application, as the existing wells were experiencing limited drainage due to the limited permeability within this portion of the pool.

5.2 Views of the Intervener

Geology

Paramount described the reservoir as being 3 to 6 m thick, occurring at a depth of about 570 to 600 m below surface. The depositional environment was a lower shore-face marine environment along an approximately north-south trend. Paramount identified the core data as being very limited (one complete core and one partial core), with core porosity ranging from 5 to 25 per cent and core permeabilities ranging from less than 1 mD to over 450 mD. Paramount testified that the permeability of the pool was in the 30 mD range, which it considered to be good permeability for a gas pool.

It was Paramount's interpretation that the Badheart sand could be subdivided into at least three units, the upper sand being the one with the highest porosities and showing a clean gamma ray profile. Paramount interpreted all three sands to be distinguishable in the central portion of the pool. On the western and eastern edges of the pool, the upper sand was usually absent, resulting in a less productive and tighter reservoir. In order to map the extent of the Badheart pool, Paramount utilized a 15 per cent porosity cutoff. In addition, a 50 per cent shale volume cutoff was used.

Paramount did not dispute Vintage's view that there were variations in reservoir properties, such as permeability in the pool. However, Paramount considered that even though there were variations in permeability, the magnitude of the permeability was such that infill drilling was not required to drain the pool.

Aquifer

Paramount recognized that some wet Badheart formation wells had been drilled to the south. However, Paramount believed that the aquifer did not have a significant impact on the existing wells.

Volumetric Analysis

Paramount calculated an OGIP of 40 bcf (1127 10^6 m^3) for the entire pool based on volumetric analysis. For the application area, the calculated OGIP was 23 bcf (648 10^6 m^3). Paramount was in agreement with Vintage's volumetric estimate of gas reserves. However, Paramount suggested that volumetric mapping was not reliable in determining pool reserves.

Production Decline Analysis

Paramount agreed with the estimated recoverable gas determined by Vintage based on exponential production decline analysis. However, Paramount testified that if a proper hyperbolic decline analysis were performed, some of the wells would be found to have more recoverable reserves than estimated by Vintage.

Paramount suggested that a variance in the reserve determination by volumetric calculations versus decline analysis was not a definitive determinant of the need to drill infill wells. Paramount stated that as one went further into the life of a pool, more reliance should be put on pressure and production data.

Material Balance Analysis

Paramount stated that the OGIP ranged from 10 to 15 bcf (282 to 423 10^6 m^3) based on material balance analysis. It considered the OGIP to be reasonable based on the number of wells and the significant level of depletion (approximately 40 per cent in the pool). Paramount stated that the reservoir pressure in July 2002 varied from 3 to 4 megapascals (MPa), with an estimated weighted average of 3.3 MPa. The exception was the tighter fringe wells, which were depleting more slowly. Paramount suggested that its material balance analysis was more representative of the reservoir than Vintage's analysis because it was more weighted towards wells that were on production and within a representative part of the pool where the infill drilling was being proposed. Paramount stated that including reservoir pressures from the fringe wells distorted the OGIP estimate. Paramount recognized that reservoir pressure measurements taken in the 00/16-27-068-22W5/0, 02/05-35-068-22W5/0, and 00/12-36-068-22W5/0 wells in February 2002 recorded pressures close to the initial pressure and were evidence of permeability variation in the pool.

Simulation Study

Paramount indicated that the reservoir simulator used was more sophisticated than a simple tank model but not as complex as a finite element simulator. Paramount testified that the model was capable of accurately simulating the pool. The original model simulation work described in the March 11, 2003, submission analyzed and history-matched 26 wells to determine reservoir characteristics, remaining reserves, and the effects of infill drilling. The updated model described in the March 26, 2003, submission incorporated production data to the end of December 2002, information from well test analysis performed by Paramount, two additional wells that were not on production at the time of the original modelling, and the seven proposed infill wells (instead of the six originally provided by Vintage). Paramount stated that the model achieved an acceptable match of individual wellhead flowing pressures and rates and obtained a good match on static bottomhole pressures. Paramount testified that a satisfactory history match

could not be obtained without reducing the net pay (i.e., without reducing the pore volume determined from volumetric analysis).

Paramount indicated that the model was limited by the lack of flow and buildup tests, the lack of permeability data from well tests, the ability to only model one well configuration at a time, the ability to only model one geological layer, and not being a finite difference simulator.

Paramount explained that the pool's performance determined from the model results did not support the volumetrically determined reserves. Paramount stated that the pool's performance in the updated model suggested a much smaller OGIP of 14.6 bcf (412 10^6 m^3) in the entire pool. In addition, the updated model predicted that 12.2 bcf (345 10^6 m^3) of gas would be recovered with the existing wells without taking into account economic limits. In Exhibit No.7, Paramount's March 11, 2003, submission, Paramount's original model estimated a OGIP of 13.5 bcf (380 10^6 m^3) and a recoverable gas-in-place of 10.1 bcf (285 10^6 m^3) with the existing wells. Paramount indicated that modelling was made more difficult because the wellbore configuration in many wells changed to coiled tubing in early 2002. However, Paramount indicated that the consistency of the OGIP estimated by the two model runs gave confidence in the model results.

Based on the history match of wellhead pressures and flow rates, Paramount determined that the reservoir had good permeability throughout, although the permeability did vary from 5 to 170 mD in the original model. Paramount submitted that the permeability in a major portion of the reservoir was greater than 50 mD.

Paramount's updated model indicated that the permeability of the pool varied between 5 and 55 mD. Paramount stated that the relatively high permeability in the pool meant that there was a high level of communication that would exist between most wells if the reservoir was continuous. Paramount testified that it was possible but not probable that incremental recovery could be obtained from drilling infill wells.

Paramount submitted that the discrepancy between the volumetric reserves and model-generated reserves may be due to the lower sand potentially contributing only a small portion of the total pool reserves. In addition, Paramount testified that water saturation and mineralogical effects on the log-derived porosity values may reduce the effective pore volume.

In Exhibit 9, Paramount stated that the initial seven infill wells proposed by Vintage would produce 1296 MMcf (million cubic feet) (36.5 10^6 m^3) of gas. The majority of the production would be from drainage of offset properties (883 MMcf, or 24.8 10^6 m^3), and very little incremental recovery was expected (413 MMcf, or 11.6 10^6 m^3).

Paramount stated that the simulation study demonstrated that its lands will be drained if downspacing were approved. Paramount said that the simulation study revealed that no significant measurable increase in hydrocarbon recovery would be obtained from infill drilling. The only benefit would be the acceleration of gas production.

Conclusion

Based on model simulation, Paramount estimated that 413 MMcf, or 0.4 bcf (11.6 10^6 m^3), of gas would be obtained by drilling the seven proposed infill wells. Paramount concluded that there was no need for reduced well spacing to economically drain remaining reserves and that additional downspacing would result in unfair drainage.

5.3 Views of the Examiners

The lack of directly correlatable geological analogs for this pool presents some difficulty in predicting its performance and estimating a reasonable recovery factor. The examiners note that the geological interpretation and mapping as presented by the applicant and the intervener are comparable.

The examiners accept Vintage's and Paramount's view that the aquifer inferred to be present to the south of the pool appears to be inactive, based on the available production and pressure history. Therefore its presence should not be a factor in assessing and interpreting pool performance.

The examiners note that Vintage and Paramount were in general agreement on the OGIP within the area of application as determined from volumetric analysis. The examiners also note that Vintage and Paramount map a similar areal extent of the pool. The examiners agree that the OGIP determined from volumetric analysis is a reasonable estimate of gas reserves.

The examiners note that Vintage and Paramount were in general agreement on the amount of recoverable gas determined from exponential production decline analysis. Although the examiners concur with the amount of recoverable gas-in-place determined from exponential production decline analysis, that amount is believed to be a conservative estimate considering that reservoirs with high permeability variations tend to decline along harmonic trends. Therefore, it is anticipated that the amount of recoverable gas will be somewhat higher than predicted by Vintage.

The examiners concur that uncertainties exist in the OGIP determined from material balance analysis because of the wide variations in reservoir pressure measurements performed in the pool to date and the lack of pressure measurements available in the interior of the pool in 2002 and 2003. For this reason, the examiners are reluctant to give preference to the OGIP determined from material balance over the OGIP determined from volumetric analysis. Pool pressure testing has not kept pace with the rate of development; consequently available pressure data are generally limited to initial well tests. Additional testing as part of the routine *Guide 40: Pressure and Deliverability Testing Oil and Gas Wells* annual pool survey for 2003 and testing of any new infill well would greatly assist in determining the OGIP from material balance analysis. However, variations in the available reservoir pressure measurements and in initial production rates indicate a heterogeneous reservoir.

The examiners recognize that model simulation can be a valuable tool to evaluate the depletion strategy for the pool. However, the examiners believe the limited static reservoir pressure measurements, limited permeability estimates (especially within the area of application), changing wellbore configurations, and relatively short production history of the pool reduce the confidence in the simulation results. Given the model limitations, the number of uncertainties in

the modelling inputs and the geological characteristics of the pool, the examiners believe that there is no compelling evidence to support the significant change in the net pay values and to discredit the volumetric estimate of the OGIP. In addition, use of a single permeability value over multiple sections is not considered to accurately reflect the heterogeneous nature of the reservoir. The examiners also note that the technical reasons that might explain the discrepancy between the OGIP estimate from model simulation and volumetric analysis were not clearly understood.

The generally low production rates for wells within the area of application and the limited recoverable reserves determined from decline analysis, compared to the OGIP determined from volumetric analysis, suggest that the existing wells are not effectively draining a one section drilling spacing unit.

The uncertainty in the reservoir characteristics of the pool and in the OGIP estimated from volumetric analysis, decline production analysis, material balance analysis, and model simulation indicate that the pool is not well understood in spite of the pool's two-year production history. Information expected to be available later this year will assist in evaluating the optimal depletion strategy for the pool. However, the examiners are satisfied that the large variation in producing characteristics and pressure information is clearly indicative of a reservoir that would benefit from additional wells. The examiners conclude that there is a significant amount of gas reserves that will not be produced by the existing wells. In addition, the examiners note that there is no evidence to suggest that increased production due to infill drilling would be detrimental to recovery.

6 LOCATION OF PROPOSED INFILL WELLS

6.1 Views of the Applicant

Vintage stated its initial plans were to drill seven infill wells. The first well was to be drilled at 10-14-069-22W5M, the second well was to be drilled at 6-11-069-22W5M, and the third well was to be drilled at 7-9-69-22 W5M. The remaining four wells were to be drilled at 12-2-069-22W5M, 13-3-069-22W5M, 10-15-069-22W5M, and 3-24-69-22 W5M, in no particular order. Vintage stated that it did not have plans for three wells in a section at this time. Vintage noted that all wells were "interior" locations, none of which was closer to Paramount lands than the existing wells. Vintage stated that the seven well locations were chosen to drain areas between existing wells that it believed were not being effectively drained by the existing wells. The locations were also based on proximity to existing pipelines (thereby minimizing tie-in expenditure) and surface issues pertaining to land owners who did not want wells on certain quarters and topographical constraints due to the many creeks in the area. These seven well locations, however, were not firm at this time and were subject to approval by Vintage management and surface owners.

Vintage stated that if the pressure information obtained during phase 1 indicated that incremental recovery was not going to be achieved, then further infill drilling would not take place. Vintage also stated that it had no intention to drill 44 infill locations, which could be permitted under a three well per section approval. Vintage explained that approval of up to three

wells per section, restricted only by a minimum interwell distance and buffer distance requirement, would offer the greatest flexibility in determining the ultimate drilling locations.

6.2 Views of the Intervener

Paramount stated that any well drilled in the area of application would ultimately have a negative impact on it due to the permeability of the pool and the communication already shown to exist between wells drilled on full section spacing. Paramount stated that if the applications were granted, it would then be forced to drill uneconomic wells to mitigate drainage created by Vintage's infill wells.

Paramount testified that if the applications were approved, it considered infill wells in the western and central region of the pool to be reasonable initial infill locations. Paramount had concerns with drilling an additional well in Section 11-69-22W5M because of the proximity of Section 11 to Paramount's well located at 02/11-01-069-22W5.

6.3 Views of the Examiners

Given the uncertainties that exist in determining the optimum pool development strategy, the examiners believe a phased approach to pool development is reasonable. Therefore, the examiners support Vintage's plans for the phase 1 drilling of seven additional wells, which would be tested and evaluated to assess the need for and location of the next phase of drilling. In addition, considering Paramount's concerns over drilling infill wells in sections close to its lands, the examiners favour initial infill locations in sections not directly offsetting sections where Paramount has a working interest.

The examiners recognize that a number of agreements have been reached with other working interest owners and surface owners in regard to the future well locations. Additional discussions would be necessary before applications for well licences are filed.

7 NEED FOR ADDITIONAL INFORMATION ON THE POOL

7.1 Views of the Applicant

Vintage stated that the best way to obtain information was to drill additional wells. However, Vintage noted that drilling of additional wells would not be considered unless the wells would be allowed to produce. Vintage believed that the available data demonstrated that improved recovery would be obtained as a result of reduced well spacing.

7.2 Views of the Intervener

Paramount stated that Vintage had not presented credible evidence warranting approval of the subject applications. Paramount suggested that interference testing was needed to evaluate communication between wells and that pressure measurements were required for wells offsetting the proposed infill locations in order to estimate the amount of incremental reserves that would be obtained from infill drilling. In addition, it stated that the 2003 pressure survey requirements should include flow and buildup tests to allow the determination of key reservoir characteristics

and performance indicators, such as permeability and radius of investigation. Paramount concurred that infill wells and the pressures obtained from those wells would be useful.

Paramount stated that the analysis of the impact of infill drilling had been limited by poor and insufficient pressure data (well tests) and lack of adequate core samples. Paramount suggested that a downspacing program should only be considered with the benefit of current pressure data in the area of application. These data could be obtained in either of two manners: 1) by a properly designed and conducted program of pressure buildup surveys on a portion of the gas producers in the pool, or 2) Vintage could proceed with drilling and completion of infill wells at its discretion and obtain reservoir pressure measurements that would clearly demonstrate the degree of drainage within the pool. Unless and until one of these options was undertaken, Paramount stated that there was no justification for approving the subject applications.

Paramount stated that further study was required to definitely prove that discontinuities exist in the reservoir. This would involve conducting additional pressure tests over and above minimum EUB requirements to evaluate depletion.

7.3 Views of the Examiners

Considering that there are no established analogs from which to draw information and the limited reservoir pressure information available for the pool, the examiners believe that additional pressure surveys for existing wells above those normally specified by *Guide 40* are required to ensure that an accurate and useful pressure history is obtained for the pool. However, the examiners also believe that data from new infill wells would be critical to fine tuning depletion planning and ultimate spacing needs.

At a minimum, the examiners believe that a requirement for approving reduced spacing should include flow and buildup tests for the first three infill wells in order to determine the formation permeability, potential reservoir boundaries, and reservoir pressure. As part of the required 2003 annual pressure survey schedule, static gradient reservoir pressures meeting *Guide 40* requirements must be carried out on wells within a representative cross-section of the pool, including the interior and fringe portions of the pool. Pressure measurements must be submitted to the EUB for quality review to ensure that this requirement is met.

8 EQUITY

8.1 Views of the Applicant

Vintage stated that if the applications were granted, the potential for drainage of Paramount's lands by additional wells would be minimal. Vintage further stated that if drainage of Paramount's lands did occur from any additional well(s), Paramount had a similar opportunity to apply for reduced spacing on its lands. Vintage did not dispute that its well at 03/05-12-069-22W5/5, within the area of application, appeared to be draining some reserves from Section 1-69-22W5M, as indicated by an initial pressure of 3731 kPaa measured in the 02/11-01-069-22W5/0 well on July 4, 2002. Vintage suggested that reduced spacing was also needed in Section 1-69-22W5M but stated that a holding application was not made because of the mixed ownership in the section and because a well was not drilled in the section at the time the subject

applications were originally submitted.

Vintage stated that the proposed 200 m buffer protected the correlative rights of offset mineral owners.

With regard to the existing plant and pipelines, Vintage stated there was capacity for any additional gas produced from the pool because one of the pipelines that had been carrying gas from the Gething Formation was no longer in use.

8.2 Views of the Intervener

Paramount stated additional wells would only accelerate production from the pool and would not lead to any significant incremental recovery of gas. Further, if the applications were granted, a large volume of gas produced from the additional wells would be a result of drainage from Paramount's lands. Paramount deemed any drilling of additional wells to be uneconomic because the only benefit was rate acceleration.

Paramount stated that its interest wells to the south at 00/12-36-068-22W5/0, 00/06-02-069-22W5/0, and 02/11-01-069-22W5/0 would be the most negatively impacted by the initially proposed infill scheme. Paramount predicted that the impact of infill drilling on these three wells to be 43 MMcf ($1.2\ 10^6\ m^3$) based on the updated model results presented in Table 1 of Exhibit 9. Paramount stated that Vintage had made no attempt to quantify the drainage to offsetting mineral rights owners. Paramount also stressed that the impact of infill drilling was likely underestimated.

Paramount stated that if the applications were granted, it would prefer that any wells that exhibited an initial pressure below 4000 kPa, indicative of 10 per cent depletion, would not be allowed to produce. Paramount also believed any infill well should be rate restricted to 500 mcf/d ($14\ 10^3\ m^3/d$).

Paramount also expressed the concern that, dependent on the number of additional wells drilled by Vintage, its production could be backed out of the existing Vintage plant due to pipelines operating at higher volumes and hence a higher pressure.

8.3 Views of the Examiners

The examiners considered what well density would represent orderly and efficient development and an optimum level for gas conservation. Once this is established, drainage concerns may be reduced by drilling appropriate, competitive wells. The examiners recognize that if the well density exceeds an optimum level, subsequent wells targeting a small resource may not be orderly or economic. In such a case, an equitable balance may not be reached by drilling offset wells and unfair drainage may occur.

The examiners support the view of a heterogeneous pool that has an OGIP that is not adequately drained by the existing wells. The examiners believe that the 200 m buffer zone and localized variation in reservoir characteristics minimize the potential for offset drainage caused by a second well in a section. Further, the examiners believe that there are sufficient reserves to warrant a competitive well if Paramount chooses to drill a well to mitigate any offset drainage

that may occur. Additional data are required to fully assess reserves and potential offset drainage prior to considering approval of the applied-for three wells per section. The examiners believe a phased development with information exchange among all parties after each drilling phase would be an appropriate way to gauge the need for and impact from further reduced well spacing.

The examiners believe that the impact of infill drilling on pipeline pressure and the potential of Paramount's gas to be backed out of the pipelines/plant are not factors for denial of the applications. Vintage has plant capacity and has guaranteed Paramount access to the plant and would work with Paramount if production restrictions occurred due to increased wellhead pressures resulting from infill drilling. The examiners note that there are regulatory options if agreement cannot be achieved.

9 CONCLUSION

The examiners conclude that the applications should be approved in part. Special gas well spacing of two wells per section is considered to be more appropriate than the requested three wells per section. Within each holding, a producing well must be 400 m from any other well producing from the same pool and a producing well must be at least 200 m from the boundaries of the holding, as requested. As a condition to the approval, additional pressure measurements as indicated in Section 7.3 and Attachment 2 must be performed.

It is the EUB's responsibility to ensure that a pool is developed in a manner that optimizes recovery of the resource and reflects orderly and efficient development. Although discrepancies exist in the interpretation of the OGIP, the examiners believe there is enough evidence supporting the need for additional wells. Special gas well spacing of two wells per section is considered appropriate to efficiently recover gas in the Sturgeon Lake South Badheart A Pool based on the presently available information.

DATED at Calgary, Alberta, on June 16, 2003.

ALBERTA ENERGY AND UTILITIES BOARD

[Original signed by]

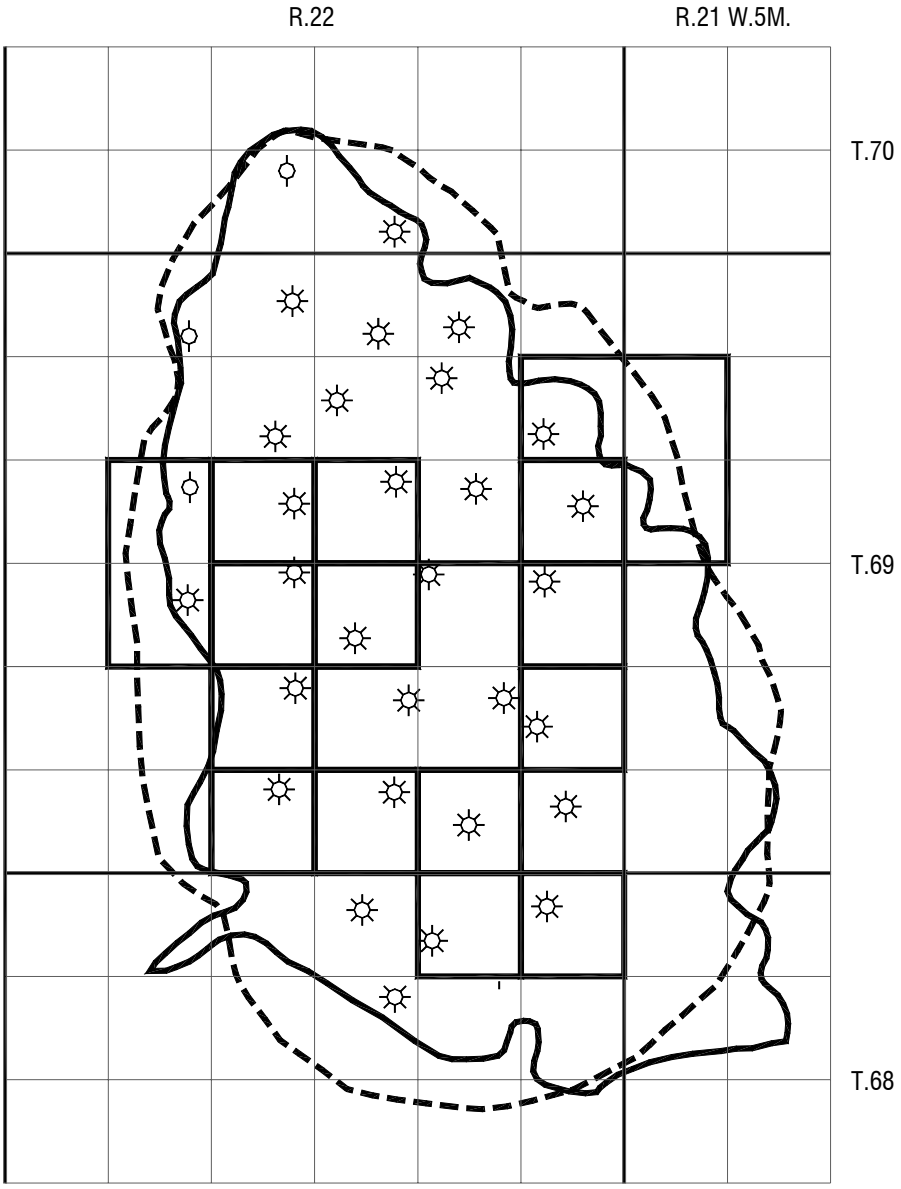
R. J. Willard, P.Eng.

[Original signed by]

W. Elsner, P.Geol.

[Original signed by]

T. Pesta, P.Eng.



Sturgeon Lake South Field

Applications No. 1257887, 1257896, 1257979, 1257980, 1257981, 1258046, 1258113, 1258114, 1258115, 1258288, 1258293, 1258295, 1258298, and 1258348

Vintage Petroleum Canada, Inc.

Decision 2003-049

ATTACHMENT 1: SUMMARY OF RESERVES

	Entire pool				Application area			
	Vintage		Paramount		Vintage		Paramount	
Reserves	**(bcf)**	**(10^6 m^3)**	**(bcf)**	**(10^6 m^3)**	**(bcf)**	**(10^6 m^3)**	**(bcf)**	**(10^6 m^3)**
Original gas-in-place								
Volumetrics	31	874	40	1127	22.3	627	23	648
Material balance	23-35	648-986	10-15	282-423	-	-	-	-
Model simulation	-	-	14.6[a]	412[a]	-	-	-	-
Recoverable gas-in-place[b]								
Decline analysis	9.2	259	-	-	5.6	158	-	-
Volumetrics	-	-	-	-	16.5[c]	465[c]	-	-
Model simulation	-	-	12.2[a]	345[a]	-	-	-	-
Incremental recovery with infill drilling								
Volumetrics minus decline analysis	-	-	-	-	11[d]	307[d]	-	-
Model simulation	-	-	-	-	-	-	0.4[e]	11.6[e]

[a] Source: updated model results in Exhibit 9, Paramount's March 26, 2003, submission.
[b] Recoverable gas-in-place without drilling infill wells.
[c] Based on a 75 per cent recovery factor.
[d] Based on full development.
[e] Based on the seven proposed infill wells.

ATTACHMENT 2: SUMMARY OF CONDITIONS

The Board expects the applicant to fully carry out the conditions below or advise the Board if, for whatever reason, it cannot fulfill the conditions. It is at that time, that the Board will assess whether the circumstances of the failed conditions may be sufficient to trigger a review of the original approval.

1) Flow and buildup test must be completed in the first three infill wells in order to determine the formation permeability, potential reservoir boundaries, and reservoir pressure.

2) In the required 2003 annual pressure survey schedule, static gradient reservoir pressures meeting EUB *Guide 40* requirements must be carried out on wells within a representative cross-section of the pool, including the interior and fringe portions of the pool. Pressure measurements must be submitted to the EUB for quality review to ensure that this condition is met.