ARGUMENT FOR THE JOINT REVIEW PANEL
By Henry Binder

Introduction

All of the reservoir engineering evidence taken together paints a very simple picture. The Milk River formation is comprised of tight rock as shown by the geological evidence, but it is also virtually all hydraulically connected, as seen from the pressure data, so virtually all rock in the reservoir contributes to production.

Roughly speaking, at the farthest distances from existing wells, there is tight rock still under relatively high pressure. This rock is helping push gas through existing wells, but the specific gas in this location will largely never actually be recovered through existing wells. It appears trapped but is contributing to production. After infill drilling, pressure at the infill locations drops. This results in reduced production of existing wells, first through less capture from the high permeability flow units and ultimately though less capture from the tighter rock that feeds into the flow units.

The reduced production from existing wells is a consequence of well interference which contributes to accelerated production. What happens in this typical situation is illustrated in Figure 2-3 A (Ex 006-039). To arrive at incremental production, the light blue wedge representing accelerated production must be subtracted from the dark blue wedge on the other side of where the curves cross. Although Figure 2-3 A is illustrative only, it reflects the typical situation seen in the M&B analysis (Ex 006-025)

I would urge the Panel to accept the evidence in the GLJ Petroleum Consultants Ltd. ("GLJ") report, which EnCana now appears to agree with, namely, that well interference and accelerated production increase with well density and that this causes incremental recovery per infill well to decrease at higher well densities.

Although EnCana's geological knowledge of the area is sound, it has misused that knowledge to create a vision of the reservoir as one without well interference or acceleration effects. This vision is reflected in EnCana's Figure 2-3 which shows existing well production carrying on as though infill had never occurred, with total production being bounded from below by existing well production. It is apparent that these curves can't cross even at the 16 wps density, so accelerated production is precluded in EnCana's analysis.

Over time EnCana has slowly abandoned key aspects of its vision in the face of credible evidence to the contrary. It nevertheless is trying to save what it can of its analysis, especially its result of 125 Bcf for incremental recovery. As a consequence, EnCana's evidence is burdened with shifting ground and inconsistencies, as it now tries to incorporate more reality into its position. This circuitous route to the truth indicates that

EnCana's evidence is unreliable, especially where it is in conflict with the analysis of Martin & Brusset Associates ("M&B").

M&B has provided the Panel with an independent evaluation, suitably qualified to point out possible sources of weakness or error. The analysis has not changed since it was first reported. It is respectfully submitted that the M&B evaluation, including all the necessary figures in support, should be accepted as providing the best evidence of incremental recovery for this reservoir.

DETAILS OF ARGUMENT

EnCana's Figure 4 (Ex 002-124) with some superimposed markings can be used to illustrate much of the disagreement between EnCana and M&B over whose method provides the better estimate of incremental recovery.

Figure 4

In the figure EnCana's historical and forecast production for 6.5 wps drilling density is shown as the green line. The black line is transposed from M&B's Figure 3 (Ex 006-025) and represents M&B's historical and forecast production for 6.5 wps drilling density. M&B's historical forecast period lies between the two small black vertical lines and ends before the commencement of 16 wps infill drilling which occurs at the red dot.

The respective historical forecast periods and forecasts are markedly different. To forecast ultimate recovery based on 6.5 wps density M&B restricted its historical forecast period to where 6.5 wps density actually existed. To forecast the same ultimate recovery, EnCana uses data mostly from the period where well density is actually 16 wps. This means that EnCana's estimate of ultimate recovery for the 6.5 wps density must be understated. It is based on 16 wps recovery, and according to GLJ, there is diminished recovery per infill well at higher densities.

EnCana now appears to adopt GLJ's view as indicated in the following statement: "So although we see interference at the pressure level, at the PID level, and although we see interference at the diminishing returns level, as we subsequently drill more, we have not seen it through a decline curve yet." (TR v.6 p.1166) EnCana nevertheless proceeds with an analysis inconsistent with this position and supplies a result that must be incorrect.

EnCana doesn't seem to appreciate that GLJ's conclusions about diminishing recovery are based on the Plot 1 data points (Ex 003A-009 p.88) which were obtained from decline analysis. So EnCana accepts the GLJ result but in accordance with its no interference vision attributes the huge drop in production after the red dot to surface effects. This failure to recognize a significant drop in production, causes EnCana to seriously overestimate incremental recovery. For EnCana this nevertheless reinforces its confidence in its previous estimate. In regard to the outcome EnCana states: " You know,

coupled, coupled with the fact that, you know, every time we present these curves to senior management or to, to this Panel, we are always presenting a 90% probability. So inherent in the 90% probability is, every time you do an update, likely as not, your estimates will creep up, they will be moving up towards the P-mean." (TR v.6 p.1176)

Well Interference or Surface Effects

EnCana indicates that interference will ultimately be seen in a decline curve(TR v.6 p. 1167). Since this statement is made in the context of declines only exhibiting surface effects, such as back-out issues it is helpful to discuss this comment by referring to Figure 4. Essentially, EnCana's internal analysis does not recognize that there is a significant change in the trend of the green curve at the red dot. EnCana asserts that the curves in Figure 4 do not show deviation from the existing decline plots and that therefore they don't reflect any interference effects through the small silt stringers (TR v. 6 pp.1176-77).

EnCana is likely right about the effect through the small silt stringers being delayed but this doesn't address the issue. M&B indicates that a significant decline trend, the black line, is established before the red dot. The explanation that appears reasonable in light of the current evidence is that the initial drop in production after infill is associated to some degree with backout, which lasts from 3 to 6 months (Ex 006-017 p.13) Interference then appears in the high permeability streaks and stringers between wells (Ex 002-060 #JRP 12), being greatest in cleaner sand which behaves more conventionally (Ex 006-017 p.13). Later, the effects of interference extend into the small silt stringers and tight formations (TR v.6 p.1167). These reservoir influences are all captured in the shape of the green decline curve which M&B indicates ultimately shows lower decline results for the pre-infill wells because of 16 wps infill drilling. (TR v.8 p.1799 and 006-035 p.4). M&B also points out that since the infill has been running for several years now, production is being driven by interference (TR v.8 p. 1797-1798).

M&B Analysis

In spite of its internal comparison results being incorrect, EnCana disagrees with M&B's internal analysis saying that M&B's choice of historical period for the 6.5 wps forecast is not suitable. M&B confirms however that a significant decline trend was established during the analysis period and that the impact of the additional wells on production (shown by the spike) did not have much impact on this trend. (002-035 p.3) (TR v.8 1777).

Since M&B's analysis recognizes the change in trend, its Figure 3 (Ex 006-025) shows two projections from the point where 16 wps infill occurs, one showing projected performance with 6.5 wps and a second, roughly equivalent to EnCana's, showing the steep drop in production of existing wells associated with infill drilling.

M&B's approach therefore incorporates the reality of diminishing return on incremental recovery into its work. Although EnCana doesn't do so, it is aware of the reality of diminishing returns (TR v.6 pp.1193-94).

Cross-examination of M&B

The validity of M&B's D6/D8 analysis was confirmed under cross-examination. Mr. Sedgwick pointed out in regard to the black line in Figure 4, that he was aware of the new wells that came on stream and that they did not affect the major trend on the decline curve (p.1776). On the refracturing issue EnCana is confused where it indicates "the decline analysis actually tracks through the blue line, not the green line, which has a 2bc difference". M&B doesn't know what EnCana is trying to get at here because the suggestion that M&B made a 2 Bcf mistake makes no sense. If one looks at Figure 3 of M&B's analysis it is clear that its analysis for the performance of pre-infill wells after infill takes into account new well production and even refracturing, as indicated by the horizontal trend and the end of the squiggly part of the curve labeled "Post Infill Forecast Pre Infill Wells". Also, as can be seen in M&B's Figure 5 (Ex 006-025) hyperbolic decline arrives at an ultimate recovery figure of 18.5 Bcf for this projection, which is the same, or even a little larger than what is shown in EnCana's Figure 4.

EnCana's cross-examination of M&B in regard to EnCana's Figure 3 (Ex 002-124) only reaffirms the correctness of M&B's work. The examination was in regard to EnCana's decline curve falling below a particular peak marking a swabbing event and M&B's curve shown in its Figure 6 (Ex 006-025) running through it. Firstly, M&B indicates that he doesn't think knowing the peak represented a swabbing event would change his graph (TR P1773 L22) Secondly, one wonders why EnCana now relies on its Figure 3, after indicating that readings from it aren't valid (TR v.2 pp.336-37). EnCana indicated instead that confidence should be placed in the figures contained in #JRP 7 (TR v.2 p.333). When one looks at the original representation, Figure 7c, (002-060 #JRP 7), in which EnCana does have confidence, it is readily apparent that EnCana's fitted curve goes through the same peak as M&B's curve.

Attributing Back – The Figure 2-3 Problem

In Figure 2-3 it is clear from EnCana's testimony that it is assuming the base wells will carry on and produce their 120 bcf (TR v. 2 pp.362-63) and that the blue area represents actual production of infill wells, assuming no well interference (Ex 006-039). EnCana however, has made various statements indicating that incremental production as depicted in Figure 2-3 doesn't change if acceleration effects happen to show up because they've attributed them to the base (TR v.2 p.363), or in EnCana's words: "So in that regard, maybe this is a good way to kind of explain how we've incorporated acceleration effects kind of and taken it out of the equation. We've attributed it to the base." (TR v.2 p.366). That incremental production is reduced by incorporating acceleration effects into Figure 2-3 has been demonstrated (Ex 006-039). EnCana's representation about attributing production back to the base appears to arise because it now realizes that it can no longer avoid the realities of well interference and accelerated production. It has to accept them, but won't admit that this acceptance also entails lower incremental recovery.

The problem with Figure 2-3 is readily appreciated by referring to EnCana's Figure 4. If the numbers from Figure 4 were depicted in a figure like Figure 2-3, incremental reserves

from Figure 4 of 5.5 Bcf would represent the blue area. The base production from the time of 16 wps infill would be represented by that portion of the red area that lies directly under the blue area. It is assumed to be unaffected by infill drilling, but because of well interference actual base production falls short of what it would have been in the absence of infill drilling. Total production can only be the sum of actual base production and incremental recovery. By assuming a greater base production than what is actually achieved, total production is exaggerated. That is why EnCana's forecast looks so odd, with total production being bounded from below by the existing well forecast curve (which is assumed not to change). The extent of the overstatement of the existing well forecast, assuming M&B's forecast for existing well production is correct, is about 22 Bcf minus 18.5 Bcf, or about 3.5 Bcf. Therefore, to properly reflect production possibilities that take well interference into account the blue area must drop down into the red area to a very significant extent.

EnCana's Figure 2-3 depiction of long term production forecasts is incorrect. That is why it is not consistent with EnCana's remaining life estimates for existing and infill wells. EnCana has now changed its remaining life forecasts to about 40 years for both infill and existing wells (TR v.6 p 1221). This is significant since the initial forecasts which indicated 20 to 25 years for existing wells and 20 to 40 years for infill wells (Ex 002-110 EIS v.1 p.2-8) were based on EnCana's decline analysis (Ex 002-060 #JRP 5). Presumably that analysis has changed, but Figure 2-3 has not.

EnCana's Offset Ring Analysis

In support of its approach, M&B points out the significant variability in ultimate recovery across the reservoir and for the D6/D8 pilot in comparison to the poorer surrounding sections. M&B points out that, unlike EnCana, GLJ Petroleum Consultants ("GLJ") who prepared Appendix H for the Great Sand Hills Regional Environmental Study used performance analysis and standard internal comparisons to evaluate the D6/D8 pilot (Ex 006-035 pp.2-3).

M&B points out that from GLJ's Plot 1 (Ex 003A-009 p.88) it is apparent that the D6/D8 pilot data points, the solid red squares, lie above the data points for the surrounding ring at all well densities, except for one anomalous outcome (Ex 006-035 p.3). This provides independent support for M&B's observation that the surrounding ring is of poorer reservoir quality than the D6/D8 pilot.

M&B points out that if EnCana had used an offset comparison within the NWA for their D14/D16 pilot evaluation, this would have resulted in zero incremental recovery, because the ultimate recovery of the offset with no infill drilling, 3.75 Bcf/section is greater than the recovery for the pilot with infill drilling, 3.5 Bcf/section (006-035 p.4)

In response EnCana produced its Figure 3 (Ex 002-124) to show that it could realize incremental recovery by using the surrounding ring as a comparison analog for the D14/D16 pilot. To arrive at this result EnCana had to revise its D14/D16 analysis and stretch ultimate recovery with infill from 3.3 Bcf/section to 4.4 Bcf/section. M&B points

out that this significant change would be questioned by a reserve auditor and is not justified by the data, which indicate no change (Ex 006-038 p.2). EnCana apparently failed to appreciate that this stretch also changed its internal comparison number from about 70 mmcf per well to 143 mmcf per well. EnCana now indicates that Figure 3 cannot be used to determine incremental recovery for it D14/D16 pilot, at least for the internal comparison (TR v.2 pp 336-37). This is surprising since the new internal comparison numbers are included in its Table 1 (Ex 002-124) and replace the earlier numbers determined from Figure 7c (Ex 002-060 #JRP 7).

The McDaniels Analysis

The Panel should attach very little or no weight to the McDaniel and Associates Consultants Ltd. ("McDaniels") letter (Ex 002-060 #JRP 7).

Firstly, the report refers to having done work on the pilot projects "including the offsetting D6/D8 pilot area". This indicates that McDaniels, just like EnCana, probably used the surrounding ring for comparison to evaluate incremental recovery for the D6/D8 pilot. McDaniels' work is therefore subject to the same criticism of overstating incremental recovery as EnCana's work.

If McDaniels did use the offset for comparison, this indicates that even though it is an independent reserve auditor its evaluation may have been very much influenced by EnCana's approach to this reservoir. It is possible that it also considered all production from infill wells to be incremental. We simply don't know. We do know that there were detailed sessions with EnCana where elements around decline analysis and reservoir models were discussed (TR v. 2 p.322).

Another concern arises out of the great variability in ultimate recovery and incremental recovery across the reservoir (Ex 006-035). Since McDaniels refers to having evaluated high density pilot plots in the area, this means they are referring to locations outside the NWA, since the NWA has only one internal pilot. So we don't have the specific information about location or performance of all these pilots necessary to determine how that information applies to this particular project.

Also, since the McDaniels evaluation is not on the record and was not presented, there could be no examination in regard to how it was done, what assumptions were made and so forth, which is the whole point of these proceedings. If the project could be appropriately evaluated on the basis of one page letters from experts, there would be no need for hearings.

In examination Mr. Denstedt points out in regard to EnCana's testimony regarding the McDaniels report that this is one more piece of information M&B didn't have (TR v.8 p.1779). What is more critical here is that the evaluation done by McDaniels is one more piece of information the Panel doesn't have. This was pointed out by Mr. Sedgwick in the following words: "Now, you claim that they, they were given specific information on this

Project. And I don't know understand, if they were, why their evaluation wasn't presented. All we got was a letter" (TR v.8 pp.1778-79).

Importance of Time

The end date for various analyses plays a significant role in determination of incremental recovery which can be seen in Figure 2-3 A (Ex 006-039). The acceleration component, represented by the light blue area, will typically require an extended time frame to cover off what initially appears to be incremental production. This is also evident in the M&B analyses where the decline results are all presented (Ex 006-025).

In cases where we simply have a number for incremental recovery, such as the McDaniels analysis or the GLJ study we don't know how end rates were determined. The GLJ study doesn't include its decline analyses for the D6/D8 pilot in its report, but the other declines included in the report show end dates only extending out usually less than 26 years and often less than 20 years. This will of course, produce a much higher result for incremental recovery than if production with acceleration effects were extended out 40, or even 60 years as in one of the M&B hyperbolic forecasts.

So, although the GLJ conclusions may be reliable for some comparative purposes and general insights, they can't be relied upon to determine actual incremental recovery for this particular pilot. This apparent from Plot 1, where it is apparent that using the actual red square to calculate incremental recovery would result in a significant change in incremental recovery per infill well.

Additional Observations

EnCana initially indicated that drainage area is an inappropriate concept for unconventional reservoirs because of the associated geological model and flow mechanisms (Ex 002-060 #JRP 12). This is typical of EnCana's reliance on complex information that only it has access to. Now EnCana discusses the reservoir in terms of drainage area (TR v.6 p.1162).

EnCana initially discusses zero incremental recovery for 32 wps density in a context that made it very clear it was discussing a physical limitation. It points out that "Facilities and economics were considered separately" and that it believed its model outcome of little or no incremental reserves was directionally correct. When it came to appreciate that this did not fit at all well with its notion of isolated trapped gas, it revised this view to incremental recovery being not sufficient to cover incremental environmental and economic costs (Ex 002-082 p.3).

EnCana has not provided the Panel with their rate vs. time declines which would indicate the extent of accelerated production and therefore the extent to which their estimate of incremental recovery is overstated.

Only M&B has provided a consistent long term evidence regarding the production from this reservoir. This longer term analysis may not be typical, but is necessary to assist the Panel in arriving at its recommendations.

EnCana's criticism of other work is often completely unfounded. Consider EnCana's criticism of my report (Ex 006-025) for applying an end rate of 5Mcf per well per day. The criticism leveled was that the report hadn't considered the "physical characteristics of the reservoir and the characteristics of the gathering system" nor that the production rate at which a field is abandoned is a function of the total rate from the field so that employing abandonment rate per well is not appropriate (Ex 002-110 p.97). Ironically it turns out that the only consideration EnCana applies to its pilot evaluations is an abandonment rate of 5Mcf per well per day. (TR v.2 p.340)

In addition to its Figures 3 and 4 (Ex 002-124) EnCana demonstrates its creative use of decline results in its Figure 7b (Ex002-060). Even though its abandonment rule is 5 Mcf/well per day the total abandonment rate for the infill case is actually lower than the total abandonment rate for the pre-infill case; also note that the end result of 118 mmcf/well for incremental recovery is obtained by very accurately reading from the horizontal scale at the respective end rates. The end rate at 16 wps section actually amounts to only about 1.9 Mcf/day per well, but does permit the high result for incremental recovery. If the 5Mcf/day/well were uniformly applied, readings from the graph would indicate incremental recovery of about 75 mmcf/infill well. Had a hyperbolic decline been used, the M&B report suggests that the number would have been far less.

Acceleration Project

M&B's conclusion regarding its economic evaluation of the project is as follows: "Our economic analysis demonstrates that even with low incremental reserves the acceleration potential provides a significant incentive to infill drill." (Ex006-025 p.6) M&B further points out that the value of oil and gas reserves are determined by discounting, so that the sooner a Mcf of gas is likely to be produced the more value it has to the reserve (Ex 006-038).

The acceleration component indicates that EnCana is drilling to recover some additional gas but also significantly to simply get the gas out faster to increase profitability. The true infill story may be partly to avoid wasted gas, but as M&B's analysis shows it is largely a story about just getting the gas out faster to increase profit. There is no doubt that the tight formations in this reservoir provide the perfect opportunity for an acceleration project.

As M&B points out, EnCana has not provided its rate vs. time projections which would show the acceleration component and has instead chosen to misrepresent rate vs. time as a different analysis technique (TR v.2 p.367) (Ex 006-038 p.3).

Economics

Dr. Power makes the point that it would be economically irrational to risk irreversible damage to a unique and valuable area like the NWA for the incremental recovery that could be gained. Also, that leaving some resource in the ground is not "waste" but instead an example of the environmental costs being so high that pursuing the natural resource doesn't' cover them. (Ex 006-037 p.3,4) EnCana has also arrived at a similar conclusion in regard to 32 wps development in the NWA. It states: "The incremental reserves at 32 wps are too small to justify the incremental environmental and economic costs" (Ex 002-082 p.3)

As the M&B report indicates, incremental reserves are much smaller than what EnCana's analysis forecasts. Using hyperbolic decline and given enough time (60 to 80 years), incremental recovery of zero is theoretically possible (Ex 006-025 p.7). The Panel must now consider whether the much smaller incremental amount justifies the incremental environmental and economic costs.