

January 19, 2007

Husky's Response to EnCana's Information Requests for Husky January 12, 2007

A) With respect to the Husky's Model Study Report dated January 8, 2007 please:

1. Provide the full results and reports of the Hycal Laboratory work referred to on pages 3 and 11-12. Please also provide any other laboratory data or tests for the Clearwater zone, whether used in the model or not, that Husky has not previously submitted.

Husky's Response:

We remind EnCana that the laboratory data mentioned on page 3 was provided in our response to EnCana's IR dated 2006-11-10.

We remind EnCana that viscosity data was provided in our response to EnCana's IR dated 2006-11-10. The relative permeability data is attached.

We believe that all encompassing request for information in the Clearwater that was not used in modeling of the effects of the gas cap depletion is irrelevant.

2. Provide the source and details of the geostatistical model referred to on page 5. If any data was incorporated from wells other than the four wells mentioned in the report please identify the wells and provide any data not previously submitted. Please provide the petrophysical evaluations and facies descriptions referred to on page 5 and any depositional environment work that was used as model input. Please indicate how many geostatistical realizations were developed and briefly discuss the criteria that were used in selecting the one that was used in the model.

Husky's Response:

See response to The Board IR 07.01.12 1a

3. Provide core analysis data (if possible similar to that submitted for confidential wells in Excel spreadsheet format) for AA/8-7-69-4W4, AA/13-8-69-4W4, and other nonconfidential Husky wells in the area with overburden plug data. It appears that the porosities for overburden plugs on Husky's wells are not available on the public record.

Husky's Response:

See response to The Board IR 07.01.12 1d and also see the attached CD for 2005 data.

Please note that the 2006 well data (15 wells) were sent earlier. Also note that, for the 2005 wells (10 wells), the commercially available public data base quoted Kmax values

are in fact Kv values and that Kv data is absent. However, data submitted by Husky to the Board is correct. Unfortunately, it has not been imported into the commercial data base correctly. Therefore, permeability values used in EnCana's simulation model as shown in Table 2 underestimate the actual measured permeabilities.

This is one example of non-uniqueness of history matching. EnCana's model can still match the piezometer data with wrong permeabilities. Results obtained in such a model can not assess the risk to bitumen resource accurately.

4. Confirm that, although a structural cross section is shown in Figure 2 on page 6, the 2D and 3 D models do not incorporate any structural data and employ a flat top and a tilted gas bitumen contact. If this is correct, why did Husky not incorporate its Top Clearwater Sand Structure Map (Figure IR6b-1) of the area or its Top Water Isopach (IR 06.11.10 2-2)?

Husky's Response:

See response to The Board IR 07.01.12 2d.

5. Provide all laboratory data referred to in discussing the shale layer on page 7. Please indicate whether Husky believes the permeability of 50 md and porosity of 10% assigned to the shale layer apply only to Husky's one section generic model or if they are appropriate values for the shale layers Husky has mapped in its Clearwater West Shale Isopach (IR 06.11.10 2-3 Nov 16 2006) and its Clearwater Shale Isopach (Figure IR3-1 October 24, 2006)

Husky's Response:

See response to The Board IR 07.01.12 2a.

6. Expand on the comment on page 6 that "several adjusted volume grid blocks were placed in the top gas zone". EnCana's preliminary review of the model input and output data indicates that the initial gas cap volume in the model was 2.4 10⁶m³ and the adjusted volume was 660.3 10⁶m³. Does this not effectively create an unconfined gas cap considering the relatively small bitumen volume in the model?

Husky's Response:

See response to The Board IR 07.01.12 2d.

7. Explain why Husky forced the model gas cap to deplete to 200 kPaa (page 8) before the start of SAGD or CSS production, as this appears to result in pressures throughout the model that are far below the current piezometer pressures. Please indicate the approximate time that would be required in the real world to achieve this level of pressure depletion throughout Husky's area of commercial bitumen reserves using Husky's estimated production declines in the Fisher Clearwater B and D pools. Please

explain why Husky chose to contrast what appears to be an unrealistically low reservoir pressure case with a case assuming no depletion. Is Husky planning on repressuring EnCana's gas pools before it commences its pilot?

Husky's Response:

Based on the available piezometer data, the current pressure depletion in the bitumen zone in the Caribou area ranges from 0.1% to in excess of 50% compared to the "initial" pressure. Therefore, the undepleted case in the generic model investigates the response of the reservoir in parts where there is small amount of pressure drop.

EnCana's intention is to produce these gas pools to an abandonment pressure of 200 kPa¹. EnCana's numerical simulation study starts the thermal recovery process at the current levels of gas cap and bitumen zone depletion. Therefore, it assumes that the thermal recovery operations will be commencing at all parts of the field right away. However, in Husky's case, we intend to implement an HSAGD demonstration project in 2010 in a 2.5 section area and if it is successful, then implement a commercial project in 2015 in the rest of our lease. There will be parts of the field that will be exploited long after the gas caps are abandoned. It is quite likely that the bitumen zone pressure in these zones will be depleted to levels that are significantly below the current levels. Our simulations show that if the gas cap is depleted to an abandonment pressure of 200 kPa, the bitumen zone pressures will decline to 300 kPa range.

There are two implications based on the aforementioned discussion: (i) EnCana's simulation study that only investigates the effect of gas cap depletion under current levels of gas cap depletion grossly underestimates the potential adverse effects on the bitumen recovery when the gas cap is abandoned. (ii) Husky's simulation study where the gas cap pressure is drawn down to the abandonment pressure characterizes the full extent of the potential risk to the bitumen reserve if EnCana continues to produce gas from the pools under question. The results indicate that there is a significant risk to the bitumen resource if EnCana is allowed to continue to produce these gas pools.

We hope that it is amply clear from the previous discussion that Husky does not intend to repressurize EnCana's gas pools.

8. Provide details on the comments on page 8 that "the depletion rates lead to pressure production over periods of time reasonably consistent with measured piezometer data" and on page 18 in item 3a "The pressure depletion observed in the field can also be duplicated in the simulation model". Please include the point in time at which pressure matches were observed, the piezometer pressures used, and how the model gas cap pressures at the time of the match relate to current estimated pressures in the Fisher Clearwater B pool. Why, after going to all the expense and effort to gather piezometer data, did Husky choose to model an area that includes only one piezometer well?

¹ Meeting with EnCana, Nov. 30, 2006

Husky's Response:

The piezometer data was necessary to prove conclusively that the bitumen zone pressures are being lowered by the depletion of gas caps in the area. This objective has been achieved. It has to be kept in mind that the selected model area had to contain enough wells to describe the geology sufficiently and yet had to be small enough so that the number of grid blocks would not become intractable.

The pressure decline rate from the piezometer data was reasonably well matched by the reservoir simulation model. These matches are shown in the attached plots. It is noted that the pressure decline rate observed in the reservoir simulation model is consistent with that of the field data (simulation values have been shifted in time to line up with first data point of piezometer data). The first plot shows the pressure decline rate from simulator together with straight line fits to the observed pressure data so that rate of pressure decline can be compared. Observed pressure decline rates are also shown on all the other plots as well. A comparison with pressure decline rate from all wells shows that the pressure decline rate of the simulations is comparable to that of the field data and is in fact conservative with respect to the well (16-7) in the area of interest.

A very important point to make is that no unusual modifications to the geology were used (such as non-geologically based reduced permeability barriers or transmissibility factors) to achieve the pressure history match.

9. Explain in more detail why the “The observed negative effect of gas cap depletion is expected to be more pronounced with larger well spacing” (page 8 item 3 e) and clarify what “observed negative effect” Husky is referring to.

Husky's Response:

Considering realistic well spacings of less than 170 m, as the well spacing is enlarged, the difference between the depleted and non-depleted cumulative oil production enlarges. This is the negative effect being referred to.

Initially in HSAGD, the SAGD wellpair and HWCSS well do not directly interact in that the steam chambers from each are not in direct contact. Later on, the steam chambers from both are large enough so that they become in direct contact with each other. A key benefit of the HSAGD process is the ability of the HWCSS well to become a producer-only well with steam being supplied to the combined chamber from the SAGD wellpair. This means that steam is injected through a single well and production occurs from two wells. Thus the economics of the overall HSAGD triplet pattern are improved over SAGD because only three wells are used instead of four. The larger the well spacing the longer it takes for the steam chambers to interact in the HSAGD process and thus the longer it takes to evolve to the single injector-dual producer operating state. If the well spacing is larger, then there is more reservoir between the SAGD wellpair and HWCSS well which under gas pool depressurization will become solution gas depleted. Thus, the oil in between the SAGD wellpair and HWCSS well becomes less “live” and its viscosity

goes up. Consequently, the larger the well spacing, the larger the impact of gas pool pressure depletion on HSAGD given the energy and time required to stimulate this larger amount of less “live” oil. Simulation runs have been done which confirm this result

10. Indicate the source of the critical gas saturation of 0.1% used in the models.

Husky’s Response:

The critical gas saturation used in the model is 2%. The liquid-gas relative permeability table shows that the critical gas saturation is 0.1%. This value is overwritten by the 'sgr' value of 2% in subsequent entries. For details, refer to the STARS Manual.

Typical critical gas saturations used in the literature are between 4 and 5% but it is not clear where these values originated. Given the mobile water in the reservoir, gas bubbles can be entrained in the water and the effective critical gas saturation would be reduced. Additionally, given that production GOR’s from the simulation are lower than that achieved in the field, this also suggests gas mobility should be enhanced and that the critical gas saturations can be below the 4% to 5% range. These observations are supported by theoretical work² which has shown that the mobilization can follow soon after nucleation of bubbles.

11. Quantify the effect on bitumen recovery in the model of each of the negative factors referred to in Husky’s conclusions on page 3 and 4. Since Husky’s HSAGD 2-D model runs show a higher cumulative oil production and presumably higher recovery level for its depleted reservoir case than for its not depleted case what specific negative impacts does the model (as opposed to technical papers dealing with other reservoirs and areas) indicate due to viscosity reduction, reduction of solution gas, mobile water migration to the gas cap, steam chamber communication with the gas cap, heat losses to the cap rock and the “other possible mechanisms”.

Husky’s Response:

Given the length of these runs, it is quite difficult to individually isolate and quantify the risk to the bitumen recovery for each of these factors listed. For instance just to investigate the effect of viscosity reduction would involve runs where a number of levels of viscosity reduction (probably 2 or 3) will have to be investigated for all 4 cases resulting in 12 new runs. The impacts of these factors on the performance of thermal processes have been well documented in the literature. Results reported in our submission are influenced by the combined effects of all these factors. We have provided scientific explanations as to why the risk to bitumen recovery is present in our results.

We provided a discussion for possible physical mechanisms for the reasons behind the increased risk observed in our study to the bitumen resource based on sound technical

² Tsimpanogiannis, I.N. and Yortsos, Y.C. The critical gas saturation in a porous medium in the presence of gravity. *J. Colloid and Interface Science.* **270**:388-395. (2004).

discussions and published papers. However, we do not see a similar approach in EnCana's submission.

12. Provide the input and output data for all economic evaluations, performed before January 8, 2007, that support Husky's eight references in the report to "downgraded" "adversely affected" or "poorer" economics.

Husky's Response:

Husky plans to implement an experimental HSAGD process that has the prospect of higher recoveries compared to a CSS operation. SAGD is not being implemented because the project is economically not attractive due to its lower oil rates even though the ultimate recovery remains the same compared to HSAGD. These economic runs are proprietary but it is obvious that Husky would rather implement a technology that is proven to work in the field (SAGD) as opposed to an experimental technology (HSAGD) which has not been applied anywhere before.

It has been clearly understood for some time that the economical attractiveness of a given thermal project, therefore whether it is implemented in the field or not, depends on the ultimate bitumen recovery, how quickly the bitumen is produced and the cSOR among other factors. For a good discussion on this topic, we refer to an earlier EnCana paper³. In fact it has been shown that the economics of a thermal project are more sensitive to the cSOR than to the oil production rate.

The following observations are made based on our simulation results. For HWCSS: the ultimate recovery is lower, the oil rate is lower and cSOR is higher when the gas cap is depleted. It is quite obvious that the bitumen resource is degraded and made economically less attractive. This is because ultimately less oil is recovered, the net present value of this oil is lower due to lower producing rates, and the operating costs are higher due to higher cSOR's. For HSAGD: even though the ultimate recovery could be slightly higher after 15 years of operation, the oil rate and the cSOR to this point is always higher for the depleted gas cap case. It should also be noted that higher cSOR means also higher initial capital investment for increased steam capacity. Again it is quite apparent that when the gas cap is depleted the risk to bitumen resource increases. This is because, the oil is produced slower resulting in lower net present value, the cost of recovering oil is higher due to higher capital costs and operating costs. Furthermore, the risks will be increased. The bitumen resource could be totally sterilized if the project becomes uneconomic for HWCSS or HSAGD due to gas cap depletion.

We do not understand the reference to January 8, 2007 date in the context of the question.

13. Husky indicated on October 4, 2006 in response to EnCana IR 1 that "Husky is currently conducting simulation studies with the intent of submitting a formal pilot application to the Board by the end of 2006. Since Husky has been working on these

³ Edmunds, N. and Chhina, H., "Economic Optimum Operating Pressure for SAGD Projects in Alberta", Journal of Canadian Petroleum Technology, Dec. 2001, Vol. 40, No. 12, pp. 13

studies for over three months it would appear that they have had time to model more cases than the simple one section generic model they have presented. If additional models or areas have been evaluated please briefly describe these models and the results.

Husky's Response:

With the resumption of delineation drilling in 2005, Husky collected new core and reservoir property data. With this new data, Husky initially performed a series of single well pair models to test the SAGD recovery potential. Deterministic reservoir descriptions based on four stratigraphic wells were used in the numerical model to evaluate the SAGD process. Three of these wells were from the 2005 drilling program and the fourth well was from an old pilot project. The well data from these locations covers the expected variations in the reservoir quality within the Husky lease. Furthermore, a location that would be representative of average reservoir properties was used to evaluate and compare SAGD and hybrid SAGD processes for initial project evaluation purposes. These were basic symmetry elements. Modelling studies using geostatistical reservoir description are being planned to further evaluate the performance of this process and newer well data is being added to the models as it becomes available.

A three-dimensional 800 m (I) × 50 m (J) × 26 m (K) model was set up based on the properties of stratigraphic well 4-5-069-4W4. At one vertical boundary, one SAGD producer was placed about 1.5 m above the bottom of pay zone, with an injector 5 m above it. At the opposing vertical boundary, one single horizontal CSS well, 50 m away from the SAGD well pair was placed 1.5 m above the base. All horizontal wells are 700 m long with 50 m buffer zone at both the heel and toe.

Hybrid SAGD achieved a recovery of 69% at a cumulative steam oil ratio (CSOR) of 3.1 m³/m³ at the end of the project life (5.9 years). The end of the project life was defined at an instantaneous steam oil ratio (ISOR) of 7.0. In comparison the recovery of SAGD alone was 67% at a CSOR of 3.6 in 9.4 years. The hybrid process recovered about the same amount of oil, but in a much shorter time. Preliminary sensitivity runs were also conducted with the block model as shown below.

	Hybrid SAGD	SAGD
Cum. Oil @ ISOR = 7.0 (m ³)	297,000	288,000
Recovery (%)	69	67
CSOR (m ³ /m ³)	3.1	3.6
Life time of well (year)	5.9	9.4
Average Rate (m ³ /d)	138	84

Case Description	Cum. Oil (m ³)	Recovery (%)	CSOR (m ³ /m ³)	Life of well (year)	Average Rate (m ³ /d)
Base case	297,000	69	3.1	5.9	138
k _v /k _h = 0.2	293,000	68	3.8	7.3	110
Perm reduced by half	291,000	68	4.2	8.7	92
Swi=0.2	280,000	65	3.2	5.7	135
Larger slug size	297,000	69	3.0	5.4	151
CSS starts 1st year	299,000	70	3.0	5.4	152

B) With respect to previous information submitted by Husky please provide:

1. The full lab reports for the clay analysis and XRD data summarized in Table 1 to Husky's Nov. 28 2006 IR responses.

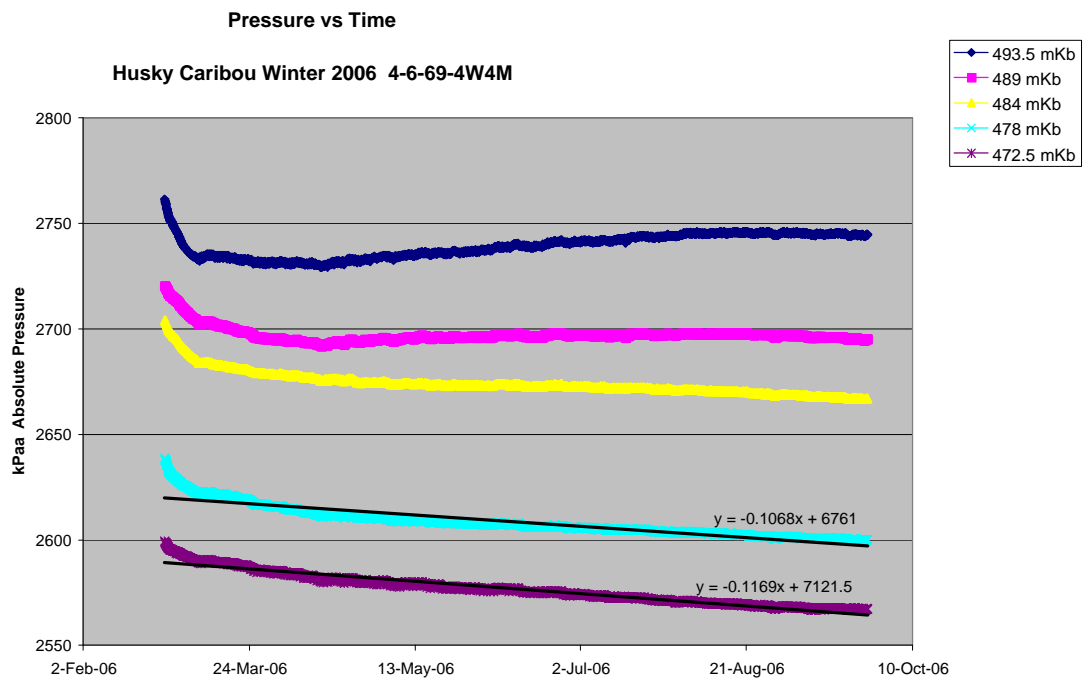
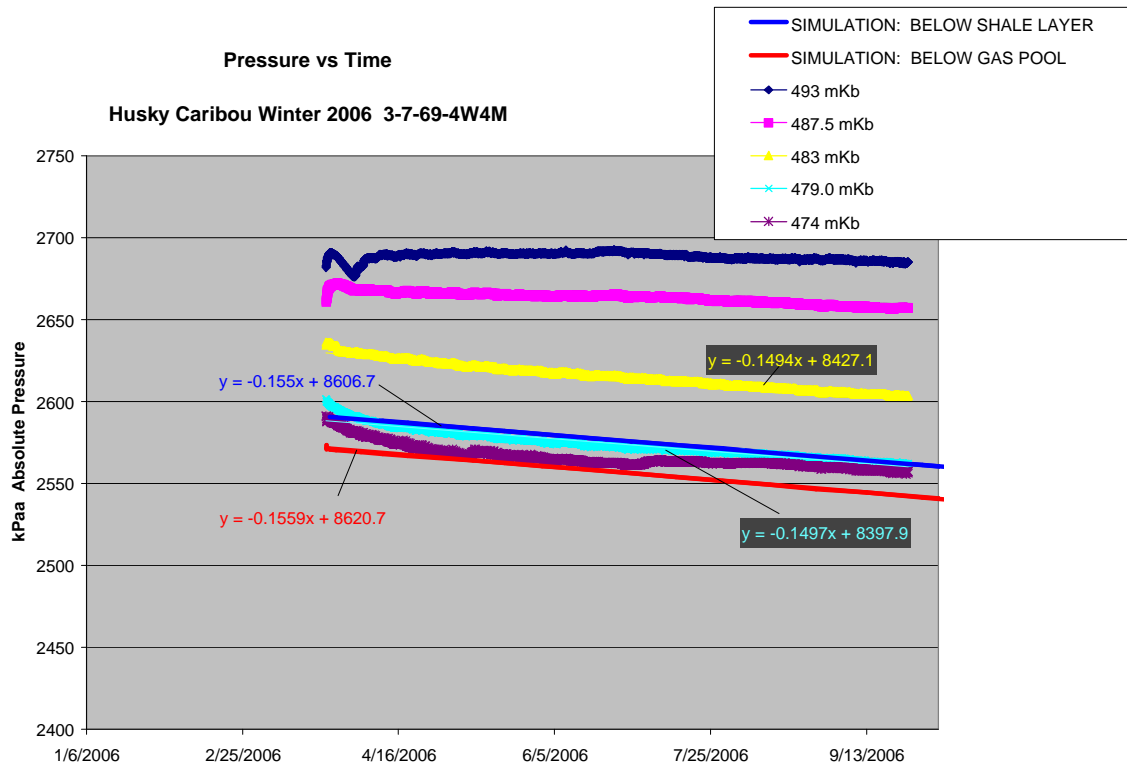
Husky's Response:

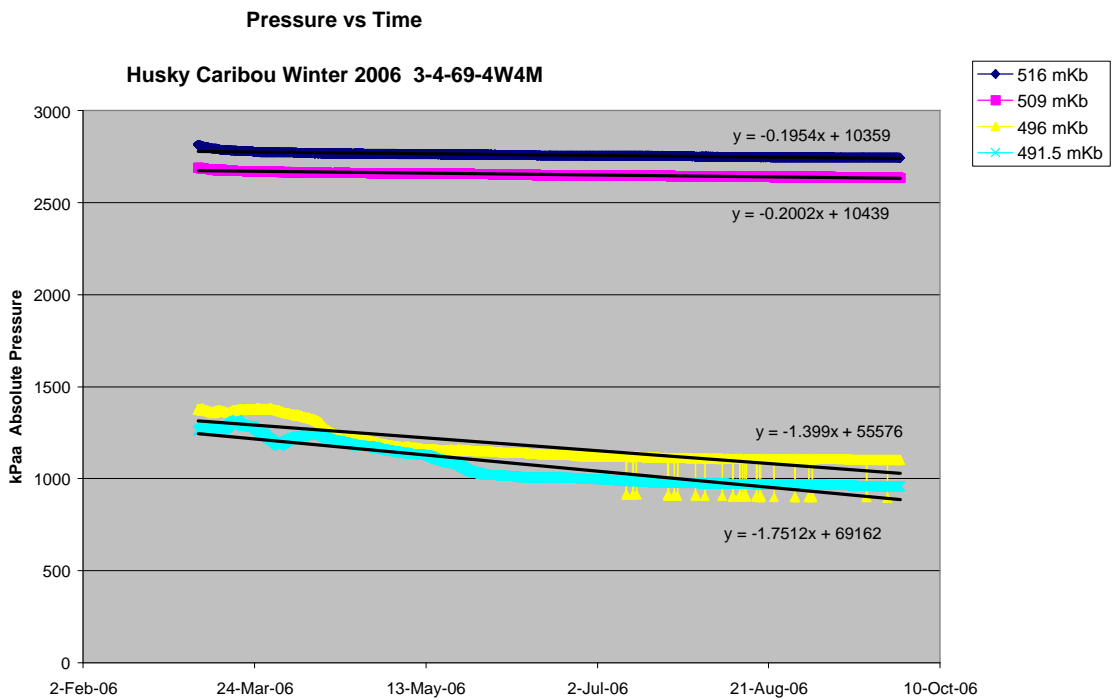
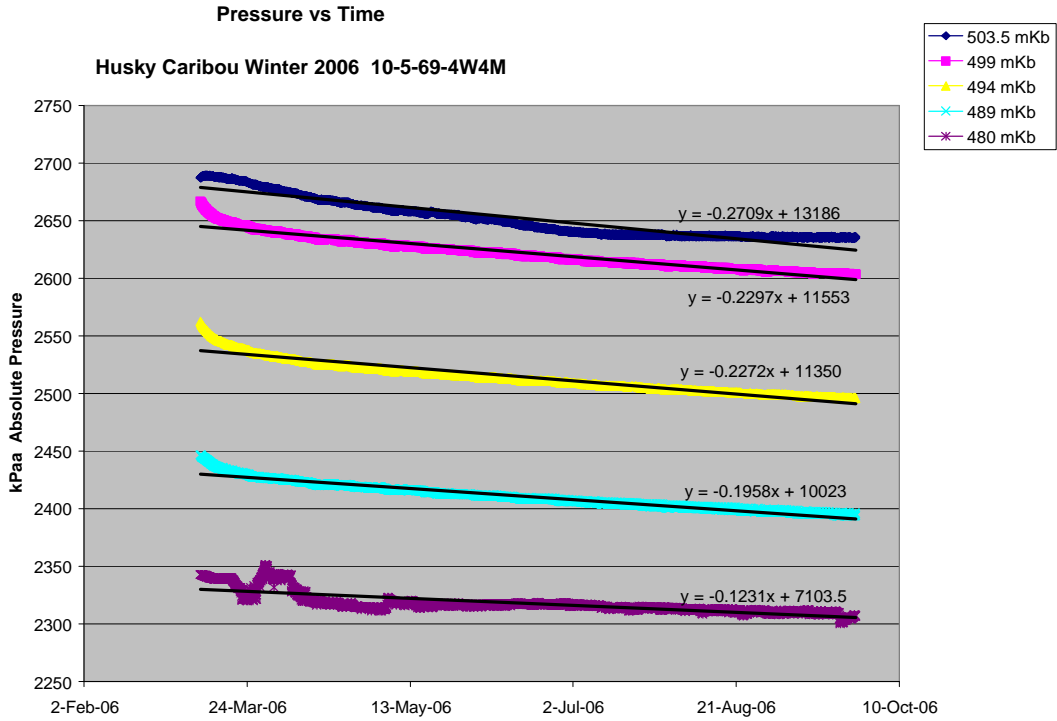
Full laboratory report is included on attached CD

2. The lab analysis reports for the oil analyses summarized in the Nov. 28 2006 IR response to EnCana's IR 5.

Husky's Response:

Laboratory reports for the oil analyses are attached.





Pressure vs Time

Husky Caribou Winter 2006 16-7-69-4W4M

