

ALBERTA ENERGY AND UTILITIES BOARD

Calgary Alberta

APPLICATION FOR A WELL LICENCE**THREE HILLS CREEK FIELD****ULSTER PETROLEUMS LTD.****LSD 8-17-36-26 W4M****Examiner Report 98-3****Application No. 970583**

1 INTRODUCTION**1.1 Application and Intervention**

Ulster Petroleums Ltd. (Ulster) applied to the Alberta Energy and Utilities Board (EUB), pursuant to section 2.020 of the Oil and Gas Conservation Regulations, for a well licence to drill a vertical sour oil well in Legal Subdivision (Lsd) 8 of Section 17, Township 36, Range 26, West of the 4th Meridian. The purpose of the well, ULSTER THREEHCK 8-17-36-26 (8-17 well), is to obtain crude oil and gas production from the Leduc Formation.

The EUB received an objection to the subject well licence application (the application) from Mr. and Mrs. Smith (the Smiths), adjacent residents located approximately 525 metres (m) south of the proposed well location. The Smiths stated they were opposed to the location of the 8-17 well, and would like to see the well moved some 250 m to the west. Accordingly, the Board directed, pursuant to section 29 of the Energy Resources Conservation Act, that a public hearing be held to hear the application.

1.2 Hearing

The hearing convened on 10 February 1998 in Red Deer, Alberta, before Board appointed examiners T. M. Hurst, C. D. Hill, and T. R. Keelan, P.Eng. The examiners and Board staff conducted a site visit of the proposed surface location for the 8-17 well, and the surrounding area prior to the commencement of the hearing.

During the hearing, Ulster committed to an undertaking of providing both the intervener and the EUB with a copy of a hydrogen sulphide (H₂S) release rate study that was being conducted on the analogue well located in Lsd 11-4-36-26 W4M (11-4 well). This report entitled *At Three Hills Creek, D-3A Pool, Gas Release Study*, was subsequently submitted to the EUB office on 5 March 1998.

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

Ulster Petroleum Ltd. (Ulster)
B. O'Ferrall

W. R. Ford, C.E.T.
P. Schmaltz
G. Strashok, P.Eng.
J. Stepaniuk, P.Eng.
R. Berrien, P.Ag.
E. Gosselin, M.Sc.

Mr. and Mrs. Smith (the Smiths)
R. Elander

D. Smith
F. Lutz
D. Collier

Alberta Energy and Utilities Board staff
S. D. Wilson, B.Sc.
A. E. Wiechert, P.Geol.
T. Donnelly, Board Counsel
M. Brown, E.I.T.

2 ISSUES

The examiners consider the issues respecting the application to be:

- \$ the need for the well,
- \$ the location and impact of the well, and
- \$ the H₂S release rate.

3 THE NEED FOR THE WELL

3.1 Views of Ulster

Ulster submitted that, through an agreement with Torrington Resources Ltd., it had earned an interest in the Petroleum and Natural Gas rights underlying the SE3 of Section 17-36-26 W4M and therefore, had the right to explore for and produce hydrocarbons. Ulster also submitted that the surface owner had granted a surface lease and agreed to the issuance of a well licence by the EUB.

3.2 Views of the Intervener

The Smiths did not offer an opinion on the need for the 8-17 well. They indicated that they would not object to a well located approximately 250 m west of the proposed location.

3.3 Views of the Examiners

The examiners acknowledge that Ulster has the right to explore for and produce oil and gas under the SE3 of Section 17. The examiners accept that a well is required to recover any hydrocarbons that may be present in this quarter section. They also note that Ulster has acquired a valid surface lease.

4 THE LOCATION AND IMPACT OF THE WELL

4.1 View of Ulster

Ulster stated that it had selected the best surface location for the 8-17 well and that there was no benefit in moving the well to the Smiths' preferred location approximately 250 m to the west. In the applied-for location the wellhead would not be visible from the Smiths' residence due to a row of trees between the house and the wellsite. Moving the well 250 m to the west would make the site more visible, place it in a low lying area that would require fill to build a pad and, in the unlikely event of odours, northwesterly winds would convey the odours to the Smiths' residence.

Further, in order to access the desired subsurface target from the Smiths' preferred location, a directional well would be required. This would result in incremental drilling costs of \$135 000 to \$216 000, lead to greater mechanical risks during drilling and completion, and result in increased operating costs. Moving the well north or east places it in a watercourse, while locating the well further south places it closer to the Smiths' residence. Ulster indicated that it was prepared to contour the earthen berm on the south end of the lease such that the visual impact of the wellsite is kept to an absolute minimum.

Ulster noted the Smiths had not approached the County of Red Deer to subdivide their acreage and viewed the land to have limited potential for further subdivision compared to lands south of the Smiths' residence. It was of the opinion that the 8-17 well would not result in devaluation of the Smiths' property, since sour oil and gas operations are already present in the area, and two wells already exist in closer proximity.

Ulster stated that the proposed bottom-hole location of the 8-17 well was selected using a combination of geology and geophysics, while taking into account the on-target location of the well. It believes that the 8-17 well would encounter a porous reef crest in the Leduc Formation.

Ulster anticipates that the Leduc reservoir would consist of porous dolomite reef material and believes that the best porosity and permeability would occur along the reef crest. The location of the reef crest was based on 3-D seismic that Ulster acquired in the area and from existing well control. To the west, the reservoir quality deteriorates as indicated by the well located in Lsd 9-17-36-26 W4M (9-17 well), which encountered the Leduc Formation in the back reef position. To the east, the Leduc Formation is encountered in a basinward position, as in the well located in Lsd 6-16-36-26 W4M. Ulster stated that to the north and south, the structure on the Leduc Formation plunges downdip and moving the well in either of these directions increases the risk of encountering uneconomic production. In cross-examination, Ulster indicated that its interpretation of the crestal reef fairway allowed for a maximum of 100 m of movement in any direction. The 8-17 well is also expected to encounter the Nisku Formation at approximately 20 m above the Leduc Formation. Ulster noted the Nisku Formation was considered to be a secondary target and therefore had no influence on the selection of the bottom hole location of the well.

To ensure the integrity of the wellbore the surface casing would be run to a depth of 312 m, some 67 m below the depth of potable water in the region. The production string would be cemented full length to ensure isolation of fresh water aquifers from deeper fluids. Ulster stated that it would use an electrical submersible pump (ESP) if oil production was of sufficient volumes and would only use a pumpjack if the well capability did not support the installation of an ESP.

In an attempt to further mitigate the impacts of a sour well at Lsd 8-17, Ulster committed to:

- \$ continuous H₂S detection while the sour zone is open during drilling, completion, and testing operations,
- \$ continuous H₂S monitoring equipment on the wellsite when the 8-17 well is placed on production such that the well will automatically shut-in at 10 parts per million (ppm) of H₂S and trigger an alarm at the Wimborne Gas Plant,
- \$ providing all residents in the area with a 24-hour emergency telephone number for the Wimborne Gas Plant where personnel are available to respond to public concerns immediately,
- \$ reducing traffic past the Smiths' residence during drilling and completion operations by routing traffic to the north,
- \$ placing the production facilities to the west side of the lease to take advantage of cover provided by the tree line,
- \$ reducing the need for trucking and on-site tankage by pipelining produced oil and gas to a remote satellite, and
- \$ testing the Smiths' water well for rate and quality prior to the commencement of drilling and after completion operations.

4.2 Views of the Intervener

The Smiths established that they were the owners of 4.0 hectares (10 acres), which included their residence and approximately 2.8 hectares (7 acres) of tree farm south of the proposed well site. The Smiths contended that a well drilled in the proposed location would have adverse impacts on the quality of their lifestyle and the value of their property. They expressed concerns related to safety, impacts on their water well, and increased truck traffic past their residence. They stated that they were not opposed to the drilling of the well providing it could be moved approximately 250 m west of the proposed location. They suggested that this would place the well out of sight, behind trees and a small ridge.

The Smiths expressed concern about their safety if there was an accidental release of H₂S at the proposed location. They argued that H₂S gas could flow south from the well, and move up a ravine that terminated immediately west of their house. They suggested that this flow path would be similar to what they observed when fog collected in low lying areas and travelled up the ravine. In their view, if the well were moved 250 m west of the proposed location, the topography would cause any sour gas leaks to flow in a northeast direction away from their

residence. They also expressed frustration over their understanding that Ulster had previously committed to, but was now denying, an offer to place H₂S detectors at their house. In addition to the safety issue, the Smiths stated that any sour gas odours would detract from the pleasurable experience of working in their tree farm and spending time on their deck.

The Smiths maintained that the proposed wellsite was clearly visible from their house and yard. They argued that this would result in a devaluation of their property and make it less saleable. Mr. Smith acknowledged that what they currently could see was a large earthen berm constructed during the lease preparation and that this berm would obstruct the view of the proposed wellhead. During cross-examination Mr. Smith indicated that, if the well was approved in the applied-for location, contouring and seeding grass on the berm would improve the aesthetics of the wellsite.

The Smiths stated that Ulster's commitment to test their water well before and after drilling would satisfy their concerns in this regard. In addition, Ulster's commitment to route truck traffic north from the proposed wellsite, rather than south past the Smiths' residence, alleviated their concerns about disturbance caused by increased truck traffic.

4.3 Views of the Examiners

The examiners acknowledge that the drilling and production of the 8-17 well would have some impact on the Smiths. It was evident through questioning at the hearing that the primary concerns of the Smiths related to the aesthetic impacts of the visibility and noise of the wellsite, and the safety concerns associated with H₂S gas. With respect to these and other impacts, the examiners note the following:

- \$ The proposed well location is approximately 525 m from the Smiths' residence. Based on evidence at the hearing and on the site visit, the examiners believe the tree line would make it difficult to see the wellhead from the Smiths' residence. The examiners also note Ulster's commitment to place any production facilities to the west of the wellhead, and to contour and seed the earthen berm to the south of the wellsite. The examiners therefore do not believe the surface facilities would present an unacceptable visual impact.
- \$ There was no substantive evidence presented to suggest the alternative site proposed by the Smiths would significantly reduce the potential for fugitive emissions to drift toward their residence. The installation of an H₂S detection system at the wellsite, as proposed by the applicant, that would shut in the well and raise an alarm if H₂S concentrations of greater than 10 ppm were detected, should provide an increased level of protection for the Smiths and other residents.
- \$ Ulster's commitment to test the Smiths' water well prior to drilling and after completion of the well has alleviated the Smiths' concerns in that regard.
- \$ Ulster's commitment to route all traffic associated with the drilling and completion of the well to the north would minimize the Smiths' concerns of increased truck traffic past their residence.
- \$ The examiners believe there was no substantive evidence presented to indicate that the drilling of the proposed well would have a measurable impact on the market value of the

Smith's property, having regard for the oil and gas activity that currently exists in the area.

- § The examiners accept the applicants contention that it needs to drill the well in the applied-for location to test its interpretation of the existence of the reef crest. There was considerable discussion around the incremental cost of drilling to the subsurface target from the intervener's alternative location. The examiners also accept that there is some additional risk and cost associated with directionally drilling the well.

In conclusion, the examiners accept the surface location put forward by Ulster and believe that the measures committed to by Ulster will mitigate the impacts of the proposed well. From evidence presented, the examiners believe that moving the wellsite 250 m to the west would not provide measurable benefit from a surface impact point of view. Therefore, the examiners do not believe the additional cost and risk of drilling directionally from the alternative site is warranted.

5 H₂S RELEASE RATE

5.1 Views of Ulster

Ulster's well licence application indicated an H₂S Release Rate (qH₂S) of 0.307 cubic metres per second (m³/s) while drilling, and 0.295 m³/s while producing. The 11-4 well was the analogue well used to determine these release rates, based on an analysis of a multi-rate test done in June and July of 1997 on the Leduc Formation and an analysis of a single-rate back pressure test done in 1981 on the Nisku Formation. Specifically, these analysis gave a qH₂S of 0.012 m³/s for the Nisku Formation and 0.295 m³/s for the Leduc Formation. While drilling, the qH₂S was the cumulative from both formations, but under production only the Leduc was assumed to contribute. Based on the drilling qH₂S, Ulster calculated an emergency planning zone (EPZ) of 1.0 kilometre (km) radius around the well.

Under cross-examination, Ulster agreed that the Leduc analysis referred to above was based on a wellhead deliverability plot for tubing in the well. It stated that a more detailed analysis was being conducted by Scientific Software-Intercomp (SSI) which would look at, among other things, the sandface release rate corrected to surface for an open borehole, and the effects of oil and water production on the release rate. However, Ulster conceded that the 8-17 well may encounter more gas pay than the offsetting 9-17 well, and may have only gas released if a blowout occurs when the drilled hole is still above the gas-oil contact. Ulster agreed, as an undertaking, to provide the panel and intervener with the results of the SSI gas release rate study, and to provide a gas-only scenario as part of the study.

Just prior to the hearing, Ulster submitted a second calculation of the drilling qH₂S, based on a drill stem test (DST) conducted on the 9-17 well. The DST result was submitted because it represented a release rate for an unstimulated well, as was the case for a well being drilled. However, under cross-examination at the hearing, Ulster agreed that the 9-17 well was not a good analogue for release rate estimates because the 8-17 well was expected to encounter a much better reservoir in the Leduc zone.

Ulster provided a copy of a letter from SSI to Ulster, dated 6 February 1998, which refuted the Smiths' q_{H_2S} of $1.352 \text{ m}^3/\text{s}$. The SSI letter stated that the $1.352 \text{ m}^3/\text{s}$ rate was based on a September 1997 Inflow Performance Relationship (IPR) study on the 11-4 well. The IPR applied to oil production only, and was not designed to calculate a gas release rate.

Ulster submitted the undertaking, entitled *A Three Hills Creek, D-3A Pool, Gas Release Rate Study*, under covering letter to the EUB, dated 4 March 1998. Three specific gas release rate scenarios for the 11-4 well were analyzed by the SSI study, based on production and pressure information from the June/July 1997 multi-rate test:

- \$ Case 1 - blowout conditions for tubing flow.
- \$ Case 2 - blowout conditions for annulus casing flow.
- \$ Case 3 - blowout conditions for annulus bore-hole flow while drilling.

For each of the three cases a two-part study was conducted:

- \$ SSI's Well Performance Model (part 1) was used to estimate the reservoir's capability to produce both gas and oil, and these capabilities were subsequently reduced to account for wellbore restrictions (well outflow performance).
- \$ A more detailed black-oil simulator (part 2) was used to model the reservoir flow of oil, gas and water to the 11-4 wellbore over several days, and the resulting flows were then adjusted to account for well outflow performance.

The part-1 results showed that, under a blowout situation, the oil rates were negligible and stabilized gas rates of $301 \text{ } 10^3 \text{ m}^3/\text{d}$, $545 \text{ } 10^3 \text{ m}^3/\text{d}$, and $753 \text{ } 10^3 \text{ m}^3/\text{d}$ were achieved for Cases 1, 2, and 3 respectively.

The part-2 results showed that for Cases 1 and 2, the gas rates remained high for the first two or three days, and then declined, but for Case 3 (drilling scenario) the gas rate dropped off immediately and at a steep decline. The initial maximum gas rates were $301.2 \text{ } 10^3 \text{ m}^3/\text{d}$, $556.7 \text{ } 10^3 \text{ m}^3/\text{d}$, and $778.3 \text{ } 10^3 \text{ m}^3/\text{d}$ for Cases 1, 2, and 3, respectively. The maximum oil rates were $156 \text{ m}^3/\text{d}$, $360 \text{ m}^3/\text{d}$, and $111 \text{ m}^3/\text{d}$ for Cases 1, 2, and 3, respectively. Oil rates declined over the simulation period in all cases, and the water production increased rapidly to very high maximum rates ($94 \text{ m}^3/\text{d}$ or greater). SSI also gave the average gas rates for 24-hour and 48-hour periods from the part-2 results and stated that either of these, rather than the initial maximum rates, should be used for determining an emergency response plan for the reservoir conditions being modelled.

In its discussion of the results, SSI noted that the drop in gas rates observed in part 2 was due to the production of the subordinate liquid phases (oil and water). Also, SSI attributed the much larger oil rates in the part-2 results to a more rigorous modelling of coning and to the different correlations used for well outflow performance. SSI did not discuss why the well outflow correlations used in part 2, were different than those used in part 1. It noted that the performance correlations used in part 2 could introduce large errors in individual phase rates at the very high gas rates observed in Case 3.

In its covering letter to the SSI study, Ulster stated that the average gas release rate estimated over the first 48 hours of a blowout should be used in preference to the initial maximum rates achieved. Ulster stated that the actual volume of gas released over a designated time period would define the area that could be impacted from a release of gas. Of the three cases looked at, Ulster proposed to base its EPZ on the Case-2 average release rate over a 48-hour period (from part 2 of the study). This release rate was $488.8 \times 10^3 \text{ m}^3/\text{d}$ and was the highest 48-hour rate from the black-oil simulator results. Ulster stated that it would prepare an emergency response plan for the drilling and completion operation of the proposed 8-17 well using:

- \$ a gas release rate of $488.8 \times 10^3 \text{ m}^3/\text{d}$,
- \$ an H_2S concentration of 16 per cent,
- \$ a qH_2S of $0.905 \text{ m}^3/\text{s}$, and
- \$ a resulting EPZ of 2.2 km.

5.2 Views of the Intervener

In the Smiths' intervention, production from the 11-4 well was used as an analogue. Gas production was quoted as $8.465 \text{ m}^3/\text{s}$ ($731.4 \times 10^3 \text{ m}^3/\text{d}$) with a H_2S concentration of 16 per cent, resulting in a qH_2S of $1.352 \text{ m}^3/\text{s}$. The Smiths stated that, because the well was predicted to have a drilling qH_2S of around $0.367 \text{ m}^3/\text{s}$, they had some concerns with regard to Ulster's credibility on this issue. During the hearing, the intervener did not speak to this calculation, nor did it cross-examine Ulster on its hearing submission and statements related to the qH_2S calculation.

5.3 Views of the Examiners

The examiners are satisfied that the qH_2S of $1.352 \text{ m}^3/\text{s}$ put forward by the Smiths is incorrect, for reasons cited in section 5.1 of this report.

Having reviewed the undertaking the examiners note that based on Ulster's expanded EPZ of 2.2 km, public notification and consultation requirements have not been satisfied. Ulster indicated it did not contact residents or landowners beyond a 1 km radius of the well. The examiners also note that those contacted by Ulster were given a lower estimate of the qH_2S than Ulster's latest proposal.

Regarding the acceptability of Ulster's proposed qH_2S , the examiners recognize that there is often some uncertainty in determining an appropriate H_2S release rate, depending on the analogue well(s) used and the quality and interpretation of the well test data. However, the examiners believe the intent is to determine the maximum qH_2S that could reasonably be expected to occur during the drilling of the well. In this regard the examiners requested Ulster, in its undertaking, to include a gas release rate which assumes there is only gas pay present in the Leduc. The examiners believe that this situation is not unreasonable for the 8-17 location if drilling encounters a thicker portion of gas pay and a blowout occurs prior to the expected gas-oil contact being reached. Having reviewed Ulster's undertaking, the examiners conclude that the stabilized gas rates given in part 1 of its study, using SSI's Well Performance Model, are most representative of the gas pay situation described above. SSI clearly states that it is the influence of oil and water production as modelled by the black-oil simulator, which causes gas rates to decline rapidly over time, particularly in the drilling scenario represented by Case 3.

Therefore, the examiners conclude that the Case 3 stabilized gas release rate of $753 \times 10^3 \text{ m}^3/\text{d}$ should be used as the maximum gas release rate expected from the Leduc Formation during the drilling of the 8-17 well. Although this case represents post-stimulation production, the examiners note that the 1997 well test analysis submitted as Exhibit 6 during the hearing states that a skin factor of +26 was calculated for the 11-4 well subsequent to the stimulation treatments. This indicates that some wellbore damage was still present during the multi-rate test, and the test rates do not reflect a reservoir with permeability improved from its natural state. Using a 16 per cent H_2S concentration, from an analysis of the 11-4 well's Leduc gas production, the resulting estimate of $q_{\text{H}_2\text{S}}$ is $1.394 \text{ m}^3/\text{s}$.

The examiners accept Ulster's value of $0.012 \text{ m}^3/\text{s}$ for $q_{\text{H}_2\text{S}}$ from the Nisku zone.

In conclusion, the examiners believe that:

- \$ the most reasonable maximum $q_{\text{H}_2\text{S}}$ is $1.394 \text{ m}^3/\text{s}$ from the Leduc, and $0.012 \text{ m}^3/\text{s}$ from the Nisku,
- \$ the $q_{\text{H}_2\text{S}}$ potential during drilling is $1.406 \text{ m}^3/\text{s}$, and
- \$ the resulting EPZ is 2.90 km.

6 OTHER MATTERS

The examiners note it was evident from the site visit and from discussions at the hearing that the surface lease for the applied-for well had been prepared without a well licence. The Smiths raised a concern about this and stated that they believed that the pre-licence site preparation was intended to defuse opposition to the wellsite. Ulster argued that, although section 11 of the Oil and Gas Conservation Act prohibits this type of activity, Informational Letter 90-20, in an attempt to address this practice, has created some ambiguity. Under cross-examination, Ulster admitted that it was aware of the Smiths' objection to the well prior to preparing the site, but that this wasn't communicated in time to those responsible. Notwithstanding Informational Letter 90-20, the examiners believe that pre-licence preparation of a wellsite, prior to ensuring there are no objections from adjacent landowners and occupants, is unacceptable. In this specific circumstance, the examiners believe the pre-licence lease preparation exacerbated communication between Ulster and the Smiths, and reduced the chance of reaching a mutual agreement.

The examiners note that Ulster has reviewed its internal communications. The examiners accept Ulsters' commitment to ensure the preparation of lease sites, prior to obtaining a well licence approval, does not happen again.

7 RECOMMENDATIONS

The examiners have carefully considered the evidence presented by the applicant and intervener. Based on this evidence, the examiners believe that the proposed well surface location is acceptable. However, given the larger H₂S release rates calculated since the original application, Ulster has not satisfied the public notification requirements. The examiners therefore recommend that well licence Application No. 970583 be denied.

Dated at Calgary, Alberta, on 26 May 1998.

ALBERTA ENERGY AND UTILITIES BOARD

<Original signed by>

T. M. Hurst

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C. D. Hill

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T. R. Keelan, P.Eng.