BLM Analysis of Anadarko Letter

Summary

In response to a July 5, 2017 letter from Anadarko, the BLM will allow a deduction for some degree of water vapor content, if requested by the operator, for OGOR B reporting months prior to February 2017. This memo presents three options for allowing a water vapor deduction:

- Allow a water vapor deduction from heating value if the relative density used in the measured volume calculation is also adjusted. We do not recommend this option because of the added audit complexity and the relative insignificance of the relative density adjustment to reported volume.
- Allow a water vapor deduction from heating value with no adjustment to the measured volume calculation. We recommend this option because it is less complex to audit and does not require a variance.
- Allow a water vapor deduction from the measured volume with a "dry" heating value. We do not recommend this option because of the extra workload required to approve the necessary variance from Onshore Order 5's requirements.

Background

The heating value – or Btu content - of natural gas has a direct effect on royalty. Therefore, it is imperative that operators sample, analyze, and report heating value properly. Prior to the promulgation of 43 CFR subpart 3175, the BLM had one requirement relating to heating value: that operators determine it at least once per year.

The Federal government and Indian tribes can lose royalty income if the operator makes an improper assumption regarding water vapor content in the gas sample. Water vapor in a gas displaces hydrocarbon molecules and lowers the heating value of the gas. The only way to accurately determine water vapor content is to measure it with a device such as laser or chilled mirror, both of which are expensive to use. Gas chromatographs, while relatively inexpensive, cannot detect water vapor and, as a result, operators rarely report water on gas analysis statements.

In lieu of measuring water vapor content, operators must make an assumption as to how much water vapor is present. The three most common assumptions are:

- Dry – assuming no water vapor is present
- Wet – generally assumes the gas is saturated with water vapor at 14.73 psia and 60°F (1.74 mole percent)
- As Delivered – assuming the gas is saturated with water vapor at meter pressure and temperature

The "wet" assumption almost always results in the reduction of heating value, and royalty income, for water vapor that cannot physically exist in the gas going through the Facility Measurement Point (FMP). For example, gas measured at an FMP that operates at 200 psia and

60°F can only hold about 0.14 mole percent of water vapor. However, operators reporting on a "wet" basis would deduct 1.74 mole percent of water vapor from the heating value of the gas measured at this FMP[1], resulting in at least a 1.60 percent reduction in royalty (1.74% - 0.14%).

While the "as-delivered" assumption is physically possible, the BLM has not received any data to validate the assumption of 100 percent water saturation at meter pressure and temperature.

Instruction Memorandum (IM) 2009-186 directed field offices to identify and pursue situations where operators report heating values on OGOR B on any basis other than "dry," unless the operator measures moisture content. The IM required that the BLM work with the operator to achieve "dry" Btu reporting or, if that was not effective, forward the issue to ONRR for resolution under their regulations (30 CFR 1202.152(a)(1)(i)).

Field offices have recently started to identify situations where operators report the heating value as "dry," but deduct assumed water vapor content from the measured volume. On Flowcal reports, this is typically indicated on "Closed" (edited) Quantity Transaction Records where "IGT Bulletin No. 8" is identified in the header. The methodology in IGT Bulletin No. 8 determines the maximum amount of water vapor that a gas can hold (i.e., saturation) based on the pressure and temperature at the meter, and subtracts that volume from the measured volume. This methodology is essentially the same as the "as delivered" methodology for adjusting heating value.

To date, the BLM has disallowed the volume reduction, citing Onshore Order 5, III.C.21, which requires all calculations to be in accordance with AGA Report No. 3 (1985). There is nothing in AGA Report No. 3 that allows flow rate or volume adjustments based on water vapor, measured or estimated.

Under the new regulations (43 CFR 3175.126(a)(1)), operators must report "dry" unless they have measured water vapor with a laser detection device or chilled mirror, and have reported the water vapor content on the gas analysis report. There is no phase-in period for this reporting requirement; therefore, all heating values reported on OGOR B after January 17, 2017, must comply with 43 CFR 3175.126. The BLM will begin enforcing the new reporting requirements starting with the reporting month of February 2017 in order to avoid the time and cost required to split the reporting month of January 2017.

Anadarko Position

On July 5, 2017, Anadarko Petroleum submitted a letter to the BLM stating that water vapor correction is allowed under AGA Report No. 3 (1985), Section 14.3.8.[2] Specifically, "If the gas mixture is water-saturated but the analysis is on a dry basis, it is necessary to adjust the mole fractions to reflect the presence of water." The letter went on to state that because the BLM incorporates AGA Report No. 3 (1985) in Onshore Order 5, the BLM should allow water vapor deductions, at least prior to the effective date of the new regulations. In addition, the letter

[1] Note that Flowcal typically uses the term "wet" on quantity transaction records to indicate water saturation at meter pressure and temperature, rather than at 14.73 psia and 60°F

[2] The BLM believes this refers to AGA Report No. 3, Section 8

states "The AGA Report 3 1985 instructs adjusting the flow equation to reflect presence of water. The AGA Report 3 1985 does not dictate, restrict or prohibit adjustment methodologies."

Anadarko's position is that adjusting the volume based on water vapor determined under IGT Bulletin 8, yields essentially the same result as adjusting the heating value based on mole fractions modified by the assumed water vapor content, also determined under IGT Bulletin No. 8. To demonstrate this, Anadarko included an analysis from 12 different locations, showing the difference in overall energy (MMBtu) between the two methodologies. From this analysis, the difference in overall energy content of monthly gas production ranged between +0.13 percent and -0.06 percent.

Anadarko's letter also argues that IM 2009-186 is only a guidance document and cannot be treated as a rule. Therefore, according to the letter, prior to January 17, 2017, the BLM had no legal authority to require the heating value to be reported as "dry" or otherwise.

BLM Analysis

This analysis addresses the following points in Anadarko's letter:

1. The gas is saturated with water vapor

Much of Anadarko's position is based on the assumption that the gas mixture at FMPs is water saturated. If the gas mixture is, in fact, water saturated then the BLM would agree with Anadarko's position. However, no entity has ever provided the BLM with data demonstrating that gas measured at FMPs is water saturated, even after the BLM specifically requested such data during the rulemaking process for 43 CFR subpart 3175. While the BLM acknowledges that virtually all gas streams likely have some moisture content, assuming that the gas at FMPs is always saturated with water vapor could result in negative bias and a loss of royalty.

2. AGA Report No. 3 (1985) requires adjustments based on water vapor content

The BLM generally agrees with Anadarko regarding AGA Report No. 3 (1985), Section 8. This section does include specific language and examples in reference to water vapor content.[3] We also agree that Onshore Order 5 incorporates AGA Report No. 3 (1985) and there is clear language in the AGA Report regarding the treatment of water vapor. Therefore, if water vapor exists, operators can use the procedures in AGA Report No. 3 to account for the water vapor. We do not agree that AGA Report No. 3 (1985) "does not dictate, restrict or prohibit water vapor adjustment methodologies." Section 8.3.2.2 of AGA Report No. 3 (1985) specifically instructs the user to "adjust the mole fractions to reflect the presence of water." Note that this method is also consistent with GPA 2172-09.

We also do not agree with Anadarko's statement that "AGA Report No. 3 (1985) instructs adjusting the flow equation to reflect the presence of water." We were unable to find any reference in AGA Report No. 3 (1985) that states or implies that the flow equation can be adjusted for water vapor content. All references to water vapor correction in Sections 8.3.2.2

[3] Specifically, sections 8.3.2.2, 8.3.2.3, and 8.3.2.4

through 8.3.2.4 call for the adjustment of the mole fractions of the components in the gas sample to allow for assumed or measured water vapor content. The adjusted mole fractions result in a reduced heating value and modified relative density, which reflect the water vapor content. The change to relative density would have some effect on volume calculation; however, this is not the same as "adjusting the flow equation" as stated by Anadarko.

3. The IM is not a rulemaking and the BLM cannot retroactively enforce the reporting of "dry" heating value

The BLM agrees with this point and has never enforced the reporting of "dry" heating value directly. Instead, the BLM relies on ONRR regulations (30 CFR 1202.152(a)(1)(i)) for enforcement. This regulation states: "Report gas volumes and British thermal unit (Btu) heating values, if applicable, under the same degree of water saturation." In its discussion of this regulation, the IM states: "While adjustments to the heating value of the gas can be made based on assumptions of water saturation, relative density is rarely adjusted to account for the water vapor that may or may not be present. In essence, the relative density used to determine volume is almost always on a dry basis because water vapor is excluded from the calculation. The relative density is included in the calculations to determine gas flow rate and gas volume; therefore, the volume is ultimately determined on a dry basis. According to the MMS regulation cited above, if volume is reported on a dry basis, heating values must also be reported on a dry basis."

By adjusting the mole fractions to include water vapor, the resulting heating value and relative density are also adjusted to include water vapor. Reporting both the volume and heating value under the same degree of water saturation meets the requirements of 30 CFR 1202.152(a)(1)(i).

4. The volume adjustment methodology yields the same result as the heating value adjustment methodology

We agree with this position. However, Onshore Order 5 (III.C.21) states: "Volumes of gas delivered shall be determined according to the flow equations specified in AGA Committee Report No. 3." As stated under point 2 above, there are no adjustments to the flow equation to account for water vapor in AGA Report No. 3; therefore, any such adjustments are prohibited by Onshore Order 5.

Conclusions

1. The BLM's regulations did not require operators to report "dry" heating value prior to January 17, 2017 (the effective date of 43 CFR subpart 3175). However, ONRR's regulations required operators to report volume and heating value at the same degree of water saturation.
2. Although ONRR's regulation allows operators to account for assumed water vapor content in either the heating value or in the volume, Onshore Order 5 prohibited volume adjustments that are not included in AGA Report No. 3. Therefore, operators can only make adjustments based on assumed water vapor content in the determination of heating value.

3. In order to comply with ONRR regulation, the operator must use the modified relative density based on the assumed water vapor content in the determination of volume. However, from a practical standpoint, this will typically make little difference in the reported volume as shown in the following table:

Effect of Water Vapor on Gas Relative Density and Flow Rate (Assumes Gas Contains 1.5 mole % Water Vapor)			
Relative Density (dry)	Relative Density (with water vapor)	Difference	Volume Difference (%)
0.5548	0.5560	-0.0012	+0.194
0.6000	0.6006	-0.0006	+0.083
0.6223	0.6223	0	0
0.7000	0.6991	+0.0009	-0.092
0.8000	0.7976	+0.0024	-0.188
0.9000	0.8963	+0.0037	-0.230

For example, if the relative density of a dry gas is 0.6000 (see Table, row 2), the addition of 1.5 mole% of water vapor will change the relative density to 0.6006. If you ignore the change in relative density due to the water vapor and use the dry relative density to calculate flow rate, the resulting flow rate will be 0.083% higher than it would be using the relative density adjusted for water vapor. Water vapor has a relative density of 0.6223. If a gas composition also has a relative density of 0.6223 (see Table, row 3), then the addition of water vapor to the analysis will have no effect on the relative density or the calculated flow rate. The more the relative density of the gas deviates from 0.6223, the higher the effect of adding water vapor will be. Note also that the flow rate will be over-reported if the dry-gas relative density is less than 0.6223 and will be under-reported if the dry-gas relative density is greater than 0.6223.

The last row in the above Table is a “near-worst-case scenario.” The dry gas relative density of 0.9000 is much different than the relative density of water vapor and the water content is very high at 1.5 mole% (this would only be possible if the meter was at low pressure and high temperature). Even in these extreme circumstances, the volume error caused by using a dry relative density instead of one adjusted for water vapor content is -0.23%. To put this into context, a -0.23% error in a FMP measuring 1,000 Mcf/day, is an annual royalty loss of about $400.

4. Reporting a “wet” heating value, as defined in the Background section of this memorandum, does not comply with 30 CFR 1202.152(a)(1)(i). In most cases, reporting a “wet” heating value means deducting water vapor that cannot physically exist at the meter. In order to comply with the ONRR regulation, operators would have to add gas volume that also did not exist to the measured gas volume in order to have the same degree of water saturation.

Recommendations

For OGOR reporting months prior to February 2017, the BLM should allow operators to report heating value based on assumed water vapor content in certain situations. In each situation the maximum amount of water vapor the operator could deduct is calculated using IGT Bulletin No. 8, based on the average meter pressure and temperature for the reporting month. The BLM has three options to account for this adjustment:

Option 1: Include the calculated mole percent of water vapor in the gas analysis report and re-normalize the components to 100 percent. Use the revised heating value from the addition of the water vapor for OGOR B. Use the revised relative density to modify the daily and hourly quantity transaction records and the volume reported on OGOR B. Although this option is the most "technically correct," it would also be the most difficult to audit because it would require the BLM to verify both the heating value from the gas analysis statement and the modified relative density from the configuration log.

Option 2: Include the calculated mole percent of water vapor in the gas analysis report and re-normalize the components to 100 percent. Use the new heating value from the addition of the water vapor for OGOR B but do not require the editing of quantity transaction records or the OGOR B volume to account for the revised relative density. This is based on the conclusion that the difference in overall volume is negligible. This option would be considerably less difficult to audit than Option 1.

Option 3: Allow operators to deduct the calculated water vapor from the OGOR B gas volume and report "dry" Btu on OGOR B. This would require a variance from Onshore Order 5, III.C.21, which might be justified by Andarko's conclusion that the difference in overall energy (MMBtu) between this option and either Option 1 or Option 2 is negligible. This option would be the easiest of the three to audit.