

December 3, 2018

## Primary Product Determination for Montney Formation Wells

The primary product of a well event determines regulatory requirements such as well spacing, metering requirements, and royalty considerations. Section 1 of the Petroleum and Natural Gas Act establishes that the Commission designate the well event primary product type.

The extensive Montney formation includes wells with production ranging from dry gas to oil, with variation based on both area and depth within the formation. Well production rates, fluid ratios and fluid properties can fluctuate significantly over the initial producing months. Understanding of Montney reservoir fluids, well production characteristics and well completions for recovery optimization has increased significantly over the ten years of development activity.

Results of an examination of mapping, statistical analysis of production histories, and oil and hydrocarbon liquids analyses of Montney wells, has established Commission policy specific for determining well primary product of these horizontal fracture-stimulated wells.

Hydrocarbon liquid density, liquid production rate, and gas-oil ratio differentiate oil wells from those that include a larger reservoir contribution of volatile oils and retrograde condensate. An API density value of 44 is consistent with light oil reserves. Consideration of GOR and hydrocarbon liquid rate within the initial 6-month production period provides for wells that rapidly transition to predominantly gas well characteristics.

Draft amendments to the Drilling and Production Regulation will require consistent timing and analyses for fluid sampling to ensure that values are valid comparisons.

As based on an evolved state of knowledge, this policy only applied to new wells which have not yet produced for an initial 6-month evaluation period. As a go-forward policy, prior well event primary product determinations will not be reviewed by the Commission.

This document allows permit holders to self-determine well event primary product. The Commission internally reviews new producing Montney wells at the end of their initial 6-month term to ensure consistent determination is applied, and contacts the well permit holder and Ministry of Finance were a change of well primary product is required, which is then applied from the date of initial production. A well permit holder may contact the Commission to evaluate the potential to identify a well event primary product as oil, for a well that by policy would be gas, where qualities are close to the determination values.

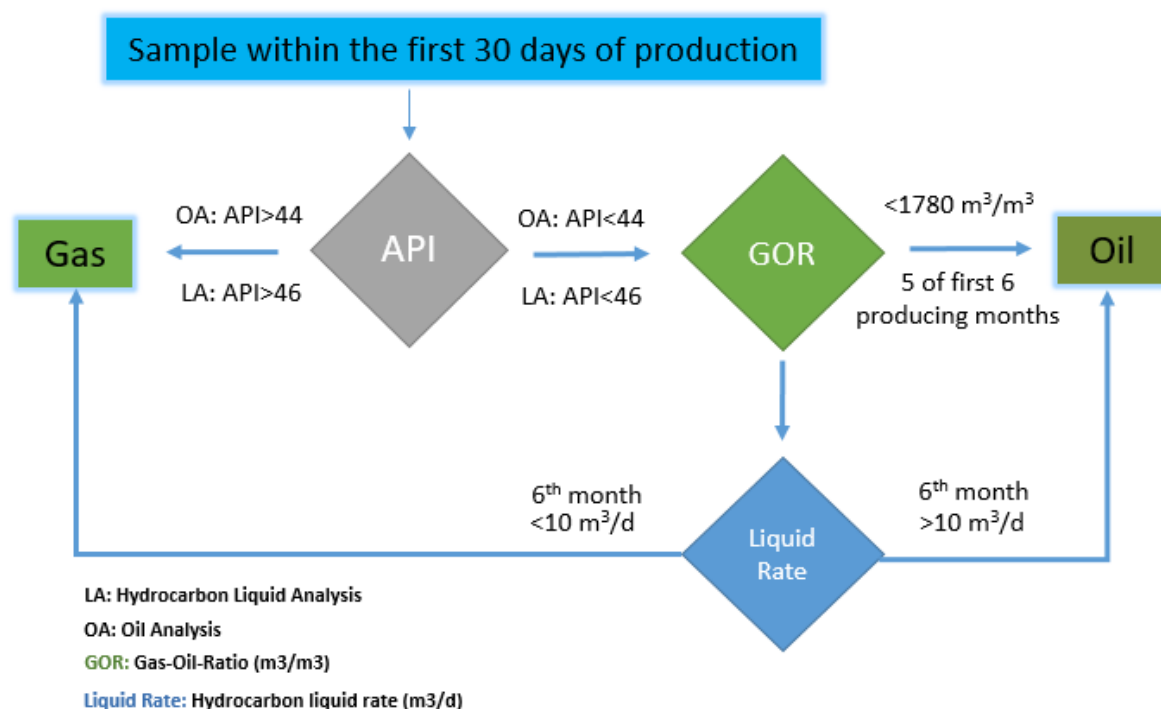
Anomalous individual wells, that marginally meet oil primary product policy, may occur within a dominantly gas production well pad. To minimize surface and operational impacts, these anomalous wells may remain as a primary product gas well event.

### Three-Step Process

Determination of Montney formation well event primary product considers three values;

- **specific gravity of produced hydrocarbon liquid;**
- **producing gas/liquid ratio;**
- **hydrocarbon liquid production rate.**

The following flowchart illustrates the methodology for determination of primary product utilizing initial 6-month production data.



See Definitions section for acronyms and further explanations.

- **Step 1: API value**  
Montney wells with an oil analysis API value equal to or below 44 are evaluated for primary product. An API value derived from a hydrocarbon liquid analysis, which is equal to or below 46, is treated as an oil analysis derived value of 44, unless an oil analysis is provided. For values above these, the primary product is gas.
- **Step 2: Production ratio**  
Oil/condensate production is the sum of field measured plus any condensate/pentene plus volume recovered at the plant. The gas-oil ratio (GOR) is calculated by dividing the monthly raw gas volume by the monthly total liquid

volume. If the GOR value is equal to or below  $1780 \text{ m}^3/\text{m}^3$  (10,000 scf/bbl) for 5 of the first 6 producing months, with API value equal to or less than 44, the well event is oil.

- **Step 3: Production rate at 6<sup>th</sup> month**

If the GOR is greater than  $1780 \text{ m}^3/\text{m}^3$  for two or more of the initial 6 months, the condensate/oil production rate is taken into consideration. An oil/condensate production rate (the sum of field values plus any condensate/pentene plus volume at the plant) below  $10 \text{ m}^3/\text{d}$  in the 6<sup>th</sup> production month, the well event primary product is gas.

## **Definition and explanation**

### ***API value***

The API value, as a proxy of density, is calculated by the following formula:

$$\text{API} = 141.5 / \text{specific gravity} - 131.5$$

Montney well field estimates of API values at the end of flow tests, were compared to oil analysis and the hydrocarbon liquid analysis. API estimate values during the flow test are usually in good agreement with the oil analysis, whereas the API values from the hydrocarbon liquid analysis, C7+ residual, generally average four percent higher.

Drilling and Production Regulation sections 62 and 67 require that oil, gas and hydrocarbon liquid samples be taken within 6 months of initial production. A current draft amendment requires sampling within 30 days of the initial production date. If the analysis of the hydrocarbon liquid sample is a value below API 46, an oil sample analysis is required. The analysis methodology must follow ASTM D5002/ASTM D4052 standard to determine the density of cleaned oil. All analysis reports must be submitted to the Commission within 60 days of the sampling date, or 30 days from the date of analysis, whichever is sooner.

As noted, a Commission primary product well review is initiated by an oil sample analysis API value equal to or lower than 44 or a hydrocarbon liquid analysis API value equal to or lower than 46.

### ***Gas-Oil Ratio (GOR)***

A gas-oil ratio of  $1780 \text{ m}^3/\text{m}^3$  (10,000 scf/bbl) is a widely utilized limit to differentiate between primary product of oil or gas. To allow for observed anomalous 1-month variations, a well producing 5 out of the initial 6 months below the GOR limit of  $1780 \text{ m}^3/\text{m}^3$  meets this decision point.

$\text{GOR} = \text{Monthly Raw gas volume} / \text{Monthly Total Liquid hydrocarbon production.}$

Total liquid production consists of the monthly field oil/condensate volume plus the monthly condensate/pentene-plus volume from the plant.

A producing month is a month with at least 10 days of production. If a well produces less than 10 days within a calendar month, that month is not included in the primary product determination.

***Liquid Rate (LR)***

The liquid rate at the 6<sup>th</sup> producing month is considered.

LR = Volumes in a liquid state at standard conditions / The number of producing days.

As noted for GOR calculation, liquid production consists of the monthly field oil/condensate volume plus the monthly condensate/pentene-plus volume from the plant.

Producing days are calculated from reported hours / 24.