EXHIBIT 6

BACKGROUND COMMENTS AND CALCULATIONS

Comments and Calculations Regarding the Extent of Potential Coal Degradation by the Luca Process

Introduction

Biogenesis of methane

The Earth contains immense resources of buried hydrocarbons and related materials in the solid and liquid phases. Coal and oil are prominent examples. It might be expected that microbial processes, so active in breaking down materials on the Earth's surface, can do similar work in the subsurface. Just as humans consume and digest materials ("foods") comprised in part of large carbon-hydrogen-containing molecules, communities of microbes break down similar materials, thereby gaining energy for their own life processes. The breaking-down of large carbon-hydrogen-containing molecules to smaller molecules (methane; carbon dioxide; water) allows carbon, hydrogen and oxygen to be recycled, as part of natural carbon and the hydrogen cycles, to support ongoing life in the biosphere.

Microbial methane production has been observed in many basins and on all continents, possibly excluding Antarctica. It has been estimated that 20% of worldwide subterranean non-hydrate methane resources (ie. 20% of the natural gas resources studied extensively by the oil industry) were created by microbes. If this calculation is extended to include the methane in hydrate resources, the figure climbs to more than 50% of global non-atmospheric methane resources as being of microbial origin.

PRB coalbed methane resources

Classical geochemical models of the subterranean generation of oil and gas, including coalbed methane, focused on thermogenic processes, which are driven by high temperatures and pressures present in the deep subsurface. By such models, there should be no coalbed methane found in the low-rank coals found in the PRB, because these soft coals have not been sufficiently altered by thermogenic forces to reach methane-creating coal rank.

Of course, we know now that very large resources of coalbed methane do in fact reside in PRB coals. This methane is of biogenic, rather than thermogenic, origin. It was created naturally by microbes living in the coal seams. Luca and other researchers have shown that these microbes continue to live in the coal seams. Luca's process is focused on re-activating these native microbes, using nutrients that stimulate and energize them.

Various authors and agencies have estimated that the total coalbed methane resources of the PRB are in the range of 20 to 30 trillion cubic feet of gas, depending on geographic areas and coal seams included. For purposes of comparison, current national consumption of natural gas is about 22 trillion cubic feet per year. PRB's methane resources are very large, even on a national scale, and demonstrate the capability of the natural biogenic process to produce large volumes of gas over large areas, even without human intervention.

It should also be noted that these resource estimates utilize measurements of the *current* volumes of methane stored in the coals. Methane created in the past that has been vented or burned at outcrop

will not be recognized, even though creation of such gas would have accentuated any degradation phenomena that might have occurred in the host seams.

Over the last thirty years or so, methane has been produced in large quantity from a number of PRB coal seams, including many mined now or in the past: Dietz, Monarch, Wyodak, Anderson, and Canyon. Methane has also been produced from other coals not mined: Big George, Carney, Wall, and others. The study of coalbed methane provenance and abundance has created data which can be used to study the question of potential coal degradation by natural methanogenesis. Some of those will be discussed below.

Direct measurement of the extent of coal degradation by the Luca process
Luca has not made such measurements. Studies proposed to be conducted under Form 2920 permits from BLM will provide data, but it will not be available for several years.

Luca's process

Comparing the Luca process to that of nature
Several of the calculations that follow below draw comparisons to the prior native bioconversion of coal to methane. Such comparisons are appropriate for several reasons, but principally because the Luca process is closely interwoven with the native process. Luca does not introduce alien microbes, and does not alter the coal material by introducing chemical agents or mechanical force to crack or change the rock. Luca seeks to re-energize the microbes already alive within the coal seams, working within the environments of water geochemistry and coal chemistry that already exist, and for which the native microbes are already adapted. The current condition of the coals, after extensive native biogenesis, and the volumes of methane previously created, give solid insight into the possible degradation impacts of deployment of the Luca process into these same coals.

Nutrients used in the Luca process
Luca's process focuses on the activation of native microbes. In PRB, native biological and geochemical conditions remain conducive to biogenesis. However, the native process has slowed or halted, and now needs a nudge to get going again. Because the native conditions are already suitable, Luca does not seek to change them. Luca does not employ aggressive chemistry, augmented biology, or dramatic alteration of the advective spaces (fractures) within the coals. Treatments are delivered under gravity, and do not crack open the coal any further than its current condition. The nutrients have been selected based on lab studies with field samples of water and coal, carried out under lab conditions that mimic the underground conditions, including exclusion of oxygen throughout. Nutrients help support the vitality of the native microbes. They must be healthy for the microbes, both in their chemical nature, and in the concentrations at which they are delivered to the coal seam by the treatment process. A Luca restoration fluid could be safely consumed by an adult human, consistent with FDA guidelines, as it enters the wellbore. Such fluid will appear, smell and taste like water. Consumption will cause no physiological harm, because the nutrients themselves and their concentrations are mild to living cells.

Luca's list of PRB nutrients is posted on its website.

Indirect Estimates and Reviews of Potential Coal Degradation

Metric #1. Comparison of process intensity: nature vs. Luca
The Wyodak coal has been a prolific methane producer over broad areas west and south of Gillette. Many Wyodak CBM wells are now very mature, making it possible to reliably review the general abundance of native (pre-Luca) biogenic methane in the Wyodak without the need to estimate future production.

A typical 640-acre section of Wyodak coal has produced about 2 billion cubic feet of methane. With a volume of methane left unproduced in the coalbed reservoir estimated at 15%, the natural provenance of methane over a section of Wyodak coal is about 2.3 billion cubic feet.

Luca's longest-term field trial is in the Tongue River area, north of Sheridan, and southwest of the Decker and Spring Creek mines. There, average recoveries to date of microbial enhanced-recovery gas are about 0.037 billion cubic feet per treatment. With wells on 80-acre spacing, and estimating that ultimate (past plus future) new microbial gas per treatment will total 0.050 billion cubic feet, then Luca's recovery from a single treatment cycle over five or six years will be about 0.4 billion cubic feet per section, or about 17% of the volume of methane created naturally within the same volume of coal.

By this calculation, the Luca process would require 30 to 35 years of continuous operation to generate the same volumes of gas as were in place within the Wyodak coal when PRB coalbed methane resource development first started thirty years ago.

Of course, even after serving as host and substrate for creation of at least 2.3 billion cubic feet of microbial gas per 640-acre section, we know that today the Wyodak remains a coal seam with attractive calorific value.

Metric #2. Comparison of calorific values of coal seams, including some methane-productive
The calorific values of coal seams within the Gillette Coal Field have been measured and studied for some time. USGS Open File Report 2008-1202, a very broad study of coal resources in this field, also tabulates average calorific values for various seams of interest within three broad areas of the field, which USGS termed North Mining Area, Central Mining Area, and South Mining Area. The seams represented in USGS's Table 5 include some seams productive of coalbed methane, and some seams that have not produced methane in significant quantity. Therefore, these data provide the opportunity to perform a high-level assessment of the extent to which the creation of methane (evidenced by its recent production) may have reduced the calorific value of methane-productive coals, compared to other coals non-productive of methane. A summary of USGS data and Luca calculations follows:

Calorific value of coals in Gillette Coal Field, btu/lb (USGS OFR 2008-1202)

		Thickness-weighted average calorific values			
	Individual seams	all coals in Area	CBM coals	non-CBM coals	CBM minus non-CBM
North Mining Area	8,110	8,200	8,268	7,978	290
Middle Mining Area	8,250	8,388	8,500	8,317	183
South Mining Area	8,442	8,718	8,875	8,597	278

It can be seen that the calorific values of CBM-productive coals are, in fact, higher than those of stratigraphically-proximate coals not productive of methane. Two scenarios come to mind: either microbes don't want to live in lower-quality coals, or else the biogenic process consumes lower-quality parts of the coals, and actually serves to high-grade the coals in situ. In any event, it is **not** apparent that coals have been harmed by the natural creation of biogenic methane.

Metric #3. Stoichiometric calculations, and comparison to intrinsic variability of calorific values of coals
Material balance calculations provide a method to estimate how much of the mass of the coal is removed to create a certain volume of new microbial methane. Such a calculation is shown on Exhibit 1, assessing the effects of a single treatment, and a series of ten treatments. It indicates that production of 0.050 bcf of new methane from a single treatment in 80 acres of a Wyodak coal seam 60 feet thick will remove less than 0.1% of the weight of the coal. In addition, by taking the volume and heating value of the new methane, and adding a 15% process inefficiency factor, it is further estimated that less than 0.1% of the calorific value of the coal will be removed. Coal quality data was taken from USGS OFR 2007-1116.

How significant is this estimated change? One standard is the variability of a coal seam's calorific value from different samples from different core hole sites. OFR 2007-1116 provides data for the Wyodak seam. Exhibit 2 shows the sample above, pre- and post-Luca, as well as data for other Wyodak samples from OFR 2007-1116 for which calorific value data was provided. Values of average calorific value, and plus and minus one standard deviation are shown. It can be seen that the estimated degradation, even of a series of **ten** treatments, is much smaller than the natural variability present in samples taken from the same coal seam.

It should be noted that this material balance is made with the implicit assumption that both Luca's process and future coal mining will take place over the 80-acre spacing used for wells in many areas prospective for deployment of the Luca process. At least initially, Luca's deployments will in fact contact a smaller volume of coal than full thickness over 80 acres. However, we think it highly unlikely that a future commercial development of a deep coal resource, post-Luca, will be undertaken assuming recovery of only a small volume of coal. Averaging pro forma degradation over full thickness and 80 acres is reasonable, since the quality of mined coal will be averaged over that scale (at a minimum) of coal tonnage.

Metric #4. Measured changes in geochemical parameters
Hypothetically speaking, it is possible that Luca's nutrient formulations might react in situ, or that their uptake by microbes could lead to deleterious geochemical consequences. Significant changes to the geochemistry of the groundwaters in the coals would be indicative of changes to the in situ chemical environment, and possibly of changes to the coal.

Luca has now performed more than 400 pilot nutrient restorations in PRB coals. We now have an extensive body of pre- and post-treatment geochemical analyses with which to assess changes to the coal seams. These results have been included in reports that Luca has submitted to WOGCC and to BLM. In summary, results are as follows:

- TDS of injected fluids is slightly higher than TDS of the field waters used to carry the nutrients into the coal seam. The difference is, of course, the nutrients.

- When treatment fluids are pumped back post-treatment, changes vs. pre-treatment levels are low or below detection for TDS, and for common individual analytes. The nutrients have been consumed, and unexpected deleterious consequences have not been encountered.
- pH is unchanged.
- Trace metals occasionally found precipitated in the coals are not mobilized.
- Pre-treatment, groundwaters held in coal seams were sodium-bicarbonate in chemical character. Post-treatment, groundwaters were still of the sodium-bicarbonate type. Concentrations of Stiff diagram ions were essentially unchanged.

Thousands of samples of coal seam waters indicate that <u>no significant abiological chemical reactions take place when Luca process nutrients are injected</u>. Hence it is unlikely that chemical alteration of the coal is taking place, beyond bioconversion of a miniscule amount of coal to methane, as discussed in Metric #3 above.

Observations.

- Luca has used tens of thousands of coal sample aliquots in its lab studies to determine appropriate nutrient formulations for PRB deployments of the Luca process. We have never observed the formation of biofilms or slimes in these coal samples.
- Three of Luca's senior managers were early-stage developers of conventional coalbed methane projects in the PRB. These managers were directly involved in the drilling of more than two thousand PRB CBM wells. They never encountered a coal interval that appeared "rotted out" or severely degraded.

<u>Concluding Remarks</u>

It is natural to think that the creation of large volumes of methane will have a material impact on the remaining coal. Luca appreciates the concerns of BLM, the coal industry, WMA representatives, and other coal stakeholders.

Luca believes that its project developments and technology deployments can co-exist well with coal mining. Luca has agreed, and legislation now requires, to abandon any of its wells that stand in the path of advancements of mining activities. Most of Luca's deployments will occur in coals deeper than the economic and technological reach of open-pit mines, where no conflict should ever occur. And, as discussed here, Luca does not anticipate that any significant degradation of coal will occur due to its activities. Therefore, from practical and commercial perspectives, the subsequent mining of coal from a former Luca project area will not be affected by Luca's operations.

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Attachment 1

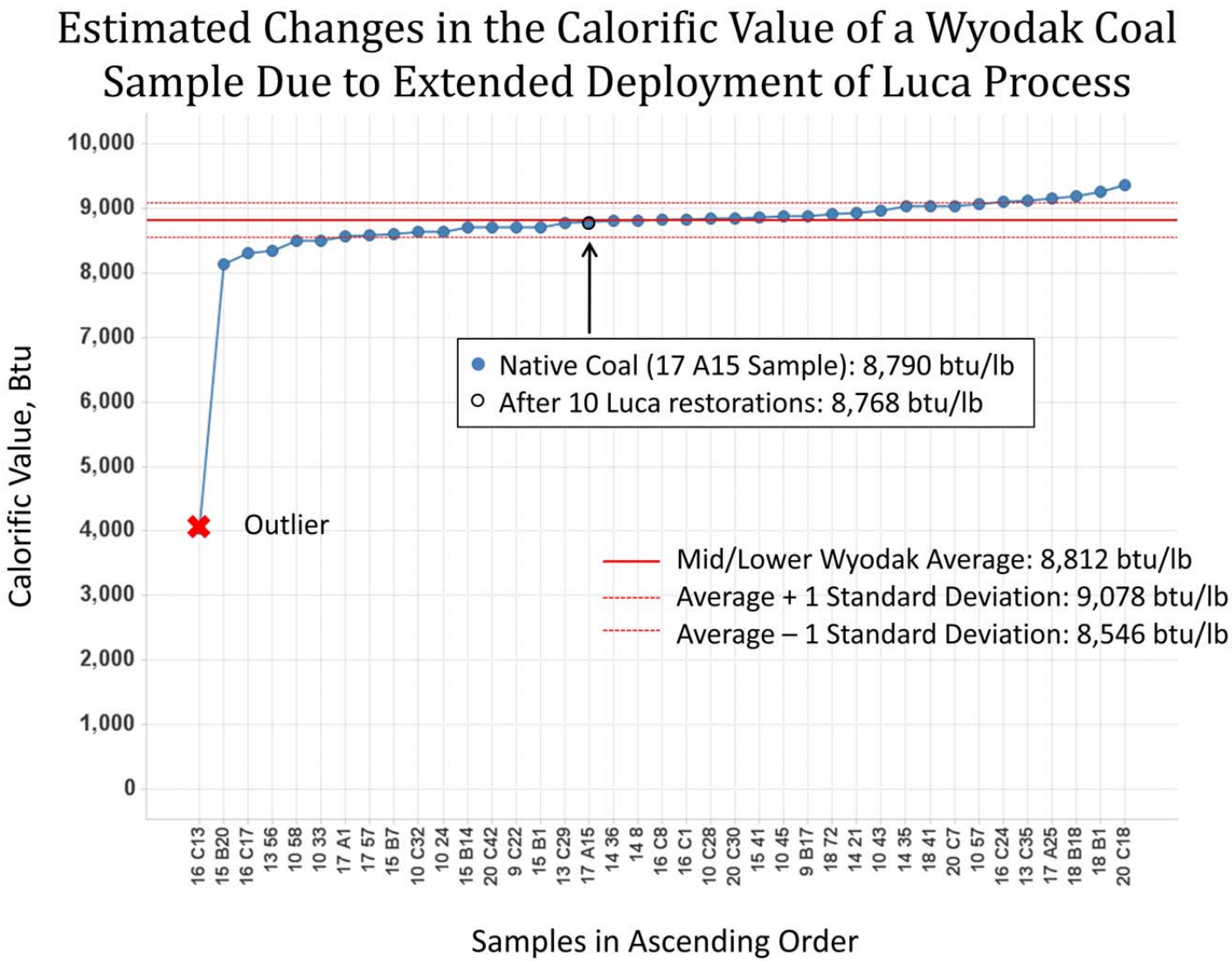
Change in Coal Quality and Mass Due to the Luca Process

Middle/Lower Wyodak Coal: Sample A15 from Core hole 17 (USGS dataset)

Basis: 8,745,590 tons original in situ weight of coal
(60' thick coal * 80 acres * 1359.7 * 1.34 gms/cc)

ie. One spacing unit of average-thickness coal

Molecular wt of methane:	16.042
Wt % carbon:	74.87%
Wt % hydrogen:	25.13%
Hydrogen atomic wt:	1.008
Carbon atomic wt:	12.01
Wt of methane (lbs/cu.ft.):	0.043
Heating value of methane: (btu/cu.ft.)	1,009.7

			Coal converted during the course of Luca's current PRB restoration field results (50,000 mcf)			Coal converted during the course of *TEN* of Luca's current PRB restoration field results (500,000 mcf)		
Original in situ coal			Tons of coal or components			Tons of coal or components		
Weight:	8,745,590	tons						
Component	Wt %	Weight (tons)	Converted to methane	Remaining as coal	Wt % in the coal	Converted to methane	Remaining as coal	Wt % in the coal
Water	27.0%						0	0.0%
Ash	2.5%	215,142		215,142	2.5%		215,142	2.5%
Carbon	52.6%	4,601,055	805	4,600,250	52.6%	8,048	4,592,202	52.6%
Hydrogen	6.7%	586,829	270	586,559	6.7%	2,702	583,857	6.7%
Oxygen	37.4%	3,271,725		3,271,725	37.4%		3,271,725	37.5%
Sulfur	0.1%	12,244		12,244	0.1%		12,244	0.1%
Nitrogen	0.7%	58,595		58,595	0.7%		58,595	0.7%
Total	100%	8,745,590	1,075	8,744,515	100%	10,750	8,733,765	100%
Heating value of coal (btu/lb):								
AF basis		9,012						
As-received:		**8,790**						
Heating values (billions of btu):								
original coal:		153,747.5		153,747.5			153,747.5	
new methane:		0		59.4			593.9	
remaining coal:		153,747.5		153,688.1			153,153.5	
btu/lb remaining coal:				**8,788**			**8,768**	
% reduction vs. original				0.0%			0.3%	
Weight of remaining coal as % of original coal			99.99%			99.86%		
Methane created			58,824	mcf		588,235	mcf	
Methane produced (85% recovery factor)			**50,000**	mcf		**500,000**	mcf	
Sulfur content per ton of coal (lbs/ton shipped):		2.80		2.80			2.80	

Attachment 2