

PARAMOUNT TRANSMISSION LTD.

4700 Bankers Hall West
888 - 3rd Street SW
Calgary, Alberta
T2P 5C5

Telephone: (403) 290-3600

Fax: (403) 266-6032

NEB File 3400-P097-1 & 2620-D-4-7

June 24, 2002

National Energy Board
444 7th Avenue S.W.
Calgary, Alberta
T2P 0X8

Attention: Mr. Michel Mantha

Dear Sir;

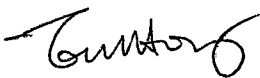
**Re: Paramount Transmission Ltd. Cameron Hills Pipeline and Fuel Gas Pipeline, Order
XO-P097-02-2002 as amended; Conditions 14: Corrosion Inhibition Program**

Paramount Transmission Ltd.'s (PTL) hereby submits three copies of the information requested in the National Energy Board's (NEB) letter of April 4, 2002 for its evaluation of PTL's corrosion inhibition program.

If further questions regarding the above matter then please contact the undersigned at (403) 290-3696 or by e-mail, tom.hong@paramountres.com.

Yours truly,

PARAMOUNT TRANSMISSION LTD.



Tom Hong, P.Eng.
Project Manager

Attachments

c.c. File Cameron Hills G 3.2

310460

MAIL ROOM
SALLE DE COURIER
2002 JUN 24 P 3:37
NEB / ONE

PARAMOUNT TRANSMISSION LTD. (PTL) CAMERON HILLS PIPELINE
Order XO-P097-02-2002 as amended, Files 3400-P097-1 & 2620-D-4-7,
Conditions 14: Corrosion Inhibition Program

Additional Information as requested in the National Energy Board (NEB) letter of April 4, 2002

Request

1) data on:

a) the flow regime and water chemistry of the Bistcho Lake Area which is reportedly analogous to the Cameron Hills Pipeline; and

b) the water chemistry of the Cameron Hills Pipeline;

2) data and analysis on:

c) the similarities of the inhibitor programs of Bistcho Lake Area and the Cameron Hills Pipeline;

Response

Table 1: Comparison between Bistcho Lake and Cameron Hills

	Bistcho Lake Area	Cameron Hills Pipeline
Flow Regime	<p>The flow regime will vary depending on the gas and liquid production rates and the terrain (i.e. uphill or downhill) which the pipelines go through.</p> <p>Generally, the flow regimes would be expected to be as follows: Level terrain – Vary from mist to laminar Uphill section – Slug flow Downhill section – Laminar</p>	<p>The terrain associated with the Cameron Hills Pipeline is generally sloping downhill slightly with some undulation in terrain when drainages or watercourses are encountered. The flow regime is expected to be generally laminar.</p>
Water Chemistry	<p>25,000 to 70,000 ppm chlorides Two group stream water analyses from the Bistcho field are attached.</p>	<p>14,000 to 68,000 ppm chlorides Well and group stream water analyses from the Cameron Hills field are attached.</p>
Similarities of the Proposed Inhibitor Programs:		
Batch Chemical	Techni-Hib 3169 based on a 1 mil film thickness.	Techni-Hib 3169 based on a 1 mil film thickness.
Continuous Injection Chemical	RCI-00125 based on 200 ppm in liquid phase	RCI-00125 based on 200 ppm in liquid phase

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Table 1 - continued

	Bistcho Lake Area	Cameron Hills Pipeline
Corrosion Coupon Monitoring	Every 90 days	Every 90 days
Iron & Manganese – Field	Every 2 months	Every 2 months
Iron & Manganese – Plant	Monthly	Monthly
Corrosion rate calculations	Monthly	Monthly
SRB ₍₁₎ Analysis – Field	Quarterly	Quarterly
SRB Analysis – Plant	Monthly	Monthly
APB ₍₂₎ Analysis – Field	Quarterly	Quarterly
APB Analysis - Plant	Monthly	Monthly
Full Scale Analysis	Every 6 months	Every 6 months
Millipore Gas Sampling	Quarterly	Quarterly
Notes: (1) Sulphide reducing bacteria (2) Acid producing bacteria	Actual frequencies may vary depending on the scheduling of activities and the trending of the data.	Actual frequencies may vary depending on scheduling of the activities and the trending of the data.

Request

2) *data and analysis on:*

d) the effect of methanol on the corrosion inhibitor film specific to the Cameron Hills Pipeline;

Response

The two influences of methanol on the corrosion inhibition film are as follows:

- The liquid volume added to the pipeline; and
- The addition of oxygen to system.

Results from experiments performed by BJ Services Company Ltd, who is implementing the corrosion inhibition program for PTL, show that oxygen-free methanol at 5 –12% by volume in a brine solution does not accelerate uninhibited corrosion. However, oxygen added to a system with H₂S and CO₂ increased the uninhibited corrosion rate by as much as a factor of ten depending on the amount of oxygen added.

The specific inhibitors used in the Bistcho Lake Field and Cameron Hills have been laboratory tested for their tolerance to methanol. The inhibitor effectiveness, expressed by the equation: (uninhibited corrosion rate – inhibited corrosion rate)/ uninhibited corrosion rate, decreased by only 0.4% for the oil soluble inhibitor and 0.8% for the water soluble inhibitor in the presence of

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5% methanol. This is a negligible influence which is less than the limits of experimental accuracy.

Request

2) *data and analysis on:*

- e) *the effect of water chemistry on the corrosion inhibitor water dispersibility for the Cameron Hills Pipeline.*

Response

The RCI-00125 inhibitor is soluble in the range of water chemistry at Cameron Hills. The Techni-Hib 3169 inhibitor has limited dispersibility in the range of water chemistry at Cameron Hills.



WATER ANALYSIS AND SCALING TENDENCY CALCULATIONS

Company:	Parmount Res. Ltd.	LSD	North Inlet
NRD #	02-013	Date D/M/Y	Jan22/2002
Sample #	P-8546N		

Cations			
Ion	mg/L	mmoles/L	meq/L
Na	35100	1526.8	1526.8
K	1010	25.8	25.8
Ca	7290	181.9	363.8
Mg	1850	76.1	152.2
Fe	<0.01	0.0	0.0
Ba	0.27	0.00	0.00
Sr	339	3.87	7.74
Total	45589.27	1814.5	2076.3

Anions			
Ion	mg/L	mmoles/L	meq/L
Cl	63400	1788.3	1788.3
SO4	1050	10.9	21.9
HCO3	752	12.3	12.3
CO3	ND	0.0	0.0
OH	ND	0.0	0.0
Total	65202	1811.5	1822.5

Ionic Strength μ	2.214	Total Hardness (mg/L as CaCO ₃)	25818
pH (@ 22 °C)	6.77	Total Alkalinity (mg/L as CaCO ₃)	617
Bottom Hole Temperature (°C)	40	Calculated Dissolved Solids (mg/L)	110791
K-factor at 40 °C	3	Specific Gravity (@ 15.6°C)	1.0751
H2S Present:	Yes	Specific Gravity (as mg/L NaCl)	105841

CaCO₃ Scaling Index Calculations

Stability Index at 40 °C 1.12

SI > 0, so CaCO₃ Scale is likely to form

CaSO₄ Scaling Prediction

CaSO ₄ Ksp at 40 °C	2.9E-03
Solubility Limit meq/L	30.9
Actual CaSO ₄ Conc. in meq/L	21.9

Limit > Actual, so CaSO₄ Scale is unlikely to form

BaSO₄ Scaling Prediction

BaSO ₄ Ksp at 40 °C	2.3E-08
Solubility Limit meq/L	0.0042
Actual BaSO ₄ Conc. in meq/L	0.0039

Limit > Actual, so BaSO₄ Scale is unlikely to form

SrSO₄ Scaling Prediction

SrSO ₄ Ksp at 40 °C	2.1E-05
Solubility Limit meq/L	4.5
Actual SrSO ₄ Conc. in meq/L	7.7

Limit < Actual, so SrSO₄ Scale is likely to form



BJ Services Company Canada

BISTCHO SOUTH LATERAL WATER ANALYSIS**WATER ANALYSIS AND
SCALING TENDENCY CALCULATIONS**

Company:	Parmount Res. Ltd.
NRD #	02-013
Sample #	P-8546D

LSD	South Inlet
Date D/M/Y	Jan22/2002

Cations			
Ion	mg/L	mmoles/L	meq/L
Na	21900	952.6	952.6
K	432	11.0	11.0
Ca	3680	91.8	183.6
Mg	1980	81.5	162.9
Fe	0.16	0.0	0.0
Ba	84.6	0.62	1.23
Sr	540	6.16	12.33
Total	28616.76	1143.7	1323.8

Anions			
Ion	mg/L	mmoles/L	meq/L
Cl	52300	1475.2	1475.2
SO ₄	44	0.5	0.9
HCO ₃	811	13.3	13.3
CO ₃	ND	0.0	0.0
OH	ND	0.0	0.0
Total	53155	1488.9	1489.4

Ionic Strength μ	1.575
pH (@ 22 °C)	6.82
Bottom Hole Temperature (°C)	40
K-factor at 40 °C	3.15
H ₂ S Present:	Yes

Total Hardness (mg/L as CaCO ₃)	17493
Total Alkalinity (mg/L as CaCO ₃)	665
Calculated Dissolved Solids (mg/L)	81772
Specific Gravity (@ 15.6°C)	1.0532
Specific Gravity (as mg/L NaCl)	74977

CaCO₃ Scaling Index Calculations

Stability Index at 40 °C 0.76

SI > 0, so CaCO₃ Scale is likely to form**CaSO₄ Scaling Prediction**

CaSO ₄ Ksp at 40 °C	2.5E-03
Solubility Limit meq/L	43.5
Actual CaSO ₄ Conc. in meq/L	0.9

Limit > Actual, so CaSO₄ Scale is unlikely to form**BaSO₄ Scaling Prediction**

BaSO ₄ Ksp at 40 °C	1.8E-08
Solubility Limit meq/L	0.1533
Actual BaSO ₄ Conc. in meq/L	0.9162

Limit < Actual, so BaSO₄ Scale is likely to form**SrSO₄ Scaling Prediction**

SrSO ₄ Ksp at 40 °C	1.8E-05
Solubility Limit meq/L	4.5
Actual SrSO ₄ Conc. in meq/L	0.9

Limit > Actual, so SrSO₄ Scale is unlikely to form



WATER ANALYSIS AND SCALING TENDENCY CALCULATIONS

Company:	Paramount Resources Ltd.	LSD	Well A-73
NRD #	02-396	Date D/M/Y	May 15/2002
Sample #	P-8930C		

Cations				Anions			
Ion	mg/L	mmoles/L	meq/L	Ion	mg/L	mmoles/L	meq/L
Na	1771	77.0	77.0	Cl	7600	214.4	214.4
K	113	2.9	2.9	SO ₄	190	2.0	4.0
Ca	1725	43.0	86.1	HCO ₃	242	4.0	4.0
Mg	730	30.0	60.1	CO ₃	ND	0.0	0.0
Fe	0.05	0.0	0.0	OH	ND	0.0	0.0
Ba	0.29	0.00	0.00				
Sr	6.15	0.07	0.14				
Total	4345.49	153.1	226.2	Total	8032	220.3	222.3

Ionic Strength μ	0.299	Total Hardness (mg/L as CaCO ₃)	7313
pH (@ 22 °C)	6.87	Total Alkalinity (mg/L as CaCO ₃)	198
Bottom Hole Temperature (°C)	40	Calculated Dissolved Solids (mg/L)	12377
K-factor at 40 °C	2.65	Specific Gravity (@ 15.6°C)	1.0065
H ₂ S Present:	No	Specific Gravity (as mg/L NaCl)	9161

CaCO₃ Scaling Index Calculations

Stability Index at 40 °C 0.45

SI > 0, so CaCO₃ Scale is likely to form

CaSO₄ Scaling Prediction

CaSO₄ Ksp at 40 °C 6.8E-04
 Solubility Limit meq/L 25.3
 Actual CaSO₄ Conc. in meq/L 4.0

Limit > Actual, so CaSO₄ Scale is unlikely to form

BaSO₄ Scaling Prediction

BaSO₄ Ksp at 40 °C 5.0E-09
 Solubility Limit meq/L 0.0051
 Actual BaSO₄ Conc. in meq/L 0.0042

Limit > Actual, so BaSO₄ Scale is unlikely to form

SrSO₄ Scaling Prediction

SrSO₄ Ksp at 40 °C 4.0E-06
 Solubility Limit meq/L 2.5
 Actual SrSO₄ Conc. in meq/L 0.1

Limit > Actual, so SrSO₄ Scale is unlikely to form



WATER ANALYSIS AND SCALING TENDENCY CALCULATIONS

Company:	Paramount Resources Ltd.
NRD #	02-396
Sample #	P-8930A

LSD	Well B-08
Date D/M/Y	May 15/2002

Cations			
Ion	mg/L	mmoles/L	meq/L
Na	24500	1065.7	1065.7
K	2440	62.4	62.4
Ca	13600	339.3	678.6
Mg	2190	90.1	180.2
Fe	0.83	0.0	0.0
Ba	0.53	0.00	0.01
Sr	120	1.37	2.74
Total	42851.36	1558.9	1989.7

Anions			
Ion	mg/L	mmoles/L	meq/L
Cl	67200	1895.5	1895.5
SO ₄	925	9.6	19.3
HCO ₃	114	1.9	1.9
CO ₃	ND	0.0	0.0
OH	ND	0.0	0.0
Total	68239	1907.0	1916.6

Ionic Strength μ	2.391
pH (@ 22 °C)	6.78
Bottom Hole Temperature (°C)	40
K-factor at 40 °C	2.95
H ₂ S Present:	No

Total Hardness (mg/L as CaCO ₃)	42976
Total Alkalinity (mg/L as CaCO ₃)	93
Calculated Dissolved Solids (mg/L)	111090
Specific Gravity (@ 15.6°C)	1.0797
Specific Gravity (as mg/L NaCl)	112324

CaCO₃ Scaling Index Calculations

Stability Index at 40 °C 0.63

SI > 0, so CaCO₃ Scale is likely to form

CaSO₄ Scaling Prediction

CaSO ₄ Ksp at 40 °C	3.0E-03
Solubility Limit meq/L	17.5
Actual CaSO ₄ Conc. in meq/L	19.3

Limit < Actual, so CaSO₄ Scale is likely to form

BaSO₄ Scaling Prediction

BaSO ₄ Ksp at 40 °C	2.4E-08
Solubility Limit meq/L	0.0050
Actual BaSO ₄ Conc. in meq/L	0.0077

Limit < Actual, so BaSO₄ Scale is likely to form

SrSO₄ Scaling Prediction

SrSO ₄ Ksp at 40 °C	2.1E-06
Solubility Limit meq/L	0.5
Actual SrSO ₄ Conc. in meq/L	2.7

Limit < Actual, so SrSO₄ Scale is likely to form



WATER ANALYSIS AND SCALING TENDENCY CALCULATIONS

Company:	Paramount Resources Ltd.	LSD	Well C-50
NRD #	02-396	Date D/M/Y	May 15/2002
Sample #	P-8930B		

Cations				Anions			
Ion	mg/L	mmoles/L	meq/L	Ion	mg/L	mmoles/L	meq/L
Na	261	11.4	11.4	Cl	660	18.6	18.6
K	19.8	0.5	0.5	SO ₄	250	2.6	5.2
Ca	181	4.5	9.0	HCO ₃	145	2.4	2.4
Mg	26.4	1.1	2.2	CO ₃	ND	0.0	0.0
Fe	0.27	0.0	0.0	OH	ND	0.0	0.0
Ba	0.05	0.00	0.00				
Sr	2.43	0.03	0.06				
Total	490.95	17.5	23.1	Total	1055	23.6	26.2

Ionic Strength μ	0.033	Total Hardness (mg/L as CaCO ₃)	561
pH (@ 22 °C)	7.5	Total Alkalinity (mg/L as CaCO ₃)	119
Bottom Hole Temperature (°C)	40	Calculated Dissolved Solids (mg/L)	1546
K-factor at 40 °C	1.9	Specific Gravity (@ 15.6°C)	1.0045
H ₂ S Present:	No	Specific Gravity (as mg/L NaCl)	6342

CaCO₃ Scaling Index Calculations

Stability Index at 40 °C 0.63

SI > 0, so CaCO₃ Scale is likely to form

CaSO₄ Scaling Prediction

CaSO ₄ Ksp at 40 °C	2.0E-04
Solubility Limit meq/L	26.4
Actual CaSO ₄ Conc. in meq/L	5.2

Limit > Actual, so CaSO₄ Scale is unlikely to form

BaSO₄ Scaling Prediction

BaSO ₄ Ksp at 40 °C	1.0E-09
Solubility Limit meq/L	0.0008
Actual BaSO ₄ Conc. in meq/L	0.0007

Limit > Actual, so BaSO₄ Scale is unlikely to form

SrSO₄ Scaling Prediction

SrSO ₄ Ksp at 40 °C	2.0E-07
Solubility Limit meq/L	0.2
Actual SrSO ₄ Conc. in meq/L	0.1

Limit > Actual, so SrSO₄ Scale is unlikely to form



BJ Services Company Canada

CAMERON PIPELINE WATER ANALYSIS
(INCLUDES SOME BISTCHO WELLS)WATER ANALYSIS AND
SCALING TENDENCY CALCULATIONS

Company:	Paramount Resources Ltd.	LSD	12" Line @ Bistcho Lake
NRD #	02-396	Date D/M/Y	May 15/2002
Sample #	P-8930D		

Cations				Anions			
Ion	mg/L	mmoles/L	meq/L	Ion	mg/L	mmoles/L	meq/L
Na	2620	114.0	114.0	Cl	24600	693.9	693.9
K	11200	286.5	286.5	SO ₄	1200	12.5	25.0
Ca	4520	112.8	225.5	HCO ₃	631	10.3	10.3
Mg	726	29.9	59.7	CO ₃	89.7	1.5	2.9
Fe	0.25	0.0	0.0	OH	ND	0.0	0.0
Ba	1.13	0.01	0.02				
Sr	31	0.35	0.71				
Total	19098.43	543.4	686.4	Total	26520.7	718.2	732.1

Ionic Strength μ	0.866	Total Hardness (mg/L as CaCO ₃)	14277
pH (@ 22 °C)	8.4	Total Alkalinity (mg/L as CaCO ₃)	667
Bottom Hole Temperature (°C)	40	Calculated Dissolved Solids (mg/L)	45619
K-factor at 40 °C	3.05	Specific Gravity (@ 15.6°C)	1.0177
H ₂ S Present:	No	Specific Gravity (as mg/L NaCl)	24945

CaCO₃ Scaling Index Calculations

Stability Index at 40 °C 2.48

SI > 0, so CaCO₃ Scale is likely to form**CaSO₄ Scaling Prediction**

CaSO ₄ Ksp at 40 °C	2.2E-03
Solubility Limit - meq/L	37.6
Actual CaSO ₄ Conc. in meq/L	25.0

Limit > Actual, so CaSO₄ Scale is unlikely to form**BaSO₄ Scaling Prediction**

BaSO ₄ Ksp at 40 °C	1.1E-08
Solubility Limit - meq/L	0.0018
Actual BaSO ₄ Conc. in meq/L	0.0172

Limit < Actual, so BaSO₄ Scale is likely to form**SrSO₄ Scaling Prediction**

SrSO ₄ Ksp at 40 °C	1.1E-05
Solubility Limit - meq/L	1.8
Actual SrSO ₄ Conc. in meq/L	0.7

Limit > Actual, so SrSO₄ Scale is unlikely to form