Table 1. Inlet Design Parameters

Olefinic NGL Inlet Design Parameters	
Standard Volume Flow Rate	238.5 Sm^3/d (1500 BBL/d)
Operating Conditions [NOTE 1]	47 kPag @ -30 °C to 781 kPag @ 30 °C (7 psig @ -22 °F to 113 psig @ 86 °F)
Composition (mole %)	
Methane	0.0300
Ethane	0.1360
Propene (Propylene)	45.8451
Propane	13.8131
i-Butane	16.4334
i-Butene	9.3574
1-Butene	6.0983
Butadiene-1,3	0.2679
n-Butane	2.2954
trans-2-Butene	3.9919
cis-2-Butene	1.7045
Methyl Mercaptan	0.0153 (153 ppm)
Ethyl Mercaptan	0.0118 (118 ppm)
Total	100.0%

Notes

1 – NGL is at equilibrium in the Storage Bullet. Conditions will fluctuate with ambient temperature.

Table 5. Inlet Feed Bullet and Truck Offloading Design Information

Inlet Feed Bullet and Truck Offloading Design Information	
Equipment Source	One (1) surplus bullet from Maxfield (based on budget quote)
Size	3,277mm ID x 39,446mm S/S (129" ID x 129'-5" S/S)
Capacity	341 m^3 (90,000 USWG)
Storage Time for production flows (see Table 1)	31 hours
Design Pressure	1,724 kPag (250 psig)
Truck Offloading	Trucks – Super-B Trains with 50 m^3 operable capacity Number of Trucks Required – 5 trucks per day Truck Frequency – every 2.4 hrs during a 12-hour day shift

Table 6. Inlet Feed Pump Design Information

Inlet Feed Pump Design Information	
Equipment Source	Two (2) x 100% Booster Pumps and Three (3) x 50% Feed Pumps
Power – motor	Boosters (7.5 kW (10 hp) each) & Feed Pumps (5.6 kW (7.5 hp) each)

Table 2. Outlet Stream Information

Outlet Stream Information			
Operating Parameters	**Sales Propene (Propylene)**	**Sales C_4+**	**Sales Propane**
Standard Volume Flow Rate	97.7 Sm^3/d (615 BBL/d)	109.2 Sm^3/d (687 BBL/d)	31.5 Sm^3/d (198 BBL/d)
Operating Conditions[NOTE 1]	1579 kPag @ 40 °C (229 psig @ 104 °F)	395 kPag @ 39 °C (57 psig @ 102 °F)	1230 kPag @ 40 °C (178 psig @ 104 °F)
Composition (mole %)			
Methane	0.0670		
Ethane	0.3035		
Propene (Propylene)	96.3000	1.9920	13.7520
Propane	3.3295	1.7852	85.3573
i-Butane		39.3401	0.5016
i-Butene		22.4143	0.2443
1-Butene		14.6223	0.1139
Butadiene-1,3		0.6426	0.0042
n-Butane		5.5149	0.0089
trans-2-Butene		9.5913	0.0145
cis-2-Butene		4.0964	0.0030
Methyl Mercaptan		7.0 ppm	2.8 ppm
Ethyl Mercaptan		2.8 ppm	0.0 ppm
Total	100.0	100.0	100.0

Notes

1 – Conditions are after level control valve and correspond to the pressure at saturation (vapour pressure) at operating temperature. For propylene, conditions will vary with air cooler performance (given conditions are for worst case scenario of 35 °C ambient air).

Table 3. Sales Propene (Propylene) Specification

Composition	Method	Units	Limits	
			Min.	Max.
Propylene	ASTM-D-2163	% vol.	95	-
Propane	ASTM-D-2163	% vol.	-	5
Ethane	ASTM-D-2163	vol. p.p.m.	-	2.000
Ethylene	ASTM-D-2163	vol. p.p.m.	-	10
Methyl Acetylene	ASTM-D-2163	vol. p.p.m.	-	20
Propadiene	ASTM-D-2163	vol. p.p.m.	-	10
Total C4´s	ASTM-D-2163	vol. p.p.m.	-	500
Water	Shaw water	p.p.m.	-	10
Sulphur	ASTM-D-3246	p.p.m.	-	2
Carbon Dioxide	UOP-803	vol. p.p.m.	-	5
Oxide de Carbon	UOP-803	vol. p.p.m.	-	5

The sales propane stream design properties are:

- Vapor Pressure @ 37.8°C: 1264 kPag
- Density @ 15°C and 670 kPag (vapor pressure @ 15°C): 510 kg/m³
- Total Sulphur: 2.1 mg/kg S

Table 4. Sales Propane Specification

BRAZEAU PIPELINE PETROLEUM SPECIFICATIONS Effective : Aug 10, 2015	Units	Test Method	ETHANE PLUS
Density at 15°C and in the liquid phase at vapor pressure	kg/m3		529 – 440
Vapour Pressure at 15°C	kPag		◄3500
Vapour Pressure at 37.8°C	kPag	ASTM D1267	N/A
Receipt Temperature	°C °C		20 (max.) 0.0 (min.)
Carbon Dioxide to Ethane Ratio	% of Ethane in mol%	GPA-2177	◄6.0
Methane to Ethane Ratio	% of Ethane in mol%	GPA-2177	◄2.5
Methane to Propane Ratio	% of Propane mol%	GPA-2177	N/A
Ethane to Propane Ratio	% of Propane mol%	GPA-2177	N/A
Copper Strip		ASTM D-1838	N/A
Moisture Content			No Free Water at -29oC & 9930 Kpa
Colour		ASTM D1500	◄ 0.5
Total Sulphur	wppm S	ASTM D5623	◄90
Hydrogen Suphide	wppm S	ASTM D5623	◄10
Carbonyl Sulphide	wppm S	ASTM D5623	◄60
Contaminants - solids using a 5 micron filter, millipore test apparatus and accepted lab practices)	mg/l		◄20[1]

NOTES:

1) Includes but not limited to sand, dust, asphaltene, crude oil, gum and gum forming substances.
In addition to the above specifications,Ethane Plus and Propane Plus Mixes must be commercially free from sand, dust, gums and gum forming substances, catalyst poisons, oxygenates, impurties and other objectional or deleterious substances which may be injurious to process equipment or pipelines, or which may interfere with the product's transmission through pipelines.
The symbol "◄" designates less than and "►" designates greater than.

3.4.1 C_3/C_4 Splitter

The Fractionation Plant is designed to produce a specification sales propylene stream to be trucked off-site and sold as chemical grade propylene. The olefinic NGL feed stream to the Frac Plant contains a substantial C_4+ content and the optimal configuration for the system in terms of equipment sizing and heat input requirements is to first split the propane/propylene stream from the heavier C_4+ components and then perform the much more difficult split of the propane from the propylene.

The first tower, reboiler and reflux system in the C_3/C_4+ splitting service, is designed to achieve 97+% recovery of the propane/propylene to the overhead stream that will feed the propane/propylene splitter. As indicated above, the bottoms liquid stream comprises primarily C_4+ with a small amount of propane/propylene (< 5% molar).

Table 8. C_3/C_4 Splitter Design Information

C_3/C_4 Splitter Design Information	
Inlet Conditions	238 Sm^3/d @ 2,068 kPag and 20 °C (1500 BBL/d @ 300 psig and 68°F)
C_3/C_4 Splitter Equipment Sizing	
Inlet Feed/Bottoms Exchanger	134.3 kW (458,251 BTU/hr) "AEU" type shell-and-tube exchanger
Feed Product Heat Exchanger	13.8 kW (47,088 BTU/hr) "AEU" type shell-and-tube exchanger
C_3/C_4 Splitter Tower	914mm x 19,812mm S/S (36" ID x 65'-0" S/S) 30 conv trays
C_3/C_4 Splitter Reboiler	831.6 kW (2.84 MMBtu/hr) duty "BKU" type shell-and-tube exchanger 489/794 mm x 3,658 mm TS/S (19/31 in x 12 ft TS/S)

C_3/C_4 Splitter Design Information	
C_3/C_4 Splitter Reflux Condenser	742 kW (2.53 MMBtu/hr) duty Aerial cooler
C_3/C_4 Splitter Reflux Drum	Horizontal reflux drum 1,067 mm ID x 3,048 mm S/S (42" ID x 10'-0" S/S)
C_3/C_4 Splitter Reflux Pumps	2 x 100% Radially Split Vertical Inline pumps 22.7 m3/h @ 100.3 m TDH (100 USGPM @ 329 ft TDH) 11 kW (15 hp) electric motors

3.4.2 Propane/Propylene Splitter

The second tower, reboiler and reflux system in the propane/propylene splitting service, is designed to achieve the required < 5% (vol.) propane content in the sales propylene stream while also achieving approximately 96% (molar) recovery of the propylene to the sales propylene stream. The boiling points of propane and propylene are extremely close, which results in a very low relative volatility. From a fractionation/distillation design standpoint, this means that a substantial number of ideal distillation stages and a large reflux ratio are required to achieve the performance specifications.

Table 9. Propane/Propylene Splitter Design Information

Propane/Propylene Splitter Design Information	
Inlet Conditions	130 Sm^3/d @ 2,265 kPag and 50 °C (813 BBL/d @ 329 psig and 122 °F)
Propane/Propylene Splitter Equipment Sizing	
Propane/Propylene Splitter Tower	1,676 mm x 51,816 mm S/S (66" ID x 170'-0" S/S) 94 conv trays
Propane/Propylene Splitter Reboiler	3,789 kW (12.93 MMBtu/hr) duty "BKU" type shell-and-tube exchanger 791/1,200mm x 5,487 mm TS/S (31/47 " x 18' TS/S)
Propane/Propylene Splitter Reflux Condenser	3,794 kW (12.95 MMBtu/hr) duty Aerial cooler
Propane/Propylene Splitter Reflux Drum	Horizontal reflux drum 1,524 mm ID x 6,096mm S/S (60" ID x 20'-0" S/S)
Propane/Propylene Splitter Reflux Pumps	2 x 100% Radially Split Vertical Inline pumps 122.5 m3/h @ 75.3 m TDH (539 USGPM @ 247 ft TDH) 30 kW (40 hp) electric motors
Propylene Product Cooler	23.7 kW (80,868 Btu/hr) duty Aerial cooler

Table 10. Heat Medium Package Design Information

Heat Medium Package Equipment Sizing	
Heat Medium Circulation Pumps	2 x 100% Pumps 174.4 m3/h @ 49.4 m TDH (768 USGPM @ 162 ft TDH) 37 kW (50 hp) electric motors
Heat Medium Heater	5,275 kW (18 MMBtu/hr)
Heat Medium Filtration	2 x 50% Filters 21.4 m3/h (100 usgpm) slipstream particulate filtration (10 micron)
Heat Medium Surge Drum	Horizontal Surge 1,219 mm OD x 6,096 mm S/S (48" OD x 20 ft S/S)
Heat Medium Pop Tank	Atmospheric Tank, 25 bbl, 16 oz DP/0.5 oz vac

Table 11. Sales Propylene Bullet and Truck Loading Design Information

Sales Propylene Bullet and Truck Loading Design Information	
Equipment Source	One (1) existing butane blending converted to sales propylene storage
Size	2,743mm ID x 21,336mm S/S (108" ID x 70'-0" S/S)
Capacity	131 m^3 (34,606 USWG)
Storage Time for production flows (see Table 2)	29 hours
Design Pressure	3,447 kPag (500 psig)
Truck Loading	Trucks – Super-B Trains with 50 m^3 operable capacity Number of Trucks Required – 2 trucks per day Truck Loading Pump Capacity – 68.2 m^3/hr (300 USGPM) Truck Loading Time – 44 minutes Truck Frequency – every 6.0 hrs during a 12-hour day shift

Table 12. Sales C_4+ Bullet and Truck Loading Design Information

Sales C_4+ Bullet and Truck Loading Design Information	
Equipment Source	One (1) new bullet from Maxfield (based on budget quote)
Size	3,277mm ID x 25,756mm S/S (129" ID x 84'-6" S/S)
Capacity	226 m^3 (59,700 USWG)
Storage Time for production flows (see Table 2)	44 hours
Design Pressure	1724 kPag (250 psig)
Truck Loading	Trucks – Super-B Trains with 50 m^3 operable capacity Number of Trucks Required – 3 trucks per day Truck Loading Pump Capacity – 68.2 m^3/hr (300 USGPM) Truck Loading Time – 44 minutes Truck Frequency – every 4.0 hrs during a 12-hour day shift

Table 13. Sales Propane Bullet and Truck Loading Design Information

Sales Propane Bullet and Truck Loading Design Information	
Equipment Source	One (1) new bullet from Maxfield (based on budget quote)
Size	3,277mm ID x 25,756mm S/S (129" ID x 84'-6" S/S)
Capacity	226 m^3 (59,700 USWG)
Storage Time for production flows (see Table 2)	154 hours
Design Pressure	1,724 kPag (250 psig)
Truck Loading	Trucks – Super-B Trains with 50 m^3 operable capacity Number of Trucks Required – 1 trucks per day Truck Loading Pump Capacity – 68.2 m^3/hr (300 USGPM) Truck Loading Time – 44 minutes Truck Frequency – any time during 12-hour shift