

CRC Crude & Vacuum Units																			
Detailed Material Balance																			
Case: 100% Bakken																			
Rev B																			
12/20/2019																			
	Units	1	2	3	4	5	6	7	8	9	10	11	12L	12V	13	14	15	16	17
Description																			
		Crude	G-4001A/B	EX-4001	EX-4002	Crude	EX-4004	EX-4005	EX-4006	EX-21001	EX-21002	Downstream	Liquid	Vapor	T-4001	AC-4001	EX-4007	Off Gas	Sour
		Feed from	Discharge	Tube Side	Tube Side	from	Tube Side	Shell Side	Tube Side	Tube Side	Shell Side	H-4001	Part of	Part of	Gross	Effluent	Effluent	from	Water
		BL		Effluent	Effluent	Desalter	Effluent	Effluent	Effluent	Effluent	Effluent	Letdown CV	Stream 12	Stream 12	Overhead			D-4001	to OSBL
		Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Mixed	Liquid Phase	Vapor Phase	Vapor Phase	Mixed Phase	Mixed Phase	Vapor Phase	Liquid Phase
Temperature	F	60.00	63.08	241.44	260.00	260.00	297.45	314.80	442.00	484.66	493.70	461.57	700.00	700.00	298.57	130.00	100.00	100.00	100.00
Pressure	psia	46.80	435.70	409.70	403.70	375.00	380.70	366.70	357.70	348.70	336.70	96.70	44.70	44.70	32.70	27.60	24.70	19.70	64.70
Molar Vapor Fraction		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00	1.00	1.00	0.04	0.02	1.00	0.00
Molar Liquid Fraction		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.60	1.00	0.00	0.00	0.96	0.98	0.00	1.00
Molar Solid Fraction		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mass Vapor Fraction		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	1.00	1.00	0.02	0.01	1.00	0.00
Mass Liquid Fraction		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.76	1.00	0.00	0.00	0.98	0.99	0.00	1.00
Mass Solid Fraction		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Molar Enthalpy	Btu/lbmol	-28070.62	-27672.10	-12789.08	-11078.00	-11078.00	-7543.28	-5868.95	7153.70	11804.64	12809.25	12809.25	107600.56	41974.45	-15144.40	-36136.17	-37764.41	-40434.89	-123830.02
Mass Enthalpy	Btu/lb	-168.75	-168.32	-77.79	-67.39	-67.39	-45.88	-35.70	43.51	71.81	77.92	77.92	239.67	295.25	-173.37	-413.68	-432.31	-936.72	-6873.33
Molar Entropy	Btu/lbmol-R	-20.03	-20.07	-0.45	1.42	1.42	5.09	6.75	18.51	23.12	23.83	27.04	159.38	53.19	6.47	-22.98	-25.29	-42.39	-59.26
Mass Entropy	Btu/lb-R	-0.12	-0.12	0.00	0.01	0.01	0.03	0.04	0.11	0.14	0.14	0.16	0.35	0.37	0.07	-0.26	-0.29	-0.98	-3.29
Molar Density	lbmol/cuft	0.31	0.31	0.27	0.26	0.26	0.25	0.25	0.22	0.21	0.21	0.02	0.10	0.00	0.00	0.09	0.16	0.00	3.40
Mass Density	lb/cuft	50.49	50.50	44.23	43.12	43.12	41.39	40.75	36.58	35.21	35.00	4.08	43.57	0.53	0.37	7.65	13.55	0.18	61.27
Enthalpy Flow	MMBtu/hr	-15.09	-14.87	-6.87	-5.95	-5.95	-4.05	-3.15	3.85	6.35	6.89	6.89	4.19	20.93	-7.49	-17.87	-18.67	-0.40	-8.45
Average MW		164.40	164.40	164.40	164.40	164.40	164.40	164.40	164.40	164.40	164.40	164.40	448.96	142.16	87.35	87.35	87.35	43.17	18.02
Mole Flows	lbmol/hr	537.53	537.53	537.53	537.53	537.53	537.53	537.53	537.53	537.53	537.53	537.53	38.95	498.57	494.42	494.42	494.42	9.91	68.23
Mass Flows	lb/hr	88367.72	88367.72	88367.72	88367.72	88367.72	88367.72	88367.72	88367.72	88367.72	88367.72	88367.72	17488.42	70879.31	43189.90	43189.90	43189.90	427.96	1229.29
H2	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N2	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
O2	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H2S	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CO2	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C1	lb/hr	34.47	34.47	34.47	34.47	34.47	34.47	34.47	34.47	34.47	34.47	34.47	0.02	34.44	36.26	36.26	36.26	26.18	0.00
C2	lb/hr	163.37	163.37	163.37	163.37	163.37	163.37	163.37	163.37	163.37	163.37	163.37	0.28	163.09	183.89	183.89	183.89	68.85	0.00
C3	lb/hr	524.01	524.01	524.01	524.01	524.01	524.01	524.01	524.01	524.01	524.01	524.01	1.08	522.93	615.62	615.62	615.62	102.08	0.01
IC4	lb/hr	710.61	710.61	710.61	710.61	710.61	710.61	710.61	710.61	710.61	710.61	710.61	1.94	708.67	851.10	851.10	851.10	63.49	0.00
NC4	lb/hr	871.91	871.91	871.91	871.91	871.91	871.91	871.91	871.91	871.91	871.91	871.91	2.61	869.30	1050.15	1050.15	1050.15	50.85	0.00
IC5	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC5	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H2O	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1519.18	1519.18	1519.18	9.43	1229.23
PC107F	lb/hr	2588.70	2588.70	2588.70	2588.70	2588.70	2588.70	2588.70	2588.70	2588.70	2588.70	2588.70	10.75	2577.94	3140.76	3140.76	3140.76	42.56	0.01
PC138F	lb/hr	1941.56	1941.56	1941.56	1941.56	1941.56	1941.56	1941.56	1941.56	1941.56	1941.56	1941.56	9.50	1932.05	2357.77	2357.77	2357.77	18.80	0.00
PC163F	lb/hr	2310.68	2310.68	2310.68	2310.68	2310.68	2310.68	2310.68	2310.68	2310.68	2310.68	2310.68	12.98	2297.70	2805.95	2805.95	2805.95	13.86	0.00
PC188F	lb/hr	2716.15	2716.15	2716.15	2716.15	2716.15	2716.15	2716.15	2716.15	2716.15	2716.15	2716.15	17.32	2698.83	3294.82	3294.82	3294.82	10.24	0.01
PC213F	lb/hr	3262.59	3262.59	3262.59	3262.59	3262.59	3262.59	3262.59	3262.59	3262.59	3262.59	3262.59	23.56	3239.03	3947.82	3947.82	3947.82	7.75	0.01
PC237F	lb/hr	4079.18	4079.18	4079.18	4079.18	4079.18	4079.18	4079.18	4079.18	4079.18	4079.18	4079.18	33.48	4045.69	4913.30	4913.30	4913.30	6.04	0.01
PC262F	lb/hr	4344.71	4344.71	4344.71	4344.71	4344.71	4344.71	4344.71	4344.71	4344.71	4344.71	4344.71	40.44	4304.27	5188.11	5188.11	5188.11	3.96	0.00
PC287F	lb/hr	3895.34	3895.34	3895.34	3895.34	3895.34	3895.34	3895.34	3895.34	3895.34	3895.34	3895.34	41.01	3854.33	4580.33	4580.33	4580.33	2.16	0.00
PC312F	lb/hr	3099.44	3099.44	3099.44	3099.44	3099.44	3099.44	3099.44	3099.44	3099.44	3099.44	3099.44	36.94	3062.51	3541.04	3541.04	3541.04	1.02	0.00
PC337F	lb/hr	2632.25	2632.25	2632.25	2632.25	2632.25	2632.25	2632.25	2632.25	2632.25	2632.25	2632.25	35.53	2596.72	2809.36	2809.36	2809.36	0.48	0.00
PC362F	lb/hr	2458.19	2458.19	2458.19	2458.19	2458.19	2458.19	2458.19	2458.19	2458.19	2458.19	2458.19	37.47	2420.71	1907.26	1907.26	1907.26	0.20	0.00
PC388F	lb/hr	2559.02	2559.02	2559.02	2559.02	2559.02	2559.02	2559.02	2559.02	2559.02	2559.02	2559.02	44.67	2514.35	419.27	419.27	419.27	0.03	0.00
PC413F	lb/hr	2580.64	2580.64	2580.64	2580.64	2580.64	2580.64	2580.64	2580.64	2580.64	2580.64	2580.64	52.08	2528.55	26.57	26.57	26.57	0.00	0.00
PC437F	lb/hr	2557.68	2557.68	2557.68	2557.68	2557.68	2557.68	2557.68	2557.68	2557.68	2557.68	2557.68	60.15	2497.52	1.28	1.28	1.28	0.00	0.00
PC462F	lb/hr	2515.62	2515.62	2515.62	2515.62	2515.62	2515.62	2515.62	2515.62	2515.62	2515.62	2515.62	69.55	2446.07	0.05	0.05	0.05	0.00	0.00
PC487F	lb/hr	2479.78	2479.78	2479.78	2479.78	2479.78	2479.78	2479.78	2479.78	2479.78	2479.78	2479.78	81.28	2398.50	0.00	0.00	0.00	0.00	0.00
PC512F	lb/hr	2460.03	2460.03	2460.03	2460.03	2460.03	2460.03	2460.03	2460.03	2460.03	2460.03	2460.03	96.24	2363.78	0.00	0.00	0.00	0.00	0.00
PC537F	lb/hr	2391.54	2391.54	2391.54	2391.54	2391.54	2391.54	2391.54	2391.54	2391.54	2391.54	2391.54	112.49	2279.05	0.00	0.00	0.00	0.00	0.00
PC562F	lb/hr	2297.67	2297.67	2297.67	2297.67	2297.67	2297.67	2297.67	2297.67	2297.67	2297.67	2297.67	130.85	2166.82	0.00	0.00	0.00	0.00	0.00
PC587F	lb/hr	2197.74	2197.74	2197.74	2197.74	2197.74	2197.74	2197.74	2197.74	2197.74	2197.74	2197.74	152.32	2045.43	0.00	0.00	0.00	0.00	0.00
PC612F	lb/hr	2123.55	2123.55	2123.55	2123.55	2123.55	2123.55	2123.55	2123.55	2123.55	2123.55	2123.55	179.99	1943.56	0.00	0.00	0.00	0.00	0.00
PC638F	lb/hr	1964.76	1964.76	1964.76	1964.76	1964.76	1964.76	1964.76	1964.76	1964.76	1964.76	1964.76	2						

	Units	1	2	3	4	5	6	7	8	9	10	11	12L	12V	13	14	15	16	17
PC762F	lb/hr	1459.61	1459.61	1459.61	1459.61	1459.61	1459.61	1459.61	1459.61	1459.61	1459.61	1459.61	435.98	1023.63	0.00	0.00	0.00	0.00	0.00
PC788F	lb/hr	1410.29	1410.29	1410.29	1410.29	1410.29	1410.29	1410.29	1410.29	1410.29	1410.29	1410.29	532.69	877.60	0.00	0.00	0.00	0.00	0.00
PC825F	lb/hr	2702.49	2702.49	2702.49	2702.49	2702.49	2702.49	2702.49	2702.49	2702.49	2702.49	2702.49	1311.52	1390.97	0.00	0.00	0.00	0.00	0.00
PC875F	lb/hr	2551.56	2551.56	2551.56	2551.56	2551.56	2551.56	2551.56	2551.56	2551.56	2551.56	2551.56	1618.33	933.23	0.00	0.00	0.00	0.00	0.00
PC925F	lb/hr	2297.66	2297.66	2297.66	2297.66	2297.66	2297.66	2297.66	2297.66	2297.66	2297.66	2297.66	1759.74	537.92	0.00	0.00	0.00	0.00	0.00
PC973F	lb/hr	1986.62	1986.62	1986.62	1986.62	1986.62	1986.62	1986.62	1986.62	1986.62	1986.62	1986.62	1709.37	277.26	0.00	0.00	0.00	0.00	0.00
PC1020F	lb/hr	1446.01	1446.01	1446.01	1446.01	1446.01	1446.01	1446.01	1446.01	1446.01	1446.01	1446.01	1329.31	116.70	0.00	0.00	0.00	0.00	0.00
PC1075F	lb/hr	1451.36	1451.36	1451.36	1451.36	1451.36	1451.36	1451.36	1451.36	1451.36	1451.36	1451.36	1393.60	57.76	0.00	0.00	0.00	0.00	0.00
PC1125F	lb/hr	1485.03	1485.03	1485.03	1485.03	1485.03	1485.03	1485.03	1485.03	1485.03	1485.03	1485.03	1455.57	29.46	0.00	0.00	0.00	0.00	0.00
PC1170F	lb/hr	1102.39	1102.39	1102.39	1102.39	1102.39	1102.39	1102.39	1102.39	1102.39	1102.39	1102.39	1090.78	11.61	0.00	0.00	0.00	0.00	0.00
PC1247F	lb/hr	525.98	525.98	525.98	525.98	525.98	525.98	525.98	525.98	525.98	525.98	525.98	524.22	1.77	0.00	0.00	0.00	0.00	0.00
PC1345F	lb/hr	590.71	590.71	590.71	590.71	590.71	590.71	590.71	590.71	590.71	590.71	590.71	590.28	0.43	0.00	0.00	0.00	0.00	0.00
PC1453F	lb/hr	1071.66	1071.66	1071.66	1071.66	1071.66	1071.66	1071.66	1071.66	1071.66	1071.66	1071.66	1071.50	0.16	0.00	0.00	0.00	0.00	0.00
PC1738F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Volume Flow	bbl/day	7480.99	7480.23	8539.43	8760.06	8760.06	9126.66	9268.65	10327.22	10727.07	10792.94	92654.63	1715.56	570215.60	502544.90	24123.38	13627.53	10088.56	85.76
Vapor Phase																			
Heat capacity, mixture	Btu/lbmol-R											60.321		96.935	44.714	21.493	18.415	18.372	
Viscosity, mixture	cP											0.011		0.012	0.010	0.009	0.009	0.009	
Thermal conductivity, mixture	Btu-ft/hr-sqft-R											0.019		0.023	0.013	0.012	0.012	0.012	
Liquid Phase																			
Standard liquid volume flow	bbl/day	7500.000	7500.000	7500.000	7500.000	7500.000	7500.000	7500.000	7500.000	7500.000	7500.000	5446.203	1276.188			3846.922	3918.025		84.337
Heat capacity, mixture	Btu/lbmol-R	73.755	74.048	91.533	93.055	93.055	96.069	97.445	107.347	110.783	111.564	134.823	319.533			54.890	52.636		22.897
Viscosity, mixture	cP	1.249	1.214	0.354	0.320	0.320	0.264	0.242	0.143	0.124	0.120	0.227	0.332			0.429	0.512		0.700
Thermal conductivity, mixture	Btu-ft/hr-sqft-R	0.067	0.067	0.057	0.056	0.056	0.053	0.052	0.039	0.034	0.033	0.042	0.036			0.068	0.070		0.360
Surface tension, mixture	dyne/cm	30.177	30.021	21.286	20.410	20.410	18.666	17.868	12.235	10.442	10.068	14.336	11.390			18.832	20.309		32.035
ASTM D86 0%, liquid volume percent, for a petroleum mixture	F	-332.75	-332.75	-332.75	-332.75	-332.75	-332.75	-332.75	-332.75	-332.75	-332.75	249.63				-444.32			-210.00
ASTM D86 5%, liquid volume percent, for a petroleum mixture	F	160.76	160.76	160.76	160.76	160.76	160.76	160.76	160.76	160.76	160.76	160.76	274.81	557.48		103.58	97.89		-40.45
ASTM D86 10%, liquid volume percent, for a petroleum mixture	F	194.05	194.05	194.05	194.05	194.05	194.05	194.05	194.05	194.05	194.05	396.56	665.96			145.72	133.34		-17.57
ASTM D86 30%, liquid volume percent, for a petroleum mixture	F	282.36	282.36	282.36	282.36	282.36	282.36	282.36	282.36	282.36	282.36	524.27	831.73			196.43	192.85		53.59
ASTM D86 50%, liquid volume percent, for a petroleum mixture	F	408.84	408.84	408.84	408.84	408.84	408.84	408.84	408.84	408.84	408.84	699.61	913.80			233.57	231.74		173.55
ASTM D86 70%, liquid volume percent, for a petroleum mixture	F	601.47	601.47	601.47	601.47	601.47	601.47	601.47	601.47	601.47	601.47	1101.64	1021.40			264.11	262.94		204.90
ASTM D86 90%, liquid volume percent, for a petroleum mixture	F	1082.74	1082.74	1082.74	1082.74	1082.74	1082.74	1082.74	1082.74	1082.74	1082.74	1169.69	1229.65			310.70	310.05		237.54
ASTM D86 95%, liquid volume percent, for a petroleum mixture	F	1155.87	1155.87	1155.87	1155.87	1155.87	1155.87	1155.87	1155.87	1155.87	1155.87	1278.26	1300.85			333.26	332.78		259.65
ASTM D86 100%, liquid volume percent, for a petroleum mixture	F	1269.70	1269.70	1269.70	1269.70	1269.70	1269.70	1269.70	1269.70	1269.70	1269.70	-48.17	1367.14			371.92	371.45		306.10
Flash point, Pennsky-Martens method	F												54.56			-139.14			-112.76

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	Units	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	
Description																				
		Reflux to	Draw to Kerosene	Vapor from	Kerosene Product to	EX-4002 Shell Side	AC4002B Effluent	EX-4008 Shell Side	Kerosene Product to	Diesel Draw from	Diesel to	Vapor from	Diesel from	Diesel from	Diesel from	Diesel from	Diesel Product	Diesel PA to	Diesel PA from	Naphtha PA to
		T-4001	Stripper	T-4002	EX-4002	Effluent		Effluent	DDS	T-4001	T-4003	T-4003	G-4007A/B	EX-4004	EX-4009	to DDS	G-4006A/B	EX-4006	G-4004A/B	
		Liquid	Liquid Phase	Vapor Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Vapor Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase
Temperature	F	100.00	437.18	426.53	402.05	307.85	130.00	100.00	100.00	557.25	557.25	550.04	529.86	300.84	100.00	100.00	557.25	390.73	334.10	
Pressure	psia	24.70	33.39	33.40	92.70	90.70	85.70	84.70	64.70	34.00	34.00	34.00	114.70	101.70	84.70	64.70	34.00	114.70	32.77	
Molar Vapor Fraction		0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Molar Liquid Fraction		1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Molar Solid Fraction		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mass Vapor Fraction		0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mass Liquid Fraction		1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Mass Solid Fraction		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Molar Enthalpy	Btu/lbmol	-20164.84	9581.49	-22336.27	3726.59	-6259.00	-23056.26	-25589.99	-25589.99	32251.80	32251.80	-22279.47	26445.36	-8242.76	-33486.37	-33486.37	32251.80	6888.21	-1177.67	
Mass Enthalpy	Btu/lb	-196.18	56.01	-222.10	21.29	-35.76	-131.73	-146.21	-146.21	136.94	136.94	-199.52	108.56	-33.84	-137.46	-137.46	136.94	29.25	-8.98	
Molar Entropy	Btu/lbmol-R	-22.18	22.85	21.24	19.76	10.25	-9.02	-12.60	-12.60	54.87	54.87	30.92	53.11	21.63	-9.31	-9.31	54.87	33.56	5.23	
Mass Entropy	Btu/lb-R	-0.22	0.13	0.21	0.11	0.06	-0.05	-0.07	-0.07	0.23	0.23	0.28	0.22	0.09	-0.04	-0.04	0.23	0.14	0.04	
Molar Density	lbmol/cuft	0.43	0.23	0.00	0.24	0.25	0.28	0.29	0.29	0.17	0.17	0.00	0.17	0.20	0.22	0.22	0.17	0.19	0.30	
Mass Density	lb/cuft	43.85	39.59	0.37	41.58	44.46	49.31	50.08	50.08	39.79	39.79	0.36	41.53	47.76	52.58	52.58	39.79	44.80	39.34	
Enthalpy Flow	MMBtu/hr	-1.50	1.12	-0.92	0.34	-0.58	-2.12	-2.36	-2.36	11.11	2.21	-0.60	1.45	-0.45	-1.83	-1.83	8.90	1.90	-0.76	
Average MW		102.79	171.06	100.57	175.02	175.02	175.02	175.02	175.02	235.52	235.52	111.66	243.61	243.61	243.61	243.61	235.52	235.52	131.15	
Mole Flows	lbmol/hr	86.43	116.81	41.33	92.13	92.13	92.13	92.13	92.13	344.41	68.42	26.97	54.77	54.77	54.77	54.77	275.99	275.99	648.13	
Mass Flows	lb/hr	7628.10	19981.22	4156.12	16125.10	16125.10	16125.10	16125.10	16125.10	81114.84	16114.84	3011.64	13343.20	13343.20	13343.20	13343.20	65000.00	65000.00	85000.00	
H2	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
N2	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
O2	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
H2S	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
CO2	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
C1	lb/hr	1.86	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.10	0.02	0.02	0.00	0.00	0.00	0.00	0.08	0.08	0.19	
C2	lb/hr	21.26	0.43	0.43	0.00	0.00	0.00	0.00	0.00	1.25	0.25	0.25	0.00	0.00	0.00	0.00	1.00	1.00	2.53	
C3	lb/hr	94.93	2.14	2.14	0.00	0.00	0.00	0.00	0.00	5.50	1.09	1.09	0.00	0.00	0.00	0.00	4.41	4.41	14.95	
IC4	lb/hr	145.59	4.45	4.44	0.01	0.01	0.01	0.01	0.01	10.66	2.12	2.12	0.00	0.00	0.00	0.00	8.54	8.54	34.94	
NC4	lb/hr	184.72	6.74	6.72	0.02	0.02	0.02	0.02	0.02	15.35	3.05	3.05	0.00	0.00	0.00	0.00	12.30	12.30	56.91	
IC5	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
NC5	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
H2O	lb/hr	2.52	5.62	270.08	35.54	35.54	35.54	35.54	35.54	10.33	2.05	220.60	21.46	21.46	21.46	21.46	8.28	8.28	37.52	
PC107F	lb/hr	572.71	34.98	34.42	0.56	0.56	0.56	0.56	0.56	71.62	14.23	14.18	0.05	0.05	0.05	0.05	57.39	57.39	406.03	
PC138F	lb/hr	432.37	32.85	31.91	0.94	0.94	0.94	0.94	0.94	65.21	12.96	12.88	0.07	0.07	0.07	0.07	52.26	52.26	449.98	
PC163F	lb/hr	516.13	50.03	47.43	2.60	2.60	2.60	2.60	2.60	93.68	18.61	18.44	0.17	0.17	0.17	0.17	75.07	75.07	810.48	
PC188F	lb/hr	607.16	75.73	68.92	6.81	6.81	6.81	6.81	6.81	131.73	26.17	25.79	0.38	0.38	0.38	0.38	105.56	105.56	1455.96	
PC213F	lb/hr	728.33	116.62	99.94	16.69	16.69	16.69	16.69	16.69	187.14	37.18	36.35	0.83	0.83	0.83	0.83	149.96	149.96	2650.59	
PC237F	lb/hr	907.12	186.81	147.58	39.23	39.23	39.23	39.23	39.23	275.90	54.81	52.98	1.83	1.83	1.83	1.83	221.09	221.09	4987.55	
PC262F	lb/hr	958.31	261.95	184.45	77.50	77.50	77.50	77.50	77.50	353.13	70.16	66.60	3.55	3.55	3.55	3.55	282.98	282.98	8128.17	
PC287F	lb/hr	846.29	318.45	193.08	125.37	125.37	125.37	125.37	125.37	385.86	76.66	70.80	5.86	5.86	5.86	5.86	309.20	309.20	11152.11	
PC312F	lb/hr	654.38	363.98	183.31	180.67	180.67	180.67	180.67	180.67	381.02	75.70	67.03	8.67	8.67	8.67	8.67	305.32	305.32	13517.96	
PC337F	lb/hr	519.23	521.20	211.55	309.64	309.64	309.64	309.64	309.64	408.48	81.15	67.58	13.58	13.58	13.58	13.58	327.33	327.33	16821.01	
PC362F	lb/hr	352.53	1274.44	407.28	867.15	867.15	867.15	867.15	867.15	489.53	97.25	74.38	22.87	22.87	22.87	22.87	392.28	392.28	17776.38	
PC388F	lb/hr	77.50	2880.84	710.20	2170.64	2170.64	2170.64	2170.64	2170.64	667.90	132.69	90.65	42.04	42.04	42.04	42.04	535.21	535.21	6057.27	
PC413F	lb/hr	4.91	3053.48	571.03	2482.45	2482.45	2482.45	2482.45	2482.45	904.34	179.66	106.44	73.23	73.23	73.23	73.23	724.68	724.68	592.52	
PC437F	lb/hr	0.24	2824.54	395.84	2428.71	2428.71	2428.71	2428.71	2428.71	1235.16	245.39	122.70	122.68	122.68	122.68	122.68	989.78	989.78	43.88	
PC462F	lb/hr	0.01	2569.02	266.04	2302.99	2302.99	2302.99	2302.99	2302.99	1742.34	346.14	142.32	203.82	203.82	203.82	203.82	1396.19	1396.19	2.88	
PC487F	lb/hr	0.00	2286.48	172.52	2113.96	2113.96	2113.96	2113.96	2113.96	2638.73	524.23	173.15	351.08	351.08	351.08	351.08	2114.50	2114.50	0.17	
PC512F	lb/hr	0.00	1863.15	101.39	1761.76	1761.76	1761.76	1761.76	1761.76	4585.40	910.97	237.44	673.53	673.53	673.53	673.53	3674.43	3674.43	0.01	
PC537F	lb/hr	0.00	1006.90	39.05	967.86	967.86	967.86	967.86	967.86	8728.85	1734.14	350.80	1383.34	1383.34	1383.34	1383.34	6994.72	6994.72	0.00	
PC562F	lb/hr	0.00	215.37	5.88	209.49	209.49	209.49	209.49	209.49	12050.72	2394.08	370.26	2023.82	2023.82	2023.82	2023.82	9656.64	9656.64	0.00	
PC587F	lb/hr	0.00	22.89	0.43	22.46	22.46	22.46	22.46	22.46	11820.79	2348.40	274.06	2074.34	2074.34	2074.34	2074.34	9472.39	9472.39	0.00	
PC612F	lb/hr	0.00	1.93	0.03	1.91	1.91	1.91	1.91	1.91	10817.90	2149.16	186.90	1962.26	1962.26	1962.26	1962.26	8668.74	8668.74	0.00	
PC638F	lb/hr	0.00	0.14	0.00	0.14	0.14	0.14	0.14	0.14	9234.55	1834.60	117.34	1717.26	1717.26	1717.26	1717.26	7399.95	7399.95	0.00	
PC664F	lb/hr	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	7087.55	1408.06	64.54	1343.52	1343.52	1343.52	1343.52	5679.49	5679.49	0.00	
PC686F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4740.35	941.75	32.14	909.61							

	Units	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
PC762F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.62	8.67	0.10	8.56	8.56	8.56	8.56	34.95	34.95	0.00
PC788F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.07	0.61	0.00	0.61	0.61	0.61	0.61	2.46	2.46	0.00
PC825F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.05	0.00	0.05	0.05	0.05	0.05	0.20	0.20	0.00
PC875F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PC925F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PC973F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PC1020F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PC1075F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PC1125F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PC1170F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PC1247F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PC1345F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PC1453F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PC1738F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Volume Flow	bbl/day	743.52	2157.37	48291.07	1657.77	1550.47	1397.93	1376.49	1376.49	8713.15	1731.02	35549.21	1373.51	1194.26	1084.73	1084.73	6982.14	6201.99	9236.33
Vapor Phase																			
Heat capacity, mixture	Btu/lbmol-R			55.766								66.713							
Viscosity, mixture	cP			0.011								0.012							
Thermal conductivity, mixture	Btu-ft/hr-sqft-R			0.015								0.017							
Liquid Phase																			
Standard liquid volume flow	bbl/day	723.800	1688.000		1352.668	1352.668	1352.668	1352.668	1352.668	6543.613	1300.000		1068.928	1068.928	1068.928	1068.928	5243.613	5243.613	7546.866
Heat capacity, mixture	Btu/lbmol-R	52.644	110.497		109.945	102.410	86.157	82.883	82.883	160.551	160.551		162.981	139.247	111.419	111.419	160.551	177.863	81.114
Viscosity, mixture	cP	0.513	0.222		0.268	0.396	1.122	1.438	1.438	0.240	0.240		0.273	0.734	4.214	4.214	0.240	0.142	0.199
Thermal conductivity, mixture	Btu-ft/hr-sqft-R	0.070	0.047		0.050	0.056	0.067	0.068	0.068	0.040	0.040		0.044	0.056	0.065	0.065	0.040	0.028	0.053
Surface tension, mixture	dyne/cm	20.319	11.503		13.421	17.577	25.925	27.390	27.390	10.618	10.618		12.025	21.225	29.986	29.986	10.618	4.703	12.103
ASTM D86 0%, liquid volume percent, for a petroleum mixture	F		-265.56		154.68	154.68	154.68	154.68	154.68	0.00			-330.20	-330.20	-330.20	-330.20			-95.74
ASTM D86 5%, liquid volume percent, for a petroleum mixture	F	98.14	343.25		388.96	388.96	388.96	388.96	388.96	459.54	459.54		525.73	525.73	525.73	525.73	459.54	459.54	263.41
ASTM D86 10%, liquid volume percent, for a petroleum mixture	F	133.93	373.94		396.01	396.01	396.01	396.01	396.01	503.54	503.54		536.47	536.47	536.47	536.47	503.54	503.54	269.79
ASTM D86 30%, liquid volume percent, for a petroleum mixture	F	192.99	402.69		413.94	413.94	413.94	413.94	413.94	547.95	547.95		559.71	559.71	559.71	559.71	547.95	547.95	296.66
ASTM D86 50%, liquid volume percent, for a petroleum mixture	F	231.82	422.40		433.26	433.26	433.26	433.26	433.26	568.99	568.99		578.95	578.95	578.95	578.95	568.99	568.99	316.66
ASTM D86 70%, liquid volume percent, for a petroleum mixture	F	262.98	448.87		457.90	457.90	457.90	457.90	457.90	594.86	594.86		603.04	603.04	603.04	603.04	594.86	594.86	334.45
ASTM D86 90%, liquid volume percent, for a petroleum mixture	F	310.07	485.78		490.39	490.39	490.39	490.39	490.39	634.88	634.88		638.92	638.92	638.92	638.92	634.88	634.88	352.75
ASTM D86 95%, liquid volume percent, for a petroleum mixture	F	332.80	505.63		509.38	509.38	509.38	509.38	509.38	654.71	654.71		658.22	658.22	658.22	658.22	654.71	654.71	367.85
ASTM D86 100%, liquid volume percent, for a petroleum mixture	F	371.47	548.18		551.94	551.94	551.94	551.94	551.94	702.16	702.16		705.62	705.62	705.62	705.62	702.16	702.16	408.28
Flash point, Pennsky-Martens method	F		51.68		125.06	125.06	125.06	125.06	125.06	74.61	74.61		224.00	224.00	223.99	223.99	74.61	74.62	16.07

CRC Crude & Vacuum Units																			
Detailed Material Balance																			
Case: 100% Bakken																			
Rev B																			
12/20/2019																			
	Units	36	37	38	39	40	41	42	43	44	45	46	47	48L	48V	49	50	51	52
Description																			
		Naphtha	AGO	AGO	AGO	AGO	AGO	Atm Resid	Superheated	Saturated	Saturated	Superheated	Naphtha	Liquid	Vapor	T-21000	LVGO	LVGO	LVGO PA
		PA from	Wash to	from	from	from	Product	to	Steam	Steam	Steam	Steam	Product	Part of	Part of	Overhead	drawoff	from	Return to
		EX-4001	T-4001	G-4008A/B	EX-4005	AC-4003	to HCU	H-21001	to T-4001	to T-4002	to H-21001	to T-21000	to NDS	Stream 48	Stream 48	to Vac System	from T-21001	AC-21001	T-21001
		Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Mixed Phase	Vapor Phase	Vapor Phase	Vapor Phase	Vapor Phase	Liquid Phase	Liquid Phase	Vapor Phase	Vapor Phase	Liquid Phase	Liquid Phase	Liquid Phase
Temperature	F	170.33	641.91	641.91	300.00	130.00	130.00	667.56	677.00	340.00	340.00	677.00	100.00	775.00	775.00	130.00	419.75	130.00	130.00
Pressure	psia	114.70	115.00	115.00	109.70	104.70	64.70	5.00	64.70	64.70	64.70	64.70	64.70	3.00	3.00	0.71	0.72	104.70	0.72
Molar Vapor Fraction		0.00	0.00	0.00	0.00	0.00	0.00	0.04	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00	0.00
Molar Liquid Fraction		1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00
Molar Solid Fraction		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mass Vapor Fraction		0.00	0.00	0.00	0.00	0.00	0.00	0.02	1.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00
Mass Liquid Fraction		1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00
Mass Solid Fraction		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Molar Enthalpy	Btu/lbmol	-13520.92	67241.12	67241.12	-10763.00	-39794.64	-39794.64	99245.03	-99001.32	-102021.85	-102021.85	-99001.32	-20164.84	190757.92	57846.84	-98317.14	16512.24	-37453.89	-37453.89
Mass Enthalpy	Btu/lb	-103.10	190.38	190.38	-30.47	-112.67	-112.67	213.88	-5495.41	-5663.07	-5663.07	-5495.41	-196.18	291.35	219.96	-4808.62	48.20	-109.33	-109.33
Molar Entropy	Btu/lbmol-R	-7.83	108.61	108.61	39.68	4.13	4.13	157.42	-7.37	-10.52	-10.52	-7.37	-22.18	264.21	114.83	-5.23	63.68	3.58	3.58
Mass Entropy	Btu/lb-R	-0.06	0.31	0.31	0.11	0.01	0.01	0.34	-0.41	-0.58	-0.58	-0.41	-0.22	0.40	0.44	-0.26	0.19	0.01	0.01
Molar Density	lbmol/cuft	0.34	0.12	0.12	0.15	0.16	0.16	0.01	0.01	0.01	0.01	0.01	0.43	0.07	0.00	0.00	0.14	0.16	0.16
Mass Density	lb/cuft	45.03	42.60	42.60	51.38	54.93	54.93	4.39	0.10	0.14	0.14	0.10	43.85	46.20	0.06	0.00	47.92	54.54	54.54
Enthalpy Flow	MMBtu/hr	-8.76	1.53	0.78	-0.12	-0.46	-0.46	4.40	-3.85	-1.70	-1.98	-1.10	-6.65	2.02	3.08	-3.28	0.38	-0.86	-0.35
Average MW		131.15	353.19	353.19	353.19	353.19	353.19	464.01	18.02	18.02	18.02	18.02	102.79	654.74	262.98	20.45	342.57	342.57	342.57
Mole Flows	lbmol/hr	648.13	22.74	11.54	11.54	11.54	11.54	44.36	38.86	16.65	19.43	11.10	329.85	10.61	53.17	33.32	23.16	23.05	9.27
Mass Flows	lb/hr	85000.00	8032.00	4075.10	4075.10	4075.10	4075.10	20582.53	700.00	300.00	350.00	200.00	33904.54	6949.10	13983.43	681.19	7896.54	7896.54	3173.97
H2	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N2	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.00	0.00	0.00	0.00
O2	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H2S	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CO2	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C1	lb/hr	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.28	0.00	0.00	0.00	0.00	0.00	0.00
C2	lb/hr	2.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	94.51	0.00	0.00	0.00	0.00	0.00	0.00
C3	lb/hr	14.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	421.92	0.00	0.00	3.94	0.00	0.00	0.00
IC4	lb/hr	34.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	647.11	0.00	0.00	23.39	0.01	0.01	0.00
NC4	lb/hr	56.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	821.04	0.00	0.00	9.35	0.01	0.01	0.00
IC5	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.80	0.01	0.01	0.00
NC5	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.49	0.02	0.02	0.01
H2O	lb/hr	37.52	5.73	2.91	2.91	2.91	2.91	10.23	700.00	300.00	350.00	200.00	11.21	0.06	360.17	559.98	0.17	0.17	0.07
PC107F	lb/hr	406.03	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	2545.52	0.00	0.01	0.01	0.00	0.00	0.00
PC138F	lb/hr	449.98	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	1921.73	0.00	0.01	0.01	0.00	0.00	0.00
PC163F	lb/hr	810.48	0.01	0.01	0.01	0.01	0.01	0.02	0.00	0.00	0.00	0.00	2294.02	0.00	0.02	0.02	0.00	0.00	0.00
PC188F	lb/hr	1455.96	0.02	0.01	0.01	0.01	0.01	0.04	0.00	0.00	0.00	0.00	2698.66	0.00	0.04	0.04	0.00	0.00	0.00
PC213F	lb/hr	2650.59	0.05	0.02	0.02	0.02	0.02	0.08	0.00	0.00	0.00	0.00	3237.21	0.00	0.08	0.08	0.00	0.00	0.00
PC237F	lb/hr	4987.55	0.10	0.05	0.05	0.05	0.05	0.15	0.00	0.00	0.00	0.00	4031.86	0.00	0.15	0.14	0.00	0.00	0.00
PC262F	lb/hr	8128.17	0.18	0.09	0.09	0.09	0.09	0.24	0.00	0.00	0.00	0.00	4259.37	0.00	0.24	0.23	0.00	0.00	0.00
PC287F	lb/hr	11152.11	0.26	0.13	0.13	0.13	0.13	0.32	0.00	0.00	0.00	0.00	3761.49	0.00	0.32	0.32	0.00	0.00	0.00
PC312F	lb/hr	13517.96	0.34	0.17	0.17	0.17	0.17	0.38	0.00	0.00	0.00	0.00	2908.53	0.00	0.38	0.38	0.00	0.00	0.00
PC337F	lb/hr	16821.01	0.49	0.25	0.25	0.25	0.25	0.49	0.00	0.00	0.00	0.00	2307.81	0.00	0.49	0.48	0.01	0.01	0.00
PC362F	lb/hr	17776.38	0.78	0.40	0.40	0.40	0.40	0.69	0.00	0.00	0.00	0.00	1566.88	0.00	0.69	0.68	0.02	0.02	0.01
PC388F	lb/hr	6057.27	1.41	0.72	0.72	0.72	0.72	1.14	0.00	0.00	0.00	0.00	344.46	0.00	1.14	1.09	0.07	0.07	0.03
PC413F	lb/hr	592.52	2.50	1.27	1.27	1.27	1.27	1.86	0.00	0.00	0.00	0.00	21.83	0.01	1.86	1.71	0.24	0.24	0.10
PC437F	lb/hr	43.88	4.33	2.20	2.20	2.20	2.20	3.04	0.00	0.00	0.00	0.00	1.05	0.01	3.03	2.56	0.78	0.78	0.31
PC462F	lb/hr	2.88	7.38	3.75	3.75	3.75	3.75	5.02	0.00	0.00	0.00	0.00	0.04	0.02	5.00	3.53	2.45	2.45	0.98
PC487F	lb/hr	0.17	12.41	6.30	6.30	6.30	6.30	8.44	0.00	0.00	0.00	0.00	0.00	0.03	8.40	4.20	6.98	6.98	2.80
PC512F	lb/hr	0.01	20.45	10.37	10.37	10.37	10.37	14.37	0.00	0.00	0.00	0.00	0.00	0.07	14.30	4.13	16.88	16.88	6.79
PC537F	lb/hr	0.00	32.14	16.30	16.30	16.30	16.30	24.04	0.00	0.00	0.00	0.00	0.00	0.14	23.90	3.28	34.16	34.16	13.73
PC562F	lb/hr	0.00	48.75	24.74	24.74	24.74	24.74	39.62	0.00	0.00	0.00	0.00	0.00	0.26	39.35	2.23	61.24	61.24	24.62
PC587F	lb/hr	0.00	72.48	36.77	36.77	36.77	36.77	64.18	0.00	0.00	0.00	0.00	0.00	0.51	63.66	1.38	102.10	102.10	41.04
PC612F	lb/hr	0.00	109.74	55.68	55.68	55.68	55.68	103.71	0.00	0.00	0.00	0.00	0.00	0.99	102.72	0.81	165.29	165.29	66.44
PC638F	lb/hr	0.00	169.20	85.84	85.84	85.84	85.84	161.51	0.00	0.00	0.00	0.00	0.00	1.87	159.64	0.44	253.89	253.89	102.05
PC664F	lb/hr	0.00	302.08	153.26	153.26	153.26	153.26	266.25	0.00	0.00	0.00	0.00	0.00	3.82	262.43	0.23	406.31	406.31	163.31
PC686F	lb/hr	0.00	568.04	288.20	288.20	288.20	288.20	457.96	0.00	0.00	0.00	0.00	0.00	7.96	450.00	0.15	670.72	670.72	269.59
PC713F	lb/hr	0.00	959.67	486.90	486.90	486.90	486.90	784.39	0.00	0.00	0.00	0.00	0.00	17.26	767.13	0.07	1065.32	1065.32	428.20
PC738F	lb/hr	0.00	1019.37	517.19	517.19	517.19	517.19	943.79	0.00	0.00	0.00								

	Units	36	37	38	39	40	41	42	43	44	45	46	47	48L	48V	49	50	51	52
PC762F	lb/hr	0.00	912.13	462.78	462.78	462.78	462.78	988.27	0.00	0.00	0.00	0.00	0.00	34.63	953.64	0.01	1038.86	1038.86	417.56
PC788F	lb/hr	0.00	764.47	387.86	387.86	387.86	387.86	1021.83	0.00	0.00	0.00	0.00	0.00	47.66	974.17	0.00	816.64	816.64	328.24
PC825F	lb/hr	0.00	1198.84	608.24	608.24	608.24	608.24	2094.20	0.00	0.00	0.00	0.00	0.00	141.49	1952.71	0.00	1118.21	1118.21	449.46
PC875F	lb/hr	0.00	819.80	415.93	415.93	415.93	415.93	2135.63	0.00	0.00	0.00	0.00	0.00	237.76	1897.87	0.00	588.34	588.34	236.48
PC925F	lb/hr	0.00	496.10	251.70	251.70	251.70	251.70	2045.96	0.00	0.00	0.00	0.00	0.00	372.48	1673.48	0.00	261.56	261.56	105.13
PC973F	lb/hr	0.00	271.60	137.80	137.80	137.80	137.80	1848.82	0.00	0.00	0.00	0.00	0.00	525.55	1323.28	0.00	99.30	99.30	39.91
PC1020F	lb/hr	0.00	120.49	61.13	61.13	61.13	61.13	1384.87	0.00	0.00	0.00	0.00	0.00	570.88	814.00	0.00	27.35	27.35	10.99
PC1075F	lb/hr	0.00	62.42	31.67	31.67	31.67	31.67	1419.69	0.00	0.00	0.00	0.00	0.00	830.30	589.39	0.00	6.64	6.64	2.67
PC1125F	lb/hr	0.00	32.62	16.55	16.55	16.55	16.55	1468.48	0.00	0.00	0.00	0.00	0.00	1075.69	392.79	0.00	1.41	1.41	0.57
PC1170F	lb/hr	0.00	12.97	6.58	6.58	6.58	6.58	1095.80	0.00	0.00	0.00	0.00	0.00	913.02	182.78	0.00	0.22	0.22	0.09
PC1247F	lb/hr	0.00	1.98	1.00	1.00	1.00	1.00	524.98	0.00	0.00	0.00	0.00	0.00	491.64	33.34	0.00	0.00	0.00	0.00
PC1345F	lb/hr	0.00	0.48	0.24	0.24	0.24	0.24	590.47	0.00	0.00	0.00	0.00	0.00	581.16	9.31	0.00	0.00	0.00	0.00
PC1453F	lb/hr	0.00	0.18	0.09	0.09	0.09	0.09	1071.57	0.00	0.00	0.00	0.00	0.00	1067.64	3.93	0.00	0.00	0.00	0.00
PC1738F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Volume Flow	bbl/day	8068.93	806.04	408.95	339.00	317.10	317.10	20051.33	31082.64	9140.69	10664.14	8880.75	3304.72	643.00	998142.25	1276238.21	707.78	618.75	248.75
Vapor Phase																			
Heat capacity, mixture	Btu/lbmol-R							141.329	8.935	9.383	9.383	8.935			176.189	8.894			
Viscosity, mixture	cP							0.010	0.023	0.015	0.015	0.023			0.011	0.011			
Thermal conductivity, mixture	Btu-ft/hr-sqft-R							0.015	0.029	0.019	0.019	0.029			0.017	0.012			
Liquid Phase																			
Standard liquid volume flow	bbl/day	7546.866	610.109	309.544	309.544	309.544	309.544	1469.496					3217.065	482.906			605.000	603.623	242.623
Heat capacity, mixture	Btu/lbmol-R	91.117	247.121	247.121	195.708	161.882	161.882	331.893					52.644	474.406			210.627	157.815	157.815
Viscosity, mixture	cP	0.118	0.292	0.292	1.652	13.775	13.775	0.407					0.513	1.860			0.703	10.994	10.994
Thermal conductivity, mixture	Btu-ft/hr-sqft-R	0.039	0.040	0.040	0.054	0.060	0.060	0.039					0.070	0.037			0.049	0.060	0.060
Surface tension, mixture	dyne/cm	6.230	11.383	11.383	24.444	31.036	31.036	12.472					20.319	9.938			19.118	30.777	30.777
ASTM D86 0%, liquid volume percent, for a petroleum mixture	F	-95.74												399.25			384.33	384.31	384.31
ASTM D86 5%, liquid volume percent, for a petroleum mixture	F	263.41	672.87	672.87	672.87	672.87	672.87	735.34					98.14	890.36			659.77	659.77	659.77
ASTM D86 10%, liquid volume percent, for a petroleum mixture	F	269.79	687.74	687.74	687.74	687.74	687.74	748.85					133.93	922.77			673.58	673.58	673.58
ASTM D86 30%, liquid volume percent, for a petroleum mixture	F	296.66	716.00	716.00	716.00	716.00	716.00	815.51					192.99	1015.58			703.83	703.83	703.83
ASTM D86 50%, liquid volume percent, for a petroleum mixture	F	316.66	741.31	741.31	741.31	741.31	741.31	889.17					231.82	1076.42			724.99	724.99	724.99
ASTM D86 70%, liquid volume percent, for a petroleum mixture	F	334.45	785.09	785.09	785.09	785.09	785.09	991.69					262.98	1143.84			755.13	755.13	755.13
ASTM D86 90%, liquid volume percent, for a petroleum mixture	F	352.75	879.07	879.07	879.07	879.07	879.07	1199.42					310.07	1435.68			824.39	824.39	824.39
ASTM D86 95%, liquid volume percent, for a petroleum mixture	F	367.85	916.03	916.03	916.03	916.03	916.03	1274.98					332.80	1470.26			856.60	856.60	856.60
ASTM D86 100%, liquid volume percent, for a petroleum mixture	F	408.28	1037.31	1037.31	1037.31	1037.31	1037.31	1342.12					371.47	1531.85			939.03	939.03	939.03
Flash point, Pennsky-Martens method	F	16.07	332.05	332.05	332.04	332.04	332.04	386.60						510.22			336.93	336.92	336.92

CRC Crude & Vacuum Units																			
Detailed Material Balance																			
Case: 100% Bakken																			
Rev B																			
12/20/2019																			
	Units	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
Description																			
		LVGO	HVGO	HVGO Wash	HVGO	HVGO	HVGO	HVGO	HVGO	Vac Resid	Vac Resid	Vac Resid	Recycle to	Vac Resid	Vac Resid	Vac Resid	Saturated	AGO	T-4004
		Product	Drawoff	to	from	PA Return	to	from	Product to	from	to	from	T-21001	to	from	Product	Steam to	from	Ovhd to
		to HCU	from T-21001	T-21001	EX-21001	to T-21001	AC-21002	AC-21002	HCU	T-21001	EX-21002	EX-21002	Bottoms	AC-21003	AC-21003	to OSBL	T-4003	T-4004	T-4001
		Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Liquid Phase	Vapor Phase	Liquid Phase	Vapor Phase
Temperature	F	130.00	586.70	586.70	544.52	544.52	544.52	130.00	130.00	555.05	555.05	520.00	520.00	520.00	180.00	180.00	340.00	641.91	657.72
Pressure	psia	64.70	0.91	0.91	109.70	0.91	109.70	104.70	64.70	0.95	89.70	84.70	83.70	83.70	74.70	64.70	64.70	34.64	34.50
Molar Vapor Fraction		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Molar Liquid Fraction		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00
Molar Solid Fraction		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mass Vapor Fraction		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Mass Liquid Fraction		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	0.00
Mass Solid Fraction		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Molar Enthalpy	Btu/lbmol	-37384.24	72326.54	72326.54	59469.40	59469.40	59374.19	-47110.50	-47110.50	102529.65	102529.65	86351.81	86351.83	86351.81	-49006.62	-49006.62	-102021.85	67241.12	-34577.45
Mass Enthalpy	Btu/lb	-109.13	158.57	158.57	130.39	130.39	130.18	-103.29	-103.29	140.78	140.78	118.57	118.57	118.57	-67.29	-67.29	-5663.07	190.38	-345.07
Molar Entropy	Btu/lbmol-R	3.48	133.86	133.86	123.46	123.46	123.15	11.54	11.54	210.62	210.62	196.44	196.44	196.44	51.52	51.52	-10.52	108.61	31.19
Mass Entropy	Btu/lb-R	0.01	0.29	0.29	0.27	0.27	0.27	0.03	0.03	0.29	0.29	0.27	0.27	0.27	0.07	0.07	-0.58	0.31	0.31
Molar Density	lbmol/cuft	0.16	0.10	0.10	0.10	0.10	0.10	0.12	0.12	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.01	0.12	0.00
Mass Density	lb/cuft	54.56	46.44	46.44	47.48	47.48	47.59	56.70	56.70	52.49	52.49	53.29	53.29	53.29	60.17	60.17	0.14	42.60	0.29
Enthalpy Flow	MMBtu/hr	-0.52	12.78	1.08	11.70	10.41	1.29	-1.03	-1.03	4.35	4.35	3.66	2.96	0.70	-0.40	-0.40	-1.36	2.30	-0.24
Average MW		342.57	456.10	456.10	456.10	456.10	456.10	456.10	456.10	728.29	728.29	728.29	728.29	728.29	728.29	728.29	18.02	353.19	100.20
Mole Flows	lbmol/hr	13.79	211.76	14.96	196.80	175.00	21.80	21.80	21.80	42.40	42.40	42.40	34.33	8.07	8.07	8.07	13.32	34.28	7.04
Mass Flows	lb/hr	4722.57	96584.98	6821.62	89763.36	79818.14	9945.21	9945.21	9945.21	30877.01	30877.01	30877.01	25000.43	5877.01	5877.01	5877.01	240.00	12107.10	705.24
H2	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N2	lb/hr	0.00	0.02	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
O2	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H2S	lb/hr	0.00	0.00	0.00	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CO2	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C1	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
C2	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
C3	lb/hr	0.00	0.01	0.00	lb/hr	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
IC4	lb/hr	0.01	0.06	0.00	0.05	0.05	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45
NC4	lb/hr	0.00	0.03	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62
IC5	lb/hr	0.00	0.04	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NC5	lb/hr	0.01	0.07	0.00	0.06	0.05	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H2O	lb/hr	0.10	0.98	0.07	lb/hr	0.91	0.81	0.10	0.10	0.10	0.24	0.24	0.24	0.20	0.05	0.05	0.05	240.00	77.34
PC107F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	2.65
PC138F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	2.36
PC163F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	3.27
PC188F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	4.44
PC213F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	6.11
PC237F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	8.72
PC262F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	10.61
PC287F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	10.83
PC312F	lb/hr	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.52	9.82
PC337F	lb/hr	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	9.53
PC362F	lb/hr	0.01	0.02	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.18	10.24
PC388F	lb/hr	0.04	0.03	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.13	12.33
PC413F	lb/hr	0.14	0.06	0.00	0.06	0.05	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.77	14.40
PC437F	lb/hr	0.47	0.13	0.01	0.12	0.11	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.53	16.47
PC462F	lb/hr	1.46	0.27	0.02	0.26	0.23	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.13	18.58
PC487F	lb/hr	4.17	0.61	0.04	0.57	0.50	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.71	20.79
PC512F	lb/hr	10.10	1.39	0.10	1.29	1.15	0.14	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.82	23.08
PC537F	lb/hr	20.43	3.20	0.23	2.97	2.64	0.33	0.33	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.44	24.78
PC562F	lb/hr	36.63	7.35	0.52	6.83	6.08	0.76	0.76	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	73.49	26.02
PC587F	lb/hr	61.06	16.87	1.19	15.68	13.94	1.74	1.74	1.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	109.25	27.18
PC612F	lb/hr	98.86	39.27	2.77	36.49	32.45	4.04	4.04	4.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	165.41	29.27
PC638F	lb/hr	151.84	89.64	6.33	83.31	74.08	9.23	9.23	9.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	255.04	32.35
PC664F	lb/hr	243.00	223.51	15.79	207.72	184.71	23.01	23.02	23.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	455.34	41.03
PC686F	lb/hr	401.13	550.41	38.87	511.53	454.86	56.67	56.68	56.68	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	856.24	57.71
PC713F	lb/hr	637.12	1429.37	100.95	1328.42	1181.24	147.18	147.19	147.19	0.03	0.03	0.03	0.02	0.01	0.01	0.01	0.00	1446.57	69.25
PC738F	lb/hr	688.55	2478.28	175.04	2303.25	2048.06	255.19	255.20	255.20	0.08	0.08	0.08	0.06	0.01	0.01	0.01	0.00	1536.56	53.22

	Units	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
PC762F	lb/hr	621.30	3563.41	251.68	3311.74	2944.82	366.92	366.93	366.93	0.19	0.19	0.19	0.15	0.04	0.04	0.04	0.00	1374.91	34.62
PC788F	lb/hr	488.39	5179.41	365.81	4813.60	4280.28	533.32	533.32	533.32	0.61	0.61	0.61	0.49	0.12	0.12	0.12	0.00	1152.33	19.22
PC825F	lb/hr	668.75	13833.98	977.07	12856.91	11432.45	1424.46	1424.45	1424.45	5.24	5.24	5.24	4.24	1.00	1.00	1.00	0.00	1807.07	18.46
PC875F	lb/hr	351.86	17250.98	1218.41	16032.57	14256.27	1776.31	1776.29	1776.29	39.29	39.29	39.29	31.81	7.48	7.48	7.48	0.00	1235.73	6.48
PC925F	lb/hr	156.43	17870.47	1262.16	16608.31	14768.22	1840.10	1840.09	1840.09	259.73	259.73	259.73	210.30	49.44	49.44	49.44	0.00	747.80	1.98
PC973F	lb/hr	59.39	15349.36	1084.10	14265.26	12684.76	1580.50	1580.51	1580.51	1097.61	1097.61	1097.61	888.69	208.91	208.91	208.91	0.00	409.41	0.55
PC1020F	lb/hr	16.35	9187.99	648.93	8539.05	7592.98	946.07	946.08	946.08	2219.36	2219.36	2219.36	1796.92	422.42	422.42	422.42	0.00	181.62	0.13
PC1075F	lb/hr	3.97	5620.52	396.97	5223.55	4644.82	578.74	578.74	578.74	4397.14	4397.14	4397.14	3560.16	836.93	836.93	836.93	0.00	94.09	0.03
PC1125F	lb/hr	0.85	2857.12	201.79	2655.33	2361.13	294.19	294.17	294.17	6166.57	6166.57	6166.57	4993.11	1173.72	1173.72	1173.72	0.00	49.18	0.01
PC1170F	lb/hr	0.13	947.54	66.92	880.62	783.05	97.57	97.55	97.55	5243.88	5243.88	5243.88	4245.75	998.10	998.10	998.10	0.00	19.56	0.00
PC1247F	lb/hr	0.00	76.65	5.41	71.23	63.34	7.89	7.89	7.89	2717.30	2717.30	2717.30	2200.21	517.20	517.20	517.20	0.00	2.98	0.00
PC1345F	lb/hr	0.00	5.40	0.38	5.02	4.46	0.56	0.56	0.56	3099.68	3099.68	3099.68	2509.77	589.98	589.98	589.98	0.00	0.72	0.00
PC1453F	lb/hr	0.00	0.52	0.04	0.48	0.43	0.05	0.05	0.05	5630.06	5630.06	5630.06	4558.55	1071.60	1071.60	1071.60	0.00	0.27	0.00
PC1738F	lb/hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Volume Flow	bbl/day	370.00	8706.50	627.86	8078.65	7185.27	893.38	749.70	749.70	2514.45	2514.45	2476.59	2005.24	471.28	417.52	417.52	7312.55	1214.99	10248.30
Vapor Phase																			
Heat capacity, mixture	Btu/lbmol-R																9.383		62.836
Viscosity, mixture	cP																0.015		0.014
Thermal conductivity, mixture	Btu-ft/hr-sqft-R																0.019		0.020
Liquid Phase																			
Standard liquid volume flow	bbl/day	361.000	8582.177	502.780	8079.397	7346.397	733.000	733.000	733.000	2117.359	2117.359	2117.359	1714.376	403.010	403.010	403.010		919.653	
Heat capacity, mixture	Btu/lbmol-R	157.671	308.426	308.426	297.225	297.225	297.342	204.135	204.135	468.892	468.892	458.214	458.214	458.214	329.590	329.590		247.121	
Viscosity, mixture	cP	10.997	0.525	0.525	0.692	0.692	0.692	67.988	67.988	8.634	8.634	10.742	10.742	10.742	686.356	686.356		0.292	
Thermal conductivity, mixture	Btu-ft/hr-sqft-R	0.060	0.043	0.043	0.045	0.045	0.045	0.057	0.057	0.043	0.043	0.044	0.044	0.044	0.053	0.053		0.040	
Surface tension, mixture	dyne/cm	30.777	14.751	14.751	16.967	16.967	16.966	32.017	32.017	17.347	17.347	18.594	18.594	18.594	31.432	31.432		11.383	
ASTM D86 0%, liquid volume percent, for a petroleum mixture	F	384.31	546.37	546.37	546.37	546.37	546.36	546.36	546.36	809.24	809.24	809.24	809.24	809.24	809.24	809.24			
ASTM D86 5%, liquid volume percent, for a petroleum mixture	F	659.77	781.58	781.58	781.58	781.58	781.58	781.58	781.58	1012.64	1012.64	1012.64	1012.64	1012.64	1012.64	1012.64		672.87	
ASTM D86 10%, liquid volume percent, for a petroleum mixture	F	673.58	792.69	792.69	792.69	792.69	792.68	792.68	792.68	1025.41	1025.41	1025.41	1025.41	1025.41	1025.41	1025.41		687.74	
ASTM D86 30%, liquid volume percent, for a petroleum mixture	F	703.83	835.45	835.45	835.45	835.45	835.45	835.45	835.45	1072.34	1072.34	1072.34	1072.34	1072.34	1072.34	1072.34		716.00	
ASTM D86 50%, liquid volume percent, for a petroleum mixture	F	724.99	874.08	874.08	874.08	874.08	874.08	874.08	874.08	1100.55	1100.55	1100.55	1100.55	1100.55	1100.55	1100.55		741.31	
ASTM D86 70%, liquid volume percent, for a petroleum mixture	F	755.13	917.16	917.16	917.16	917.16	917.16	917.16	917.16	1191.22	1191.22	1191.22	1191.22	1191.22	1191.22	1191.22		785.09	
ASTM D86 90%, liquid volume percent, for a petroleum mixture	F	824.39	997.35	997.35	997.35	997.35	997.35	997.35	997.35	1426.66	1426.66	1426.66	1426.66	1426.66	1426.66	1426.66		879.07	
ASTM D86 95%, liquid volume percent, for a petroleum mixture	F	856.60	1032.98	1032.98	1032.98	1032.98	1032.97	1032.97	1032.97	1457.80	1457.80	1457.80	1457.80	1457.80	1457.80	1457.80		916.03	
ASTM D86 100%, liquid volume percent, for a petroleum mixture	F	939.03	1119.26	1119.26	1119.26	1119.26	1119.24	1119.24	1119.24	1518.92	1518.92	1518.92	1518.92	1518.92	1518.92	1518.92		1037.31	
Flash point, Pennsky-Martens method	F	336.92	440.87	440.87	440.87	440.87	440.86	440.86	440.86	623.52	623.52	623.52	623.52	623.52	623.52	623.52		332.05	



CRC Crude & Vacuum Units				
Detailed Material Balance				
Case: 100% Bakken				
Rev B				
12/20/2019				
	Units	71	72	73
Description				
		Saturated	AGO	Diesel
		Steam to	Draw from	from
		T-4004	T-4001	AC-4002A
		Vapor Phase	Liquid Phase	Liquid Phase
Temperature	F	340.00	662.26	130.00
Pressure	psia	64.70	34.47	94.70
Molar Vapor Fraction		1.00	0.00	0.00
Molar Liquid Fraction		0.00	1.00	1.00
Molar Solid Fraction		0.00	0.00	0.00
Mass Vapor Fraction		1.00	0.00	0.00
Mass Liquid Fraction		0.00	1.00	1.00
Mass Solid Fraction		0.00	0.00	0.00
Molar Enthalpy	Btu/lbmol	-102021.85	69719.62	-30072.52
Mass Enthalpy	Btu/lb	-5663.07	209.67	-123.45
Molar Entropy	Btu/lbmol-R	-10.52	105.43	-4.38
Mass Entropy	Btu/lb-R	-0.58	0.32	-0.02
Molar Density	lbmol/cuft	0.01	0.12	0.21
Mass Density	lb/cuft	0.14	41.01	51.90
Enthalpy Flow	MMBtu/hr	-0.45	7.33	-1.65
Average MW		18.02	332.53	243.61
Mole Flows	lbmol/hr	4.44	105.19	54.77
Mass Flows	lb/hr	80.00	12812.00	13343.20
H2	lb/hr	0.00	0.00	0.00
N2	lb/hr	0.00	0.00	0.00
O2	lb/hr	0.00	0.00	0.00
H2S	lb/hr	0.00	0.00	0.00
CO2	lb/hr	0.00	0.00	0.00
C1	lb/hr	0.00	0.01	0.00
C2	lb/hr	0.00	0.17	0.00
C3	lb/hr	0.00	0.67	0.00
IC4	lb/hr	0.00	1.23	0.00
NC4	lb/hr	0.00	1.69	0.00
IC5	lb/hr	0.00	0.00	0.00
NC5	lb/hr	0.00	0.00	0.00
H2O	lb/hr	80.00	0.67	21.46
PC107F	lb/hr	0.00	7.23	0.05
PC138F	lb/hr	0.00	6.43	0.07
PC163F	lb/hr	0.00	8.93	0.17
PC188F	lb/hr	0.00	12.13	0.38
PC213F	lb/hr	0.00	16.71	0.83
PC237F	lb/hr	0.00	23.92	1.83
PC262F	lb/hr	0.00	29.17	3.55
PC287F	lb/hr	0.00	29.90	5.86
PC312F	lb/hr	0.00	27.24	8.67
PC337F	lb/hr	0.00	26.65	13.58
PC362F	lb/hr	0.00	29.00	22.87
PC388F	lb/hr	0.00	35.56	42.04
PC413F	lb/hr	0.00	42.71	73.23
PC437F	lb/hr	0.00	50.88	122.68
PC462F	lb/hr	0.00	60.85	203.82
PC487F	lb/hr	0.00	73.84	351.08
PC512F	lb/hr	0.00	91.20	673.53
PC537F	lb/hr	0.00	111.99	1383.34
PC562F	lb/hr	0.00	138.36	2023.82
PC587F	lb/hr	0.00	174.33	2074.34
PC612F	lb/hr	0.00	231.55	1962.26
PC638F	lb/hr	0.00	322.20	1717.26
PC664F	lb/hr	0.00	529.64	1343.52
PC686F	lb/hr	0.00	942.94	909.61
PC713F	lb/hr	0.00	1516.03	315.10
PC738F	lb/hr	0.00	1554.90	59.02

	Units	71	72	73
PC762F	lb/hr	0.00	1355.89	8.56
PC788F	lb/hr	0.00	1109.68	0.61
PC825F	lb/hr	0.00	1708.35	0.05
PC875F	lb/hr	0.00	1151.48	0.00
PC925F	lb/hr	0.00	691.51	0.00
PC973F	lb/hr	0.00	377.14	0.00
PC1020F	lb/hr	0.00	166.99	0.00
PC1075F	lb/hr	0.00	86.41	0.00
PC1125F	lb/hr	0.00	45.14	0.00
PC1170F	lb/hr	0.00	17.95	0.00
PC1247F	lb/hr	0.00	2.74	0.00
PC1345F	lb/hr	0.00	0.66	0.00
PC1453F	lb/hr	0.00	0.25	0.00
PC1738F	lb/hr	0.00	0.00	0.00
Volume Flow	bbl/day	2437.52	1335.46	1099.05
Vapor Phase				
Heat capacity, mixture	Btu/lbmol-R	9.383		
Viscosity, mixture	cP	0.015		
Thermal conductivity, mixture	Btu-ft/hr-sqft-R	0.019		
Liquid Phase				
Standard liquid volume flow	bbl/day		981.345	1068.928
Heat capacity, mixture	Btu/lbmol-R		235.664	116.254
Viscosity, mixture	cP		0.259	2.868
Thermal conductivity, mixture	Btu-ft/hr-sqft-R		0.037	0.064
Surface tension, mixture	dyne/cm		10.319	28.641
ASTM D86 0%, liquid volume percent, for a petroleum mixture	F			-330.20
ASTM D86 5%, liquid volume percent, for a petroleum mixture	F		571.32	525.73
ASTM D86 10%, liquid volume percent, for a petroleum mixture	F		641.84	536.47
ASTM D86 30%, liquid volume percent, for a petroleum mixture	F		702.04	559.71
ASTM D86 50%, liquid volume percent, for a petroleum mixture	F		728.64	578.95
ASTM D86 70%, liquid volume percent, for a petroleum mixture	F		771.76	603.04
ASTM D86 90%, liquid volume percent, for a petroleum mixture	F		869.79	638.92
ASTM D86 95%, liquid volume percent, for a petroleum mixture	F		907.46	658.22
ASTM D86 100%, liquid volume percent, for a petroleum mixture	F		1028.35	705.62
Flash point, Pennsky-Martens method	F		79.28	223.99