

APPENDICES

APPENDIX A
ESTIMATED LABOR REQUIREMENTS AND ASSOCIATED COSTS
CAMP, AIRPORT, AND TOWNSITE O/M

DESCRIPTION	QUANTITY	HOURLY RATE	DAILY RATE (1)	PAYROLL BURDEN 30%	OVERHEAD AND GSA 80%	SUB-TOTAL	FEE - 10%	DAILY TOTAL	WEEKLY TOTAL 7	MONTHLY TOTAL 30	ANNUAL TOTAL 365
Project Manager	1	20.00	220.00	66.00	110.00	396.00	39.60	435.60	3,049.20	13,068.00	358,995.00
Secretary	1	11.70	128.70	38.61	64.35	231.66	23.17	254.83	1,783.81	7,664.90	53,012.95
Total Project Mgt.	2		348.70	104.61	174.35	627.66	62.77	690.43	4,833.01	20,732.90	252,008.95
Administration Mgr.	1	17.50	192.50	57.75	96.75	346.50	34.65	381.15	2,668.05	11,434.50	139,119.75
Contracts Admin.	1	17.80	187.00	56.10	91.50	336.60	33.66	370.26	2,591.82	11,107.80	135,244.90
Finance & Acct. Sup.	1	16.50	181.50	54.45	90.75	326.70	32.67	359.37	2,515.59	10,781.10	131,170.05
Personnel Sup.	1	16.50	181.50	54.45	90.75	326.70	32.67	359.37	2,515.59	10,781.10	131,170.05
Medical Doctor	1	20.00	220.00	66.00	110.00	396.00	39.60	435.60	3,049.20	13,068.00	158,994.00
Para-Medic/EN	3	16.00	528.00	158.40	264.00	950.40	95.04	1,045.44	7,318.08	31,363.20	381,585.60
Medical Technician	2	15.50	361.00	102.30	170.00	633.80	63.38	697.18	4,766.26	20,255.40	246,440.70
Accountants	3	15.50	511.50	153.45	255.75	920.70	92.07	1,012.77	7,089.39	30,383.10	369,661.05
Clerk/Typist	3	11.00	363.00	108.90	181.50	653.40	65.34	718.74	5,031.18	21,562.20	262,340.10
Typist	2	10.00	220.00	66.00	110.00	396.00	39.60	435.60	3,049.20	13,068.00	158,994.00
Total Administration	18		2,926.00	872.80	1,463.00	5,266.80	526.68	5,793.48	40,554.36	173,804.40	2,114,620.20
Facility/Planning Mgr.	1	17.50	192.50	57.75	96.75	346.50	34.65	381.15	2,668.05	11,434.50	139,119.75
Civil Engineer	1	17.00	187.00	56.10	91.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Electrical/Mech. Eng.	1	17.00	187.00	56.10	91.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Draftsman	1	16.31	156.94	47.08	78.47	282.49	28.25	310.74	2,175.18	9,322.20	113,420.10
Blkd. Maint. Sup.	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Roads & Grounds Sup.	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Utilization Sup.	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Carpenter/Painter	2	16.50	363.00	108.90	181.50	653.40	65.34	718.74	5,031.18	21,562.20	262,340.10
Plumber	2	17.00	374.00	112.20	187.00	673.20	67.32	740.52	5,183.64	22,215.60	270,289.80
Electrician	2	17.00	374.00	112.20	187.00	673.20	67.32	740.52	5,183.64	22,215.60	270,289.80
Welder/Sheet Metal	1	17.00	187.00	56.10	91.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Equipment Operator	4	16.00	704.00	211.20	352.00	1,267.20	126.72	1,393.92	9,757.44	41,817.60	508,780.80
Laborer	4	14.31	627.76	188.32	311.88	1,128.96	112.89	1,241.86	8,700.72	37,288.80	453,680.40
F.D.			3,891.40	1,167.41	1,945.70	7,004.51	700.45	7,704.96	53,934.72	231,148.80	2,812,310.40
NOTES: (1) 10 hour work day (over time @ 1 1/2 reg. rate over 8 hours per day).											
CIRI/H&N ANCHORAGE, ALASKA											
ESTIMATING ENGINEERING WORKSHEET											
Beluga Hethanol Project O & H Personnel-50 Man Camp & Townsite											
PREPARED BY W. R. Lantz											
CHECKED BY											
DATE 5/16/81											
JOB NO. 7500											
SHEET NO. 1 OF 3											
TYPE OF ESTIMATE - Preliminary - 0%											
Order of Magnitude - Preliminary - 20%											

DESCRIPTION	QUANTITY	HOURLY RATE	DAILY RATE (1)	PAYROLL BURDEN 30%	OVERHEAD AND GSA 50%	SUB-TOTAL	FEE - 10%	DAILY TOTAL	WEEKLY TOTAL 7	MONTHLY TOTAL 30	ANNUAL TOTAL 366
FWD.			3,891.40	1,167.41	1,943.70	7,004.51	700.45	7,704.96	53,934.72	231,148.80	2,812,310.40
Water/Sewage Operator	2	16.00	352.00	105.60	176.00	633.60	63.36	696.96	4,878.72	20,908.80	254,390.40
Telephone Com. Tech.	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Clerk/Typist	3	11.00	363.00	108.90	103.50	633.60	63.36	718.74	5,031.18	21,562.20	262,340.10
Power PLANE OPERATOR	2	16.00	352.00	105.60	176.00	633.60	63.36	696.96	4,878.72	20,908.80	254,390.40
Total Facility	30		5,145.40	1,543.61	2,572.70	9,261.71	926.17	10,187.88	71,315.16	305,636.40	3,719,576.20
Procurement/Logistics Mgr.	1	17.50	192.50	57.75	96.25	346.50	34.65	381.15	2,668.05	11,434.50	139,119.75
Transportation Exp.	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Warehouse Sup.	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Clerk/Typist	8	11.00	968.00	290.40	484.00	1,742.40	174.24	1,916.64	13,416.48	57,499.20	699,573.60
Laborer	10	14.31	1,569.40	470.80	764.70	2,824.90	282.49	3,107.40	21,751.80	93,222.00	1,134,201.80
Equipment Operators	6	16.00	1,056.00	316.80	528.00	1,900.80	190.08	2,090.88	14,636.16	62,726.40	763,171.20
Drivers	12	14.31	1,883.28	565.00	941.64	3,389.92	339.00	3,728.92	26,102.44	111,867.60	1,361,055.80
Mechanical Foreman	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Mechanics	4	16.00	704.00	211.20	332.00	1,267.20	126.72	1,393.92	9,757.44	41,812.80	508,780.80
Welder/Mechanics	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Total Logistics	45		7,090.38	2,129.31	3,549.19	12,772.08	1,277.22	14,049.30	98,383.50	421,644.00	5,120,002.00
Housing/Comm. Ser. Mgr.	1	17.50	192.50	57.75	96.25	346.50	34.65	381.15	2,668.05	11,434.50	139,119.75
Chief Fire/Security	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Housekeeper	1	14.31	156.94	47.08	78.47	282.49	28.25	310.74	2,175.18	9,322.20	113,420.10
Laundry Worker	1	14.31	156.94	47.08	78.47	282.49	28.25	310.74	2,175.18	9,322.20	113,420.10
Head Cook P.S. SUP.	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Lead Cook - Baker	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Cook											
Lead Kitchen Helper											
Kitchen Helper	1	14.31	156.94	47.08	78.47	282.49	28.25	310.74	2,175.18	9,322.20	113,420.10
Storekeeper/Clerk											
FWD.			1,209.12	362.73	604.56	2,176.41	217.64	2,394.05	16,758.35	71,881.50	873,628.25

ESTIMATING ENGINEERING WORKSHEET

CIRI/H&N

ANCHORAGE, ALASKA

Beluga Methanol Project

G & M Personnel-50 Man Camp 6

Tonniste

DATE5/16/81

CHECKED BY

PREPARED BYW. R. Lutz

7500

JOB NO.

23

SHEET NO. OF

02

- Preliminary + 20%

TYPE OF ESTIMATE

Order of Magnitude

NOTES: (1) 10 hour work day (overtime @ 1 1/2 reg. rate over 8 hours per day).

DESCRIPTION	QUANTITY	HOURLY RATE	DAILY RATE (1)	PAYROLL BURDEN 40%	OVERHEAD AND GSA 50%	SUB-TOTAL	FEES - 10%	DAILY TOTAL	WEEKLY TOTAL 7	MONTHLY TOTAL 30	ANNUAL TOTAL 365
Project Manager	1	20.00	220.00	66.00	110.00	396.00	39.60	435.60	3,049.20	13,068.00	158,994.00
Secretary	1	11.70	128.70	38.61	64.35	231.66	23.17	254.83	1,783.81	7,644.90	91,012.85
Total Project Mgt.	2		348.70	104.61	174.35	627.66	62.77	690.43	4,833.01	20,712.90	252,006.95
Administration Mgt.	1	17.50	192.50	57.75	96.25	346.50	34.65	381.15	2,668.05	11,436.50	139,119.75
Contracts Administration	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Finance & Act. Sup.	1	16.50	181.50	54.45	90.75	326.70	32.67	359.37	2,515.59	10,781.10	131,170.05
Personnel Sup.	1	16.50	181.50	54.45	90.75	326.70	32.67	359.37	2,515.59	10,781.10	131,170.05
Medical Doctor	1	20.00	220.00	66.00	110.00	396.00	39.60	435.60	3,049.20	13,068.00	158,994.00
Para-Medic/EM	3	16.00	528.00	158.40	264.00	950.40	95.04	1,045.44	7,318.08	31,363.20	381,585.60
Medical Technician	2	15.50	341.00	102.30	170.50	613.80	61.38	675.18	4,726.26	20,255.40	246,440.70
Accountants	3	15.50	511.50	153.45	255.75	920.70	92.07	1,012.77	7,089.39	30,387.10	369,661.05
Clerk/Typist	1	11.00	163.00	48.90	81.50	293.40	29.34	322.74	2,259.18	9,372.20	113,420.10
Typist	2	10.00	220.00	66.00	110.00	396.00	39.60	435.60	3,049.20	13,068.00	158,994.00
Total Administration	18		2,936.00	877.80	1,463.00	5,266.80	526.68	5,793.48	40,554.36	173,800.40	2,114,620.20
Facility/Planning Mgt.	1	17.50	192.50	57.75	96.25	346.50	34.65	381.15	2,668.05	11,436.50	139,119.75
Civil Engineer	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Electrical/Mech. Eng.	1	27.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Draftsman	1	14.31	156.94	47.08	78.47	282.49	28.25	310.74	2,175.18	9,372.20	113,420.10
Bldg. Maint. Sup.	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Roads & Grounds Sup.	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Utilities Sup.	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Carpenter/Painter	2	16.50	363.00	108.90	181.50	653.40	65.34	718.74	5,031.18	21,562.20	262,340.10
Plumber	2	17.00	374.00	112.20	187.90	673.20	67.32	740.52	5,183.64	22,215.60	270,289.80
Electrician	2	17.00	374.00	112.20	187.90	673.20	67.32	740.52	5,183.64	22,215.60	270,289.80
Welder/Sheet Metal	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Equipment Operator	4	16.00	704.00	211.20	352.00	1,267.20	126.72	1,393.92	9,757.44	41,817.60	508,780.80
Laborer	4	14.31	627.76	188.32	313.88	1,129.96	113.00	1,242.96	8,700.72	37,288.80	453,680.40
MD.			3,891.40	1,167.42	1,965.70	7,004.52	700.45	7,704.96	53,936.72	231,148.80	2,812,310.40
NOTES: (1) 10 hour work day (over time @ 1 1/2 reg. rate over 8 hours per day).											
CIRI/H&N											
ANCHORAGE, ALASKA											
ESTIMATING ENGINEERING WORKSHEET											
Beluga National Project											
O & H Personnel-3,000 man camp											
TYPE OF ESTIMATE				SHEET NO. OF		JOB NO.		PREPARED BY		CHECKED BY	
Order of Magnitude - Preliminary + 20%				1		7500		H. B. Lanz		5/16/81	

DESCRIPTION	QUANTITY	HOURLY RATE	DAILY RATE (1)	PAYROLL BURDEN 30%	OVERHEAD AND GSA 80%	SUB-TOTAL	FES - 10%	DAILY TOTAL	WEEKLY TOTAL 7	MONTHLY TOTAL 30	ANNUAL TOTAL 365
FWD.			3,891.40	1,167.61	1,945.76	7,004.51	700.45	7,704.96	53,934.72	231,168.80	2,812,310.40
Water/Sewage Operator	2	16.00	352.00	105.60	176.00	633.60	63.36	696.96	4,818.72	20,908.80	254,390.40
Telephone Comm. Tech.	1	17.00	187.00	56.10	91.30	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Clerk/Typist	3	11.00	363.00	108.90	181.50	653.40	65.34	718.74	5,031.18	21,562.20	262,340.10
Power Plant Operator	2	16.00	352.00	105.60	176.00	633.60	63.36	696.96	4,818.72	20,908.80	254,390.40
Total Facility	30		5,145.40	1,543.61	2,572.70	9,261.71	926.17	10,187.88	71,315.16	305,636.40	3,718,576.80
Procurement/Logistics Mgr.	1	17.50	192.50	57.75	96.25	346.50	34.65	381.15	2,668.05	11,434.50	139,119.75
Transportation Sup.	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Warehouse Sup.	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Clerk/Typist	8	11.00	988.00	296.40	484.00	1,768.40	176.84	1,945.24	13,616.68	57,499.20	699,573.60
Equipment Operators	10	14.31	1,589.40	476.80	784.70	2,850.90	285.09	3,135.99	21,751.80	93,222.00	1,136,201.00
Drivers	1	16.00	1,056.00	316.80	528.00	1,900.80	190.08	2,090.88	14,636.16	62,776.80	763,171.20
Mechanical Foreman	12	14.31	1,717.20	515.16	841.64	3,074.00	307.40	3,381.40	23,669.80	99,651.60	1,206,619.20
Mechanics	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Welder/Mechanic	2	16.00	704.00	211.20	352.00	1,267.20	126.72	1,393.92	9,757.44	41,817.60	501,811.20
Total Logistics	45		7,098.38	2,129.51	3,519.19	12,736.66	1,273.66	14,010.32	98,076.56	418,177.60	5,018,255.30
Housing/Comm. Sup. Mgr.	1	17.50	192.50	57.75	96.25	346.50	34.65	381.15	2,668.05	11,434.50	139,119.75
Chief Fire/Security	1	17.00	187.00	56.10	91.30	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Housekeeper	53	14.31	8,317.82	2,495.24	4,158.91	14,971.97	1,497.19	16,469.16	115,284.54	494,076.60	6,011,255.30
Laundry Worker	10	14.31	1,569.40	470.80	784.70	2,850.90	285.09	3,135.99	21,751.80	93,222.00	1,136,201.00
Head Cook F.S. Sup.	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Lead Cook - Baker	2	16.31	358.80	107.64	179.40	645.84	64.58	710.42	4,972.94	21,312.60	259,303.20
Cook	6	15.95	1,052.70	315.82	526.36	1,894.88	189.48	2,084.36	14,590.52	61,530.80	760,791.40
Lead Kitchen Helper	4	14.57	641.08	192.32	320.56	1,153.96	115.40	1,269.36	8,885.52	38,090.80	463,316.40
Kitchen Helper	18	14.31	2,824.92	847.48	1,412.46	5,084.86	508.48	5,593.34	39,153.38	167,800.20	2,041,549.10
Storekeeper/Clerk	4	11.00	484.00	145.20	242.00	871.20	87.12	958.32	6,708.24	28,749.60	349,786.60
FWD.			15,307.62	4,742.17	7,903.84	28,453.63	2,845.41	31,299.04	219,093.28	938,971.20	11,424,142.60

NOTES: (1) 10 hour work day (overtime @ 1 1/2 reg. rate over 8 hours per day.)

CIRI/H&N
ANCHORAGE, ALASKA

ESTIMATING ENGINEERING WORKSHEET

Beluga Helium Project

O & H Personnel - 5,000 Man Camp

TYPE OF ESTIMATE	02	SHEET NO.	2	OF	3	JOB NO.	7500	PREPARED BY	W. B. Lane	CHECKED BY	DATE
Order of Magnitude - Preliminary + 20%											

DESCRIPTION	QUANTITY	HOURLY RATE	DAILY RATE (1)	PAYROLL BURDEN 30%	OVERHEAD AND DIA 50%	SUB-TOTAL	FEE - 10%	DAILY TOTAL	WEEKLY TOTAL 7	MONTHLY TOTAL 30	ANNUAL TOTAL 365
END.											
Fireman/Security Capt.	1	16.50	15,007.62	4,742.17	7,903.84	28,653.63	2,865.36	31,519.04	219,993.28	938,971.20	11,426,149.60
Fireman/Security-Off.	4	16.00	1,056.00	316.80	528.00	1,900.80	190.08	2,090.88	14,636.16	62,726.40	763,171.20
Safety Engineer	1	16.50	181.50	54.45	90.75	326.70	32.67	359.37	2,515.59	19,781.10	131,170.05
Chief/Typist	4	11.00	484.00	145.20	242.00	871.20	87.12	958.32	6,708.24	28,749.60	349,786.80
Laborer	4	14.31	627.76	188.32	313.86	1,129.96	112.99	1,242.96	8,700.72	37,288.80	453,680.40
Air Traffic Control/ Radio	2	17.00	371.00	111.30	187.00	673.20	67.32	740.52	5,183.64	22,215.60	270,289.80
Total Comm. Services	118		18,712.38	5,613.59	9,356.22	33,682.19	3,368.22	37,050.46	259,353.22	1,111,513.80	13,523,417.90
Grand Total	213	16.48 (2)	34,230.86	10,269.12	17,115.46	61,615.44	6,161.54	67,777.05	474,439.35	2,053,311.50	24,798,623.25
Summary											
Project Management	2		348.70	106.61	174.35	627.66	62.77	690.43	4,833.01	20,712.90	252,006.95
Administration	18		2,926.00	877.80	1,463.00	5,266.80	526.68	5,793.48	40,554.36	173,804.40	2,115,420.20
Facilities	30		5,145.40	1,543.61	2,572.70	9,261.71	926.17	10,187.88	71,315.16	305,636.40	3,718,326.20
Logistics	45		7,098.38	2,129.51	3,549.19	12,777.08	1,277.72	14,054.80	98,383.60	421,664.00	5,130,002.00
Community Services	118		18,722.38	5,613.59	9,356.22	33,682.19	3,368.22	37,050.46	259,353.22	1,111,513.80	13,523,417.90
Total	213		34,230.86	10,269.12	17,115.46	61,615.44	6,161.54	67,777.05	474,439.35	2,053,311.50	24,798,623.25
Project Management			Average Cost Per Resident			(Camp Population 3,000)		.23	1.61	6.90	86.00
Administration								1.93	13.52	57.93	706.87
Facilities								3.40	23.77	101.88	1,239.33
Logistics								4.58	32.72	140.55	1,710.00
Community Services								12.35	86.45	370.50	4,502.81
Total								24.59	158.16	677.16	8,246.21
NOTES: (1) 10 hour work day (overtime @ 1 1/2 reg. rate over 8 hours per day.) (2) Average hourly rate of pay.											
CIRI/H&N ANCHORAGE, ALASKA ESTIMATING ENGINEERING WORKSHEET Beluga Methanol Project O & M Personnel-3,000 Man Camp											
PREPARED BY: W. R. Lanz CHECKED BY: DATE: 5/16/81											

DESCRIPTION	QUANTITY	HOURLY RATE	DAILY RATE (1)	PAYROLL BURDEN 30%	OVERHEAD AND GSA 80%	SUB-TOTAL	FEE - 10%	DAILY TOTAL	WEEKLY TOTAL 7	MONTHLY TOTAL 30	ANNUAL TOTAL 365
Project Manager	1	20.00	220.00	65.00	110.00	395.00	39.50	435.00	3,045.00	13,068.00	158,994.00
Secretary	1	11.70	128.70	38.61	64.35	231.66	23.17	254.83	1,783.81	7,644.90	92,012.95
Total Project MGMT	2		348.70	104.61	174.35	627.66	62.77	690.43	4,828.81	20,712.90	2,51,006.95
Administration MGR.	1	17.50	192.50	57.75	96.25	346.50	34.65	381.15	2,668.05	11,434.50	139,119.75
Contracts Administration	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Personnel Supervisor	1	16.50	181.50	54.45	90.75	326.70	32.67	359.37	2,515.59	10,781.10	131,170.05
Medical Doctor	1	20.00	220.00	66.00	110.00	396.00	39.60	435.60	3,049.20	13,068.00	158,994.00
Para-medical / RN	1	16.00	176.00	52.80	88.00	316.80	31.68	348.48	2,439.36	10,454.40	127,195.20
Medical Technician	1	15.50	170.50	51.15	85.25	306.90	30.69	337.59	2,363.13	10,127.70	123,220.35
Accountants	2	15.50	341.00	102.30	170.50	613.80	61.38	675.18	4,726.26	20,235.40	246,440.70
Clerk/typist	2	11.00	242.00	72.60	121.00	435.60	43.56	479.16	3,354.12	14,374.80	174,893.40
Typist	1	10.00	110.00	33.00	55.00	198.00	19.80	217.80	1,524.60	6,536.00	79,497.00
Total Administration	11		1,820.50	546.15	910.25	3,276.90	327.69	3,604.59	25,232.13	108,137.70	1,315,675.15
Facility/Planning Mgr.	1	17.50	192.50	57.75	96.25	346.50	34.65	381.15	2,668.05	11,434.50	139,119.75
Civil Engineer	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Electrical/Mech. Eng.	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Draftsman	1	14.31	156.94	47.08	78.47	282.49	28.25	310.74	2,175.18	9,322.20	113,620.10
Bldg. Maintenance Sup.	1	16.31	179.40	53.82	88.70	322.92	32.29	355.21	2,486.47	10,556.30	129,651.65
Roads & Grounds Sup.	1	16.31	179.40	53.82	88.70	322.92	32.29	355.21	2,486.47	10,556.30	129,651.65
Utilities Sup.	1	16.31	179.40	53.82	88.70	322.92	32.29	355.21	2,486.47	10,556.30	129,651.65
Carpenter/Painter	1	16.50	181.50	54.45	90.75	326.70	32.67	359.37	2,515.59	10,781.10	131,170.05
Plumber	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Electrician	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Welder/Sheet Metal	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Equipment Operator	1	16.00	176.00	52.80	88.00	316.80	31.68	348.48	2,439.36	10,454.40	127,195.20
Laborer	1	14.31	156.94	47.08	78.47	282.49	28.25	310.74	2,175.18	9,322.20	113,620.10
FOU			2,332.08	701.12	1,168.54	4,201.74	420.17	4,621.91	32,391.87	139,422.30	1,688,004.65

NOTES: (1) 10 hour work day (over time @ 1 1/2 reg. rate over 8 hours per day).

CIRI/H&N
ANCHORAGE, ALASKA

ESTIMATING ENGINEERING WORKSHEET

Beluga Methanol Project

O & M Personnel-500 Man Camp

TYPE OF ESTIMATE - 02
Order of Magnitude - Preliminary + 20%

JOB NO. 7500

SHEET NO. 1 OF 3

PREPARED BY
W. R. Lenz

CHECKED BY

DATE 5/16/81

DESCRIPTION	QUANTITY	HOURLY RATE	DAILY RATE (1)	PAYROLL BURDEN 30%	OVERHEAD AND GSA 50%	SUB-TOTAL	FEE - 10%	DAILY TOTAL	WEEKLY TOTAL 7	MONTHLY TOTAL 30	ANNUAL TOTAL 365
FWD			2,670.82	801.00	1,335.01	4,806.83	480.60	5,286.63	37,006.41	158,598.90	1,979,619.95
Water/Security Operator	1	16.00	176.00	52.80	88.00	316.80	31.68	348.48	2,439.36	10,454.40	127,195.20
Telephone Comm. Tech.	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Clerk/Typist	2	11.00	242.00	72.60	121.00	435.60	43.56	479.16	3,354.12	14,374.80	174,893.40
Power Plant Operator	1	16.00	176.00	52.80	88.00	316.80	31.68	348.48	2,439.36	10,454.40	127,195.20
Total Facility	20		3,451.02	1,035.30	1,725.51	6,211.83	621.18	6,833.01	47,831.07	204,990.30	2,494,048.65
Procurement/Logistics Mgr	1	17.50	192.50	57.75	96.25	346.50	34.65	381.15	2,668.05	11,434.50	139,119.75
Transportation Sep.	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Warehouse Supervisor	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Clerk/Typist	4	11.00	484.00	145.20	242.00	871.20	87.12	958.32	6,708.24	28,749.60	349,786.80
Laborer	4	14.31	627.76	188.32	313.88	1,129.96	113.00	1,242.96	8,700.72	37,288.80	453,680.40
Equipment Operators	2	16.00	352.00	105.60	176.00	633.60	63.36	696.96	4,878.72	20,908.80	254,390.40
Driveway	4	14.31	627.76	188.32	313.88	1,129.96	113.00	1,242.96	8,700.72	37,288.80	453,680.40
Mechanical Foreman	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Mechanics	2	15.00	352.00	105.60	176.00	633.60	63.36	696.96	4,878.72	20,908.80	254,390.40
Welder	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Total Logistics	21		3,361.22	1,008.35	1,600.61	6,050.18	605.02	6,655.20	46,586.40	199,456.00	2,428,168.00
Housing/Comm. Ser. Mgr	1	17.50	192.50	57.75	96.25	346.50	34.65	381.15	2,668.05	11,434.50	139,119.75
Chief Fire/Security	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Housekeeper	18	14.31	2,824.22	847.48	1,412.46	5,084.86	508.48	5,593.34	39,153.38	167,800.20	2,041,569.10
Laundry Worker	6	14.31	941.64	282.50	470.82	1,694.96	169.50	1,864.46	13,051.22	55,933.80	680,377.90
Head Cook FS Supervisor	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Lead Cook - Baker	2	16.31	358.80	107.64	179.40	645.84	64.58	710.42	4,972.94	21,312.60	259,303.30
Cook	3	15.95	526.35	157.91	263.18	947.44	94.74	1,042.18	7,295.26	31,265.40	380,385.70
Lead Kitchen Helper	2	14.57	320.54	96.16	160.28	576.98	57.70	634.68	4,442.76	19,040.40	231,658.20
Kitchen Helper	6	14.31	941.64	282.50	470.82	1,694.96	169.50	1,864.46	13,051.22	55,933.80	680,377.90
Storekeeper/Clerk	2	11.00	242.00	72.60	121.00	435.60	43.56	479.16	3,354.12	14,374.80	174,893.40
FWD.			6,714.79	2,014.46	1,357.41	12,086.66	1,208.66	13,295.32	93,067.24	398,859.60	4,852,791.80
NOTES: (1) 10 hour work day (overtime @ 1 1/2 reg. rate over 8 hours per day.)											
CIRI/H&N											
ANCHORAGE, ALASKA											
ESTIMATING ENGINEERING WORKSHEET											
Beluga Methanol Project											
O & N Personnel-1,000 Man Camp											
PREPARED BY V. R. Lane											
CHECKED BY											
DATE 5/16/81											
JOB NO. 7500											
SHEET NO. 2 OF 3											
TYPE OF ESTIMATE - OR											
Order of Magnitude - Preliminary + 20%											

DESCRIPTION	QUANTITY	HOURLY RATE	DAILY RATE (1)	PAYROLL BURDEN 30%	OVERHEAD AND GRA 80%	SUB-TOTAL	FEE - 10%	DAILY TOTAL	WEEKLY TOTAL	MONTHLY TOTAL	ANNUAL TOTAL
PMO.			6,714.79	2,014.46	3,357.41	12,086.66	1,208.66	13,295.32	93,067.24	398,859.60	4,832,791.80
Fireman/Security Capt.	1	16.50	181.50	54.45	50.75	326.70	32.67	359.37	2,515.59	10,781.10	131,170.05
Fireman/Security Off.	3	16.00	528.00	158.40	268.00	950.40	95.04	1,045.44	7,318.08	31,363.20	381,585.60
Safety Engineer	1	16.50	181.50	54.45	50.75	326.70	32.67	359.37	2,515.59	10,781.10	131,170.05
Clerk/Typist	2	11.00	242.00	72.60	121.00	435.60	43.56	479.16	3,354.12	14,374.80	174,893.40
Laborer	2	14.31	313.88	94.16	156.94	564.98	56.50	621.48	4,350.36	18,544.40	226,840.20
Air Traffic Cont./Radio	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Total Com. Ser.	52		8,348.67	2,504.62	4,174.35	15,027.64	1,502.76	16,530.40	115,712.80	495,912.00	6,033,596.20
Grand Total	108	14.91 (2)	17,687.61	5,306.28	8,843.82	31,837.71	3,183.77	35,021.48	245,150.36	1,050,644.40	12,782,840.20
Summary											
Project Management	2		348.70	104.61	174.15	627.66	62.77	690.43	4,833.01	20,712.90	252,064.95
Administration	13		2,178.00	653.40	1,069.00	3,920.40	392.04	4,312.44	30,187.08	129,373.20	1,574,040.60
Facilities	20		3,451.02	1,035.30	1,725.51	6,211.83	621.18	6,833.01	47,831.07	204,990.30	2,494,048.65
Logistics	21		3,361.22	1,008.35	1,680.63	6,050.18	605.02	6,655.20	46,586.40	199,656.00	2,429,148.00
Community Services	52		8,348.67	2,504.62	4,174.35	15,027.64	1,502.76	16,530.40	115,712.80	495,912.00	6,033,596.00
Total	108		17,687.61	5,306.28	8,843.82	31,837.71	3,183.77	35,021.48	245,150.36	1,050,644.40	12,782,840.20
Project Management			Average	Cost Per Employee	(Camp Population 1,000)		.69	4.83	20.71	252.01	
Administration							4.31	30.19	129.37	1,574.04	
Facilities							6.83	47.83	204.99	2,494.05	
Logistics							6.66	46.59	199.66	2,429.11	
Community Services							16.53	115.71	495.91	6,033.59	
Total							35.02	245.15	1,050.64	12,782.84	

CIRI/H&N
ANCHORAGE, ALASKA

ESTIMATING ENGINEERING WORKSHEET

Beluga Hachanal Project
O & H Personnel-1,000 Man Camp

DATE
5/16/81

CHECKED BY
W. L. Lenz

7500

JOB NO.

SHEET NO. 3 OF 3

TYPE OF ESTIMATE
Order of Magnitude - Preliminary - 02

NOTES: (1) 10 Hour Work day (Guarantee @ 1 1/2 hrs. per. rate over 8 hours per day).

(2) Average Hourly Rate of Pay

DESCRIPTION	QUANTITY	HOURLY RATE	DAILY RATE (x1)	PATROLL BUREAU 30%	OVERHEAD AND GSA 50%	SUB-TOTAL	FEE - 10%	DAILY TOTAL	WEEKLY TOTAL 7	MONTHLY TOTAL 30	ANNUAL TOTAL 366
Project Manager	1	20.00	220.00	66.00	110.00	396.00	39.60	435.60	3,049.20	13,068.00	158,994.00
Secretary	1	11.70	128.70	38.61	64.35	231.66	23.17	254.83	1,783.81	7,544.90	93,012.95
Total Project Mgmt.	2		248.70	104.61	174.35	627.66	62.77	690.43	4,833.01	20,712.90	252,006.95
Administration Mgr.	1	17.50	192.50	57.75	96.25	346.50	34.65	381.15	2,668.05	11,434.50	139,119.75
Contracts Adm.	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Finance & Acct. Sup.	1	16.50	181.50	54.45	90.75	326.70	32.67	359.37	2,515.59	10,781.10	131,170.05
Personnel Sup.	1	16.50	181.50	54.45	90.75	326.70	32.67	359.37	2,515.59	10,781.10	131,170.05
Medical Doctor	1	20.00	220.00	66.00	110.00	396.00	39.60	435.60	3,049.20	13,068.00	158,994.00
Paramedic/EM	2	16.00	352.00	105.60	176.00	633.60	63.36	696.96	4,878.72	20,908.80	256,980.60
Medical Technician	1	15.50	170.50	51.15	85.25	306.90	30.69	337.59	2,363.13	10,127.70	123,220.35
Accountants	2	15.50	341.00	102.30	170.50	613.80	61.38	675.18	4,726.26	20,255.60	246,460.70
Clark/Typist	2	11.00	242.00	72.60	121.00	435.60	43.56	479.16	3,354.12	14,374.80	174,893.40
Typist	1	10.00	110.00	33.00	55.00	198.00	19.80	217.80	1,524.60	6,534.00	79,497.00
Total Administration	13		2,178.00	653.40	1,089.00	3,920.40	392.04	4,312.44	30,187.08	129,373.20	1,574,060.60
Facility/Plumbing Mnt.	1	17.50	192.50	57.75	96.25	346.50	34.65	381.15	2,668.05	11,434.50	139,119.75
Civil Engineer	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Electrical/Hech. Eng.	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Draftsperson	1	14.31	156.94	47.08	78.47	282.49	28.25	310.74	2,175.18	9,322.20	113,470.10
Bldg. Maintenance Sup.	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Roads & Grounds Sup.	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Utilities Supervisor	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Carpenter/Plumber	1	16.50	181.50	54.45	90.75	326.70	32.67	359.37	2,515.59	10,781.10	131,170.05
Plumber	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Electrician	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Welder/Sheet Metal	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Equipment Operator	2	16.00	352.00	105.60	176.00	633.60	63.36	696.96	4,878.72	20,908.80	254,390.60
Laborer	2	14.31	313.88	94.16	156.94	564.98	56.50	621.48	4,350.56	18,444.60	224,860.20
PK3.			2,670.02	801.00	1,235.01	4,806.03	480.60	5,286.63	37,006.61	158,598.90	1,929,619.95
NOTES: (1) 10 Hour work day (overtime @ 1 1/2 reg. rate over 8 hours per day.)											
C R I / H & N ANCHORAGE, ALASKA											
ESTIMATING ENGINEERING WORKSHEET											
Beluga Methanol Project O & M Personnel-1,000 Men Camp											
PREPARED BY: H. R. Lunde											
CHECKED BY: DATE: 5/16/81											
JOB NO. 7500											
SHEET NO. 1 OF 3											
TYPE OF ESTIMATE - 02											
Order of Magnitude - Preliminary + 20%											

DESCRIPTION	QUANTITY	HOURLY RATE	DAILY RATE (1)	PAYROLL BURDEN %	OVERHEAD AND GSA %	SUB-TOTAL	FEE - 10%	DAILY TOTAL	WEEKLY TOTAL 7	MONTHLY TOTAL 30	ANNUAL TOTAL 365
FWD			3,881.51	1,164.46	1,940.76	6,986.73	698.67	7,685.40	53,797.80	230,562.00	2,805,171.00
Fireman/Security-Officer	3	16.00	528.00	158.40	264.00	950.40	95.04	1,045.44	7,318.08	31,363.20	381,585.60
Safety Engineer	1	16.50	181.50	54.45	90.75	326.70	32.67	359.37	2,515.59	10,781.10	131,170.05
Clerk/Typist	1	11.00	121.00	36.30	60.50	217.80	21.78	239.58	1,677.06	7,187.40	87,446.70
Laborer	1	14.31	156.94	47.08	78.47	282.49	28.25	310.74	2,175.18	9,322.20	113,420.10
Air Traffic Control/Helper	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Total Comm. Services	31		5,055.95	1,516.79	2,527.98	9,100.72	910.07	10,010.79	70,075.53	300,325.70	3,653,938.35
Grand Total	74	15.20 (2)	12,361.69	3,708.50	6,180.85	22,251.04	2,225.10	24,476.14	171,332.98	734,284.20	8,933,791.10
Summary											
Project Management	2		348.70	104.61	174.35	627.66	62.77	690.43	4,833.01	20,712.90	252,006.95
Administration	11		1,820.50	546.15	910.25	3,276.90	327.69	3,604.59	25,232.13	108,137.70	1,315,675.35
Facilities	17		2,997.08	899.12	1,498.54	5,394.74	539.47	5,934.21	41,539.67	178,026.30	2,165,986.65
Logistics	13		2,139.46	641.83	1,069.73	3,851.02	385.10	4,236.12	29,652.84	127,083.60	1,546,183.80
Community Services	31		5,055.95	1,516.79	2,527.98	9,100.72	910.07	10,010.79	70,075.53	300,325.70	3,653,938.35
Total	74		12,361.69	3,708.50	6,180.85	22,251.04	2,225.10	24,476.14	171,332.98	734,284.20	8,933,791.10
Project Management				Average Cost	Per Resident	(Camp Population = 500)		1.38	9.68	41.42	504.01
Administration								7.21	50.47	216.28	2,631.35
Facilities								11.87	83.05	356.05	4,331.97
Logistics								8.47	59.32	254.17	3,092.37
Community Services								20.02	140.15	660.65	7,307.88
Total								48.95	342.67	1,488.57	17,867.58
NOTES:	(1) 10 Hour work day (overtime @ 1 1/2 reg. rate over 8 hours per day).										
	(2) Average hourly rate of pay.										
CIRI/H&N											
ANCHORAGE, ALASKA											
ESTIMATING ENGINEERING WORKSHEET											
Beluga Methanol Project											
O & M Personnel-500 Man Camp											
PREPARED BY W. R. Lenz											
CHECKED BY											
DATE 5/16/81											

DESCRIPTION	QUANTITY	HOURLY RATE	DAILY RATE (1)	PAYROLL BURDEN 30%	OVERHEAD AND GSA 50%	SUB-TOTAL	FEE - 10%	DAILY TOTAL	WEEKLY TOTAL 7	MONTHLY TOTAL 30	ANNUAL TOTAL 365
FWD.			2,337.08	701.12	1,169.54	4,206.74	420.67	4,627.41	32,391.87	138,822.30	1,689,094.65
Water/Seague Operator	1	16.00	176.00	52.80	88.00	316.80	31.68	348.48	2,439.36	10,454.40	127,195.20
Telephone Comm. Tech.	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Clerk/Typist	1	11.00	121.00	36.30	60.50	217.80	21.78	239.58	1,677.06	7,187.40	87,446.70
Power Plant Operator	1	16.00	176.00	52.80	88.00	316.80	31.68	348.48	2,439.36	10,454.40	127,195.20
Total Facility	17		2,997.08	899.12	1,498.54	5,394.74	539.47	5,934.21	41,539.47	178,026.30	2,165,986.45
Procurement/Logistics Mgr	1	17.50	192.50	57.75	96.25	346.50	34.65	381.15	2,668.05	11,434.50	139,119.75
Transportation Supervisor	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Warehouse Supervisor	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Clerk/Typist	2	11.00	242.00	72.60	121.00	435.60	43.56	479.16	3,354.12	14,378.80	174,893.40
Laborer	2	14.31	313.88	94.16	156.94	564.98	56.50	621.48	4,350.36	18,644.40	226,840.20
Equipment Operators	1	16.00	176.00	52.80	88.00	316.80	31.68	348.48	2,439.36	10,454.40	127,195.20
Drivers	2	14.31	313.88	94.16	156.94	564.98	56.50	621.48	4,350.36	18,644.40	226,840.20
Mechanical Foreman	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Mechanics	1	16.00	176.00	52.80	88.00	316.80	31.68	348.48	2,439.36	10,454.40	127,195.20
Welder/Mechanist	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Total Logistics	17		2,130.46	641.81	1,069.73	3,851.02	385.10	4,236.12	29,652.84	127,083.60	1,546,183.80
House/g/Comm. Ser. Mgr.	1	17.50	192.50	57.75	96.25	346.50	34.65	381.15	2,668.05	11,434.50	139,119.75
Chief Fire/Security	1	17.00	187.00	56.10	93.50	336.60	33.66	370.26	2,591.82	11,107.80	135,144.90
Housekeeper	9	14.31	1,412.46	423.74	706.23	2,542.43	254.24	2,796.67	19,576.69	83,500.10	1,020,784.55
Laundry Worker	4	14.31	627.76	188.33	313.88	1,129.97	113.00	1,242.97	8,700.79	37,288.10	453,684.05
Head Cook FS Sup.	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Lead Cook-Baker	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,656.30	129,651.65
Cook	2	15.95	330.90	105.27	175.45	631.62	63.16	694.78	4,863.46	20,843.40	253,594.70
Lead Kitchen Helper	1	14.57	160.27	48.08	80.14	288.49	28.85	317.34	2,221.38	9,520.20	115,829.10
Kitchen Helper	3	14.31	470.82	141.25	235.41	847.48	84.75	932.23	6,525.61	27,966.30	340,263.95
Storekeeper/Clerk	1	11.00	121.00	36.30	60.50	217.80	21.78	239.58	1,677.06	7,187.40	87,446.70
FWD			3,881.51	1,164.46	1,940.76	6,986.73	698.67	7,685.40	53,797.80	230,562.00	2,805,171.00

NOTES: (1) 10 Hour work day (overtime @ 1 1/2 reg. rate over 8 hours per day).

C I R I / H & N
ANCHORAGE, ALASKA

ESTIMATING ENGINEERING WORKSHEET

Beluga Methanol Project

DESCRIPTION	QUANTITY	HOURLY RATE	DAILY RATE (1)	PAYROLL BURDEN 30%	OVERHEAD AND GSA 80%	SUB-TOTAL	FEE - 10%	DAILY TOTAL	WEEKLY TOTAL 7	MONTHLY TOTAL 30	ANNUAL TOTAL 366
<u>Project Management</u>											
Project Manager	1	20.00	220.00	66.00	110.00	396.00	39.60	435.60	3,049.20	13,068.00	156,996.00
<u>Administration</u>											
Accountant	1	15.50	170.50	51.15	85.25	306.90	30.69	337.59	2,363.13	10,127.70	123,220.35
<u>Facilities</u>											
Water/Sewage Operator	1	16.00	176.00	52.80	88.00	316.80	31.68	348.48	2,439.36	10,454.40	127,195.20
Power Plant Operator	1	16.00	176.00	52.80	88.00	316.80	31.68	348.48	2,439.36	10,454.40	127,195.20
<u>Logistics</u>											
Procurement Logistics Per	1	17.50	192.50	57.75	96.25	346.50	34.65	381.15	2,668.05	11,434.50	139,118.75
<u>Community Services</u>											
Housekeeper	1	14.31	156.94	47.08	78.47	282.49	28.25	310.74	2,175.18	9,322.20	113,430.10
Head Cook	1	16.31	179.40	53.82	89.70	322.92	32.29	355.21	2,486.47	10,556.30	129,531.65
Kitchen Helper	1	14.31	156.94	47.08	78.47	282.49	28.25	310.74	2,175.18	9,322.20	113,430.10
Total	8	16.74 (2)	1,428.28	437.98	746.64	887.90	88.79	976.69	6,836.83	29,300.70	356,494.85
						2,574.90	257.09	2,827.99	19,795.93	84,839.70	1,032,216.31
<u>Project Management</u>											
Administration								8.71	60.98	261.36	3,179.88
<u>Facilities</u>								6.75	47.26	202.55	2,464.61
<u>Logistics</u>								13.94	97.57	418.18	5,087.87
<u>Community Services</u>								7.62	53.36	218.69	2,782.60
Total								19.53	136.74	586.01	7,129.84
								56.55	395.91	1,656.79	20,684.36

NOTES: (1) 10 hour work day (overhead @ 1 1/2 reg. rate over 8 hours per day)

(2) Average hourly rate of pay

CIRI/H&N
ANCHORAGE, ALASKA

ESTIMATING ENGINEERING WORKSHEET

Beluga Mathanol Project
O & M Personnel - 50 Man Camp

TYPE OF ESTIMATE Order of Magnitude - Preliminary + 20%	SHEET NO. 1 OF 1	JOB NO. 7500	PREPARED BY V. R. Lanz	CHECKED BY	DATE 5-13-81
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COOK INLET PIPE LINE COMPANY

**BELUGA METHANOL PLANT
PIPELINE TRANSPORTATION STUDY**

GRANITE POINT TO DRIFT RIVER, ALASKA

**PREPARED BY
MOBIL PIPE LINE COMPANY
ENGINEERING DEPARTMENT
DALLAS, TEXAS
FOR
COOK INLET PIPE LINE COMPANY
AUGUST, 1981**

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Summary

The objective of this report is to present the results of a pipeline transportation study to convert Cook Inlet Pipe Line Company's common carrier pipeline and tanker loading facility located at Drift River, Alaska, to multi-product service for handling shipments of methanol from a proposed 54,000 BPD capacity coal to methanol processing plant located near Granite Point, Alaska.

Cook Inlet Region, Inc. and Placer Amex, Inc. requested the study in connection with the Beluga Methanol Study (D.O.E. grant No. DE-FG01-80RA50299). Mobil Pipe Line Company performed the study with assistance from Mobil Research and Development Corporation's Dallas Field Research Laboratory. The areas of study the report deals with are:

- 1) Evaluation of the compatibility of crude oil and methanol in a multi-product batching type pipeline operation.
- 2) Engineering design requirements and operating procedures for the CIPL system to operate in crude/methanol service.
- 3) Estimation of transportation and ship loading cost (tariffs) to ship methanol through the CIPL system with crude on a batch basis.

The study established that it is feasible to batch in the CIPL system with modifications and additions to existing facilities. The 1981 average cost to transport methanol would be in the range of \$0.56/bbl to \$0.79/bbl, as shown in the table below. These costs are based on the present method of determining tariffs for crude oil, the current construction and material cost, and the proposed methanol production rate of 50,000 BPD. The dismantling and restoration cost in these tariffs are \$0.08/bbl and \$0.10/bbl for the constant and declining crude volume, respectively.

<u>Case</u>	<u>Case Description</u>	<u>Tariff \$/bbl</u>	
		<u>1981</u>	<u>1986*</u>
Case I	Fuel grade methanol and constant crude production	0.56	0.62
Case I Sensitivity	Fuel grade methanol and declining crude production	0.58	0.70
Case II	1/3 chemical grade and 2/3 fuel grade methanol with constant crude production	0.66	0.70
Case II Sensitivity	1/3 chemical grade and 2/3 fuel grade methanol with declining crude production	0.68	0.79

*With 1981 investment

The 1981 \$0.56/bbl tariff of transporting fuel grade methanol is comparable to the present tariff of \$0.58/bbl of transporting crude which includes dismantling and restoration cost of \$0.12/bbl. As a result of the effects of inflation on operating, construction, and material costs, future tariffs would be higher compared to present tariffs. Since tariffs are sensitive to volume, the effect of lower volumes compared to those used in this study would also result in higher tariffs.

The future dismantling of the system and restoration of the area is also highly affected by inflation and volume throughput. Based on the volumes and the project life used in this study, the dismantling and restoration could be as low as \$0.08/bbl, or as high as \$0.10/bbl.

The cost of transporting both chemical grade and fuel grade methanol, as shown in Case II, is \$0.10/bbl higher due to the additional required facilities. For this study, an average tariff was applied to all volumes in the system. However, in view of the special handling requirements for chemical grade methanol, the added cost would usually be charged only to the chemical grade.

It must be kept in mind that the tariff estimates referred to above are all based on the cases studied, and the economic criteria and assumptions made as a basis of the study listed under Appendix "B" of this report. Any actual variations from these assumptions which would apply in the future would, of course, impact on any newly calculated tariffs at a particular time.

Mobil Pipe Line Company and/or Cook Inlet Pipe Line Company does not guarantee, whether expressed or implied, a commitment to handle methanol in the CIPL system by conducting this feasibility study. This decision is solely the right of the owners of Cook Inlet Pipe Line Company.

1.0 Introduction

Cook Inlet Pipe Line Company (CIPL) is a common carrier crude oil pipeline system located near Anchorage, Alaska.

CIPL transports crude produced from several offshore production platforms located in Cook Inlet. CIPL takes custody of the crude from producer-owned land-based terminal facilities at Granite Point and West Foreland Stations on the western shore of Cook Inlet. The crude is pumped through a 20 inch diameter pipeline to CIPL's Drift River Terminal on a common stream basis where it is stored in seven 270,000 barrel tanks. The crude is periodically loaded into shippers' tankers, up to 70,000 DWT, through a single berth, fixed platform, offshore loading facility (See Appendix C).

Due to declining crude production from existing fields, the CIPL system is projected to have spare capacity to handle other liquid materials. However, modification and additions of existing facilities for such service is subject to the approval of the owners of CIPL. Investments would require an economic justification reflecting the risk of regulatory conditions in existence at that time.

Cook Inlet Region, Inc. and Placer Amex, Inc. (CIRI/Placer) has proposed a 54,000 barrels per day coal processing plant, located at Granite Point, for the production of methanol. CIRI/Placer requested CIPL to evaluate the technical feasibility of transporting methanol through CIPL's pipeline, and estimate tariffs based on certain assumptions and economic criteria. Mobil Pipe Line Company, acting on behalf of the CIPL system, evaluated the operational problems of batching methanol and crude in the CIPL pipeline system. Mobil Research and Development Corporation analyzed the effects of mixing Cook Inlet crude with methanol. Based on these evaluations and assumptions the tariff estimates were calculated.

2.0 Scope of Work

The objectives of this study are: (1) to investigate the effects of and any constraints that may be incurred as a result of batching crude oil and methanol in CIPL facilities; (2) to determine the necessary modifications of the existing CIPL pipeline, pumping equipment, storage, and tanker loading facilities in order to transport, store and load into tankers methanol and crude oil as segregated liquids; (3) to estimate the cost of the modifications and additions to the system; and (4) to calculate tariff rates for the various cases of transporting, storing and ship loading methanol and crude.

3.0 Case Description

Four economic cases were selected on the basis of various throughput levels in the CIPL system as follows:

Case I Base:

- 18,360 TBY fuel grade methanol;
- 18,250 TBY crude oil
- Throughput volumes constant over the project life (19 years).

Case I Sensitivity:

- Same as Case I Base except crude throughput volumes decline 912,000 barrels each year.

Case II Base:

- 12,240 TBY fuel grade methanol
- 6,120 TBY chemical grade methanol
- 18,250 TBY crude oil
- Throughput volumes constant over the project life.

Case II Sensitivity:

- Same as Case II Base except crude throughput decline at 912 TBY over project life.

* TBY - Thousand barrels per year

4.0 Operational Criteria

It is essential that both crude production and methanol production not be interrupted. Since methanol and crude oil will be batched as segregated fluids through a single pipeline, continuous production requires a proper balance between production storage capacity and pipeline pumping rates.

The proposed methanol plant storage was given as 15 days. There is existing producer owned crude oil tankage at Granite Point and West Foreland for 15 days and 3 days of crude production, respectively (See Appendix C) with all crude producers tankage combined into one unit for common usage.

A preliminary analysis showed that the existing producer tankage will be sufficient if methanol is batched at a rate of 332,000 BPD. This design minimizes the investment for proposed facilities required to handle methanol.

Proposed and existing tankage at Drift River Terminal has been sized to meet pipeline batch sizes based on a 10 day pipeline cycle for tanker loadings of up to 70,000 DWT capacity for crude oil or fuel grade methanol, and 35,000 DWT capacity for chemical grade methanol.

5.0 Concept of Operation

Crude and methanol will be pumped in segregated batches from Granite Point Pump Station to Drift River Terminal through the 20" line. Between Granite Point and Drift River, crude will enter the 20" line at West Foreland Junction. Methanol production will be stored at the Beluga Plant while crude is being pumped. Crude will be stored in producer tankage located at Granite Point and West Foreland Stations during methanol pipeline shipments.

Crude oil batches will be pumped for 8 days out of a 10 day cycle. The remaining 2 days will be allotted to methanol batching. Crude oil batches from Granite Point will take place every other cycle. This is required because the low crude production rate will not be adequate to displace methanol from the Granite Point to West Foreland Junction section of the pipeline on a 10 day cycle.

Custody transfer for both methanol and crude will occur at Granite Point and crude only at West Foreland. Tank gages will be used for measurement of tanker loadings at Drift River.

All "slop" generated from methanol and crude mixing will go into proposed slop tanks at Drift River.

All interface volumes generated from chemical and fuel methanol mixing will go directly into fuel methanol tanks.

Product contamination will be minimized by launching spheres in the pipeline between batches. New sphere launching and receiving facilities and interface detection equipment will be installed at Granite Point, West Foreland Junction and Drift River for batching operations. Shipments of chemical grade methanol will be scheduled between a 3/4 to 1/4-front to rear fuel grade methanol batch buffer to minimize the contamination with crude.

At Drift River, tankage and piping for both crude and methanol will be completely segregated. Slop tanks will be installed for crude oil - methanol mixtures generated by pipeline and tanker loading operations.

Existing tankage converted to methanol service will have internal floating roofs installed. Dedicated surveillance metering systems will be installed on the incoming pipeline stream. New pipe manifold-ing will be installed for product segregation.

Blending facilities will be installed to blend crude contaminated methanol slop into the outgoing fuel grade stream. No other means of slop disposal will be provided.

Tanker loading facilities at Drift River will be modified for multi-product service. Two 30" loading lines will have reverse flow capability to accommodate change of product service. Drain up and flushing capability will be provided for the loading pump manifold to reduce contamination. Sphere launching and receiving facilities will be installed on the two loading pipelines. Contaminated product will be returned to the slop tanks.

Wax build-up on the pipe walls will be kept to a minimum by cleaning the walls through frequent "pigging" operations. Any wax dissolved by methanol which precipitates will be kept in suspension while in terminal tankage by using tank mixers.

Water in the crude (as high as 1% by volume) which appears in the crude/ methanol interface, will be totally absorbed by the methanol. If required, chemical treatment will be considered to facilitate separation of the crude/methanol slop mixture, and also to control precipitation of wax from the methanol. However, no cost for chemical control of wax precipitation has been included in this study.

As mentioned previously, custody transfer will occur at Granite Point by metering and at Drift River by tank gaging. All product loss will be at shippers expense. Shipper will not receive any compensation for product loss. CIPL will deliver slightly less volume into tankers at Drift River than received at Granite Point due to normal losses.

6.0 Product Quality Control

Laboratory tests were performed on crude oil-methanol mixtures to determine any effects on either material as a result of the proposed batching operation. The full lab report text may be found in Appendix "E". A summary of this report is as follows:

- Anhydrous methanol separates readily from Cook Inlet crude after equilibration at 30°, 77° and 120°F.
- After separation, the methanol contains 6-8% by volume of dissolved oil but the oil contains no methanol.
- At 30° and 77°F, the liquids formed methanol-in-oil dispersions on shaking, but at 120°F, oil-in-methanol dispersions formed.
- Small amounts of water in the methanol caused a stable emulsion of methanol-in-oil to form. This emulsion will require the application of a chemical demulsifier to cause separation in a reasonable time.
- Methanol equilibrated with Cook Inlet oil at 30°, 77°, and 120°F did not contain any detectable heavy metals after settling.
- Diluting separated methanol 1:1 with acidified water and centrifuging in a calibrated tube is an accurate method for measuring the oil content of the methanol.
- Methanol selectively dissolves a colorless component from paraffin deposits from Cook Inlet oil. Dissolution rates are initially high but decrease to very low rates as the surface of the wax is depleted of the soluble component.
- Methanol dissolved 7.3% of a wax deposit in one hour at 77°F and 10% in one hour at 120°F. Part of the wax precipitated from the 120°F methanol when it was cooled to 77°F.
- Capacitance probes or other methods of measuring dielectric constants are good interface detectors for the methanol/oil system. The dielectric constant of methanol is 32.6 and that of oil is 2.0.

- From a chemical assay of water sampled from the bottom of a crude tank at Drift River, the sodium content of water was determined to be .8% by volume.

It should be noted that the crude used in the analysis contained no water. In actual pipeline operations, crude oil could contain up to 1% water.

Combining the laboratory test results with the pipeline operations analysis the following product contamination values were predicted:

- 1500 barrels of interface (50% crude - 50% methanol) will be produced per 540,000 barrel batch of methanol.
- The methanol in the interface will contain up to 8% crude by volume that will not separate from the methanol, and 1% salt water by volume absorbed from the crude.
- No methanol will be absorbed into the oil.
- Based on the slop being blended into 540,000 barrels of fuel grade methanol, the following contamination of the total methanol was determined.

-3
6x10 % Crude by volume
-4
8x10 % Water by volume
-6
8x10 % Sodium by volume

It is predicted that some of the sodium found in the water will precipitate out of the methanol/water mixture.

- Based on thorough internal cleaning of the pipe prior to methanol shipments, methanol contamination from absorbed wax is predicted
-3
to be 1x10 % by volume per 540,000 barrel batch.

No specific tests were made with respect to batching chemical grade methanol. If however, chemical grade batches are buffered by fuel grade batches, it can be assumed that the chemical grade can be handled with minimal contamination.

Chemical grade would be cut clean, with the fuel/chemical interface going to fuel grade tankage. The only contamination that might be considered significant will be wax. However, since the fuel grade batch will be washing the walls ahead of the chemical grade batch, wax content is not expected to be a problem in chemical grade methanol (unless specifications do not allow trace amounts of wax).

Any economic penalty due to downgrading of chemical grade methanol interface to fuel grade methanol will be borne by the shipper.

It should be noted that further quantification of predicted contamination values will require more extensive testing. The laboratory tests are thought to be representative, but actual field data will be required on wax deposition before firm values can be established for wax contamination. A pipeline test loop may be required to verify contamination values.

7.0 System Modifications and Additions

The following modifications and additions will be required to convert CIPL's crude oil system to a multi-product service.

7.1 Beluga Methanol Plant (to be installed by CIRI/Placer)

- Install 810,000 barrels of methanol storage.
- Install a 332,000 BPD booster pump station and delivery line to supply CIPL's Granite Point methanol pump station with 75 psig suction pressure.
- Install a natural gas fuel line to CIPL's Granite Point Station.

7.2 CIPL 20" Mainline

- Hydrostatic test mainline.
- Internally inspect pipeline.
- Install sphere launcher/retriever and batch detection facilities at Granite Point, West Foreland Junction, and Drift River.
- Install pipeline surveillance metering facilities at Drift River.

7.3 CIPL Granite Point and West Foreland Crude Oil Production Facilities (to be performed by crude producers)

- Modify production facilities required to unitize production tankage.
- Modify booster pump station as required to supply CIPL's Granite Point and West Foreland pump stations with 82,000 BPD and 56,000 BPD, respectively.

7.4 CIPL Granite Point Pump Station

- Construct a new 332,000 BPD capacity methanol custody transfer meter system.
- Construct a new 332,000 BPD capacity, remotely controlled, 10,500 HP (3-3500 HP units), gas turbine driven methanol pump station.

- Increase capacity of crude oil pump station to 82,000 BPD.

7.5 CIPL West Foreland Station

No work required.

7.6 CIPL Drift River Terminal

- Convert three (3) existing 270,000 barrel, cone roof tanks to internal floating roof tanks, and change service from crude to methanol.
- Modify and expand terminal manifolding for segregated multi-product service.
- Construct two (2) new 270,000 barrel, internal floating roof tanks with manifolding for chemical grade methanol service.
- Construct two (2) 10,000 barrel slop tanks, slop gathering facilities, and slop blending facilities to handle crude/methanol interface mixtures.

7.7 CIPL Drift River Tanker Loading Facility

- Install sphere launcher/retriever and batch detection facilities on both 30" loading lines.
- Modify pumping manifold for reversible flow capabilities on both 30" loading lines.
- Install crude/methanol interface collection and transfer facilities onshore and offshore.

8.0 Economic and Tariff Summary

For purposes of this study, Cook Inlet's current method of establishing tariffs for crude shipments was assumed for estimating tariffs for methanol shipments. These estimated tariffs are based on methanol production rate of 18,360 TBY and crude oil production rate of 18,250 TBY. Additionally, it was assumed that product losses, downgrading of chemical grade methanol batch interface to fuel grade methanol, and crude oil loss by absorption into the methanol would be paid for by the shippers. The tariffs based on these assumptions are summarized in the following table:

		<u>\$ Tariff (\$/bbl)*</u>	
		<u>1981</u>	<u>1986</u>
Case I:	Fuel grade methanol and constant crude volume	0.56	0.62
Case I Sensitivity:	Fuel grade methanol and declining crude volume	0.58	0.70
Case II:	1/3 chemical grade and 2/3 fuel grade methanol, constant crude volume	0.66	0.70
Case II Sensitivity:	1/3 chemical grade and 2/3 fuel grade methanol, declining crude volume	0.68	0.79

*With 1981 investment

The 1981 cost to transport methanol including dismantling and restoration cost would be in the range of \$0.56/bbl to \$0.79/bbl. In Case I, the tariff for handling a constant 18,360 TBY volume of methanol and 18,250 TBY of crude oil is \$0.56/bbl in the first year increasing to \$0.62/bbl by the fifth year due to the effect of inflation on operating cost. In the Case I sensitivity, the declining crude volume results in the distribution of the plant and operating cost over a smaller volume, thereby increasing the fifth year tariff to \$0.70/bbl compared to \$0.62/bbl in Case I.

In Case II, the additional facilities required to handle chemical grade methanol result in 1981 tariffs of \$0.66/bbl and \$0.70/bbl for the first and fifth year, respectively.

A declining crude volume would increase the fifth year tariff to \$0.79/bbl for the same reason cited in Case I. Although the cost of handling chemical grade methanol presented in this paper is distributed over the entire pipeline throughput, it is industry practice to post a higher tariff for speciality products such as chemical grade methanol to account for the additional facilities and special handling requirements.

The tariffs presented include dismantling and restoration cost which is presently \$0.12/bbl of the \$0.58/bbl posted tariff. Since the future dismantling of the system and restoration of the site escalated with inflation, the dismantling and restoration cost could be as low as \$0.08/bbl or as high as \$0.10/bbl. This cost is lower than the present charge due to the additional methanol volumes to the system.

9.0 Appendix

- A. Engineering Design Criteria and Assumptions
- B. Economic Criteria
- C. System Schematics
- D. Project Schedule
- E. Laboratory Test Report

APPENDIX "A"

Design Criteria and Assumptions

Hydraulic Assumptions

Liquid Characteristics:

	Specific Gravity @ 60°F	Viscosity CP @ 32°F	Reid Vapor Pressure PSIA @ 100°F
Methanol	0.795	1	4.4
Crude	0.88	10.0	8.5

Design Flow Rates: (1000 BPD)

	<u>Methanol</u>	<u>Crude</u>
Granite Point to West Foreland Junction	332	82
West Foreland to West Foreland Junction	N/A	56
West Foreland to Drift River	332	66
Drift River to Offshore Loading	840	840

Design Operating Pressure: PSIG

	<u>Methanol</u>	<u>Crude</u>
Granite Point - Suction	75	75
Discharge	900	325
West Foreland - Suction	N/A	50
Discharge	N/A	285
Drift River - Suction	50	50

Methanol Tanker Specifications

Tankers to be used for transporting fuel grade methanol and chemical grade methanol will be in the 70,000 DWT and 35,000 DWT class, respectively.

- (1) Methanol capacity of tanker to be 3% less than the rated vessel tonnage (long tons).
- (2) No ballast will be unloaded from methanol tankers. Tankers will have segregated ballast tanks.

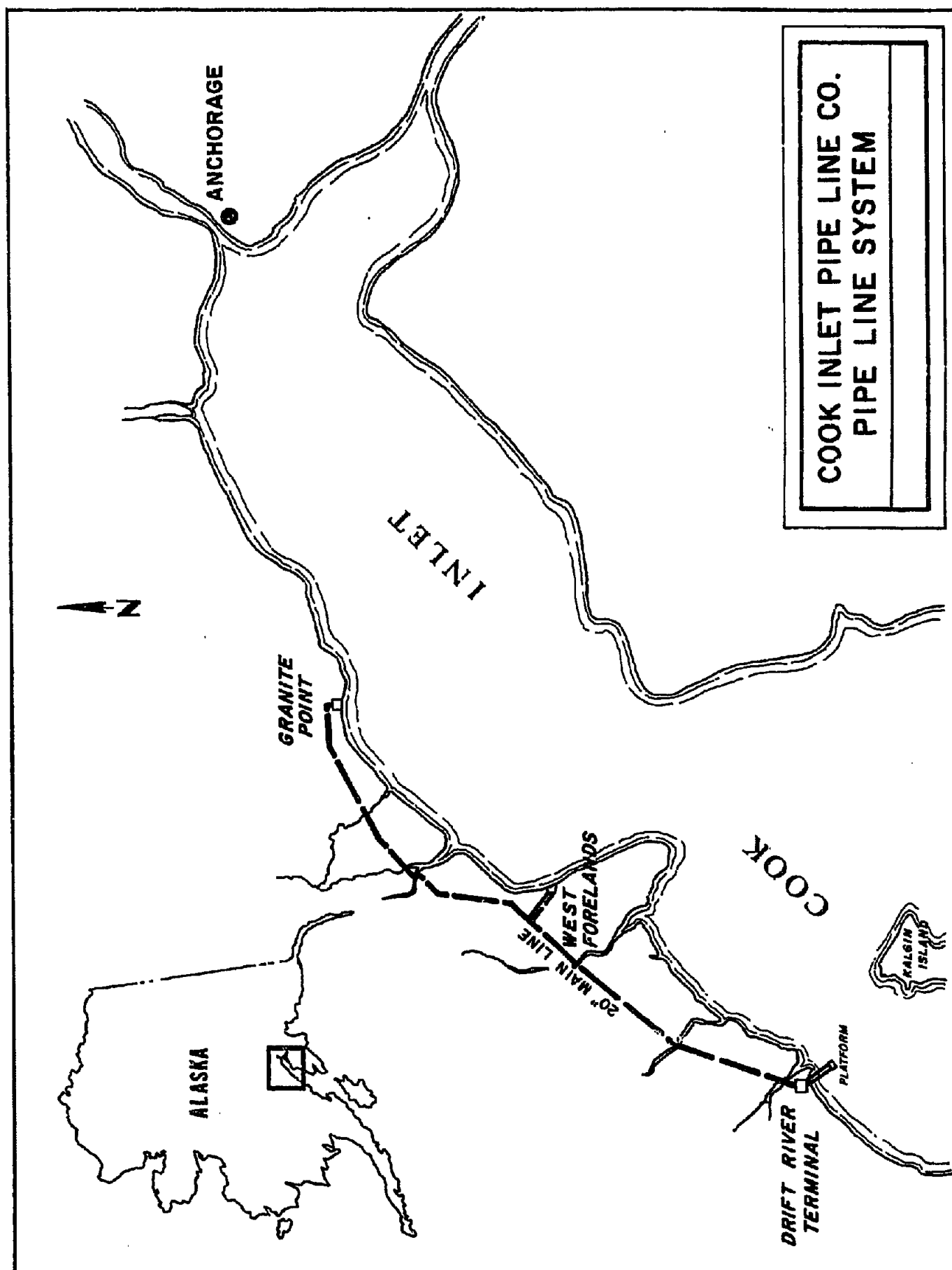
- (3) Methanol tanks will be clean and ready for receiving product upon arrival at Drift River. No cleaning of product or disposition of product tank washings will be allowed at Drift River.

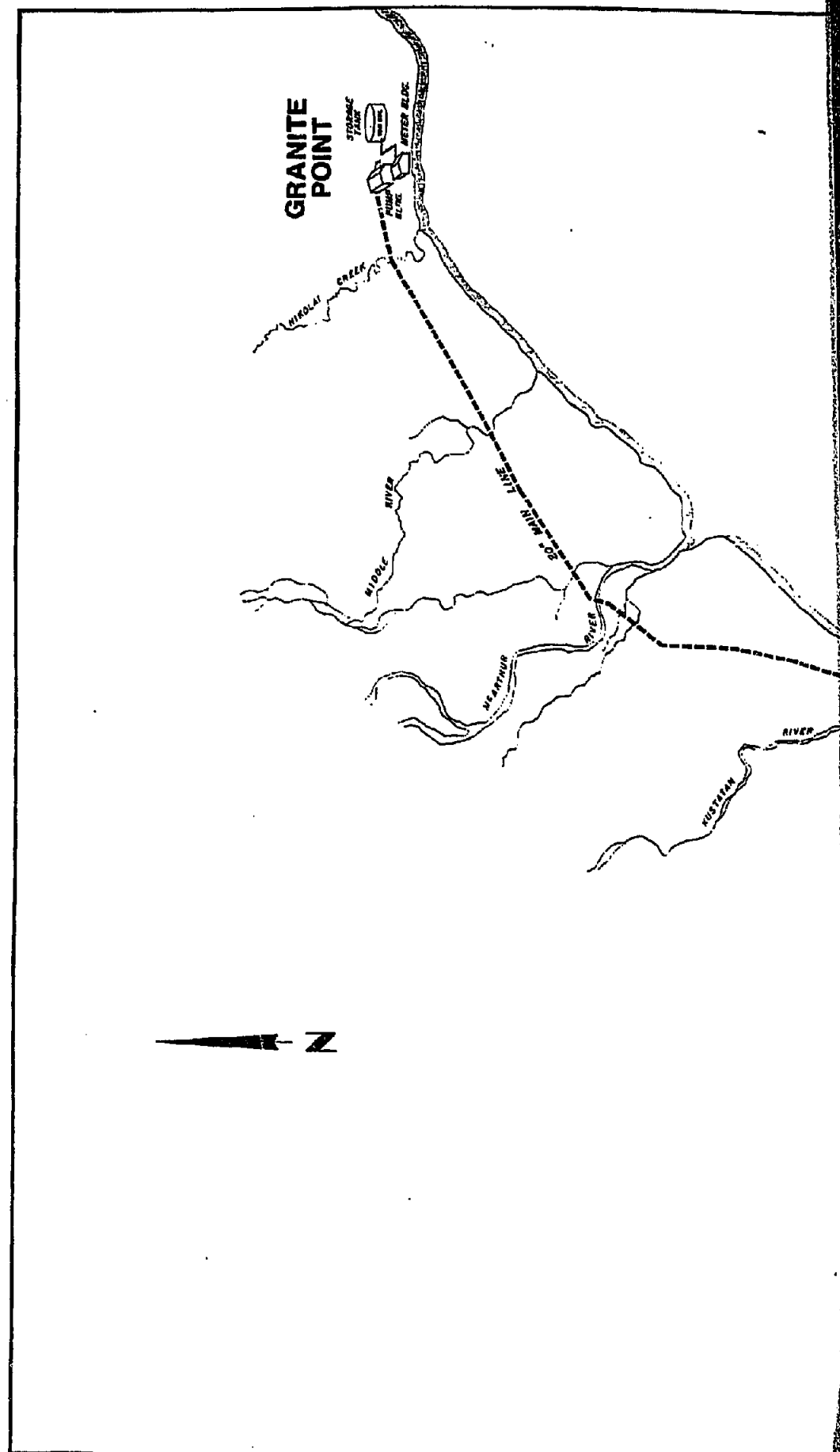
APPENDIX "B"

Economic Criteria and Assumptions

1. Project Life: 19 years
2. Tax Rates: Federal 46%
State 9.4%
Investment Tax Credit 10%
3. Depreciation: Tax - 1 1/2 year DOB/16 year SYD
Book - Straight line
4. Operating Cost
Inflation Factors: Labor 9%
Materials and Supplies 10%
Ad Valorem Tax 7%
Power and Fuel Costs 11%
5. Gas fuel price: \$4/MCF delivered to Granite Point Station.
6. Tariff calculations do not include any costs associated with the following items. All costs listed below are assumed to be at shippers expense.
 - Methanol and crude loss associated with normal pipeline operation.
 - Downgrading of chemical grade methanol to fuel grade methanol.
 - Crude oil lost by absorption into methanol.
 - Delays associated with tanker loading (Demurrage).
 - Modifications and additions to crude producers' facilities.

APPENDIX "C"
SYSTEM SCHEMATICS





INLET

WEST
FORELANDS

COOK

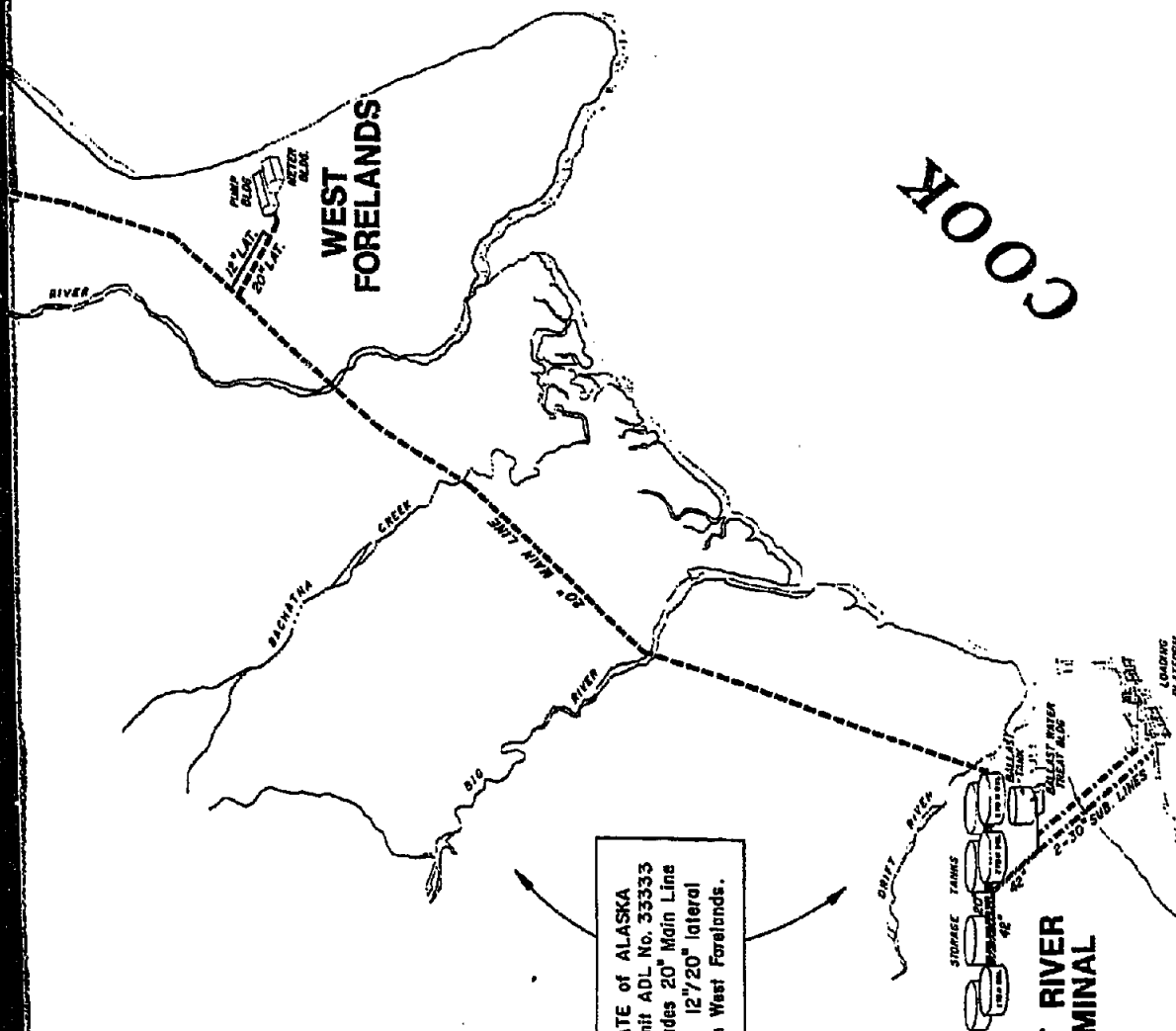
COOK INLET PIPE LINE CO.
SYSTEM FACILITIES

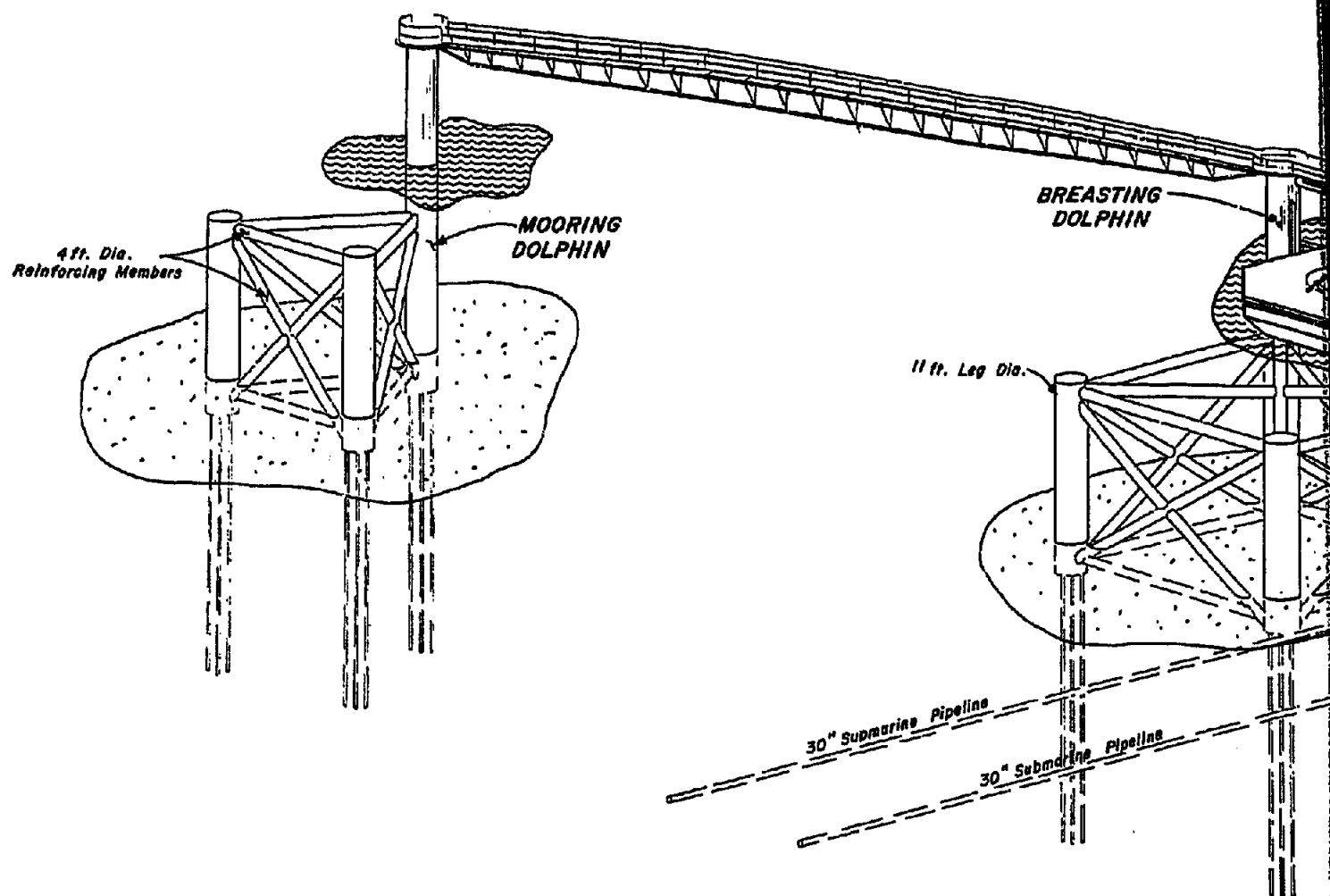
KALGIN
ISLAND

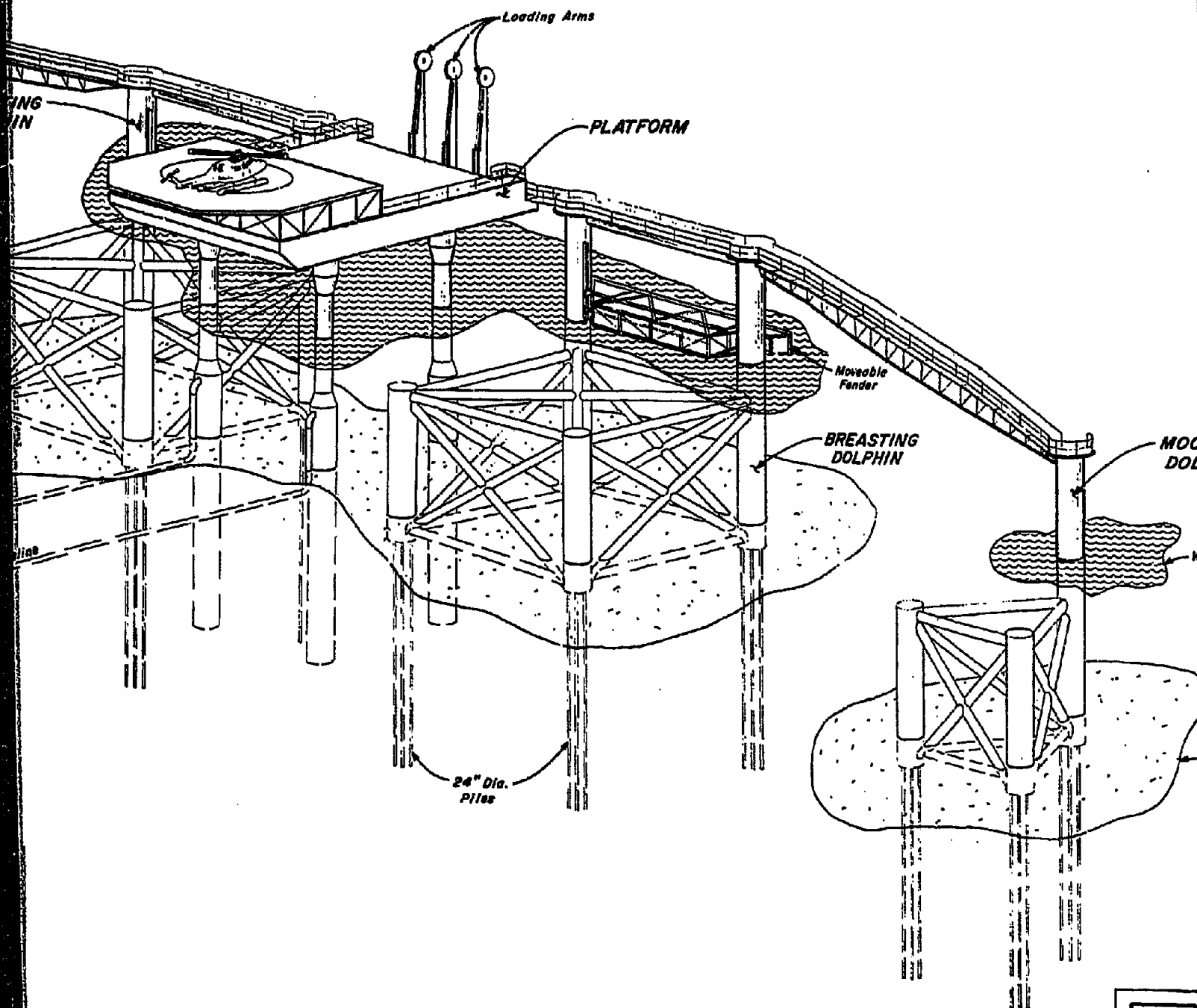
STATE of ALASKA
Permit ADL No. 33333
includes 20" Main Line
plus 12" 1/2 20" lateral
from West Forelands.

Offshore facilities, beginning
at shore line, are covered by:
- STATE of ALASKA tideland
lease, ADL No. 32391
- U.S. Corps of Engineers permit

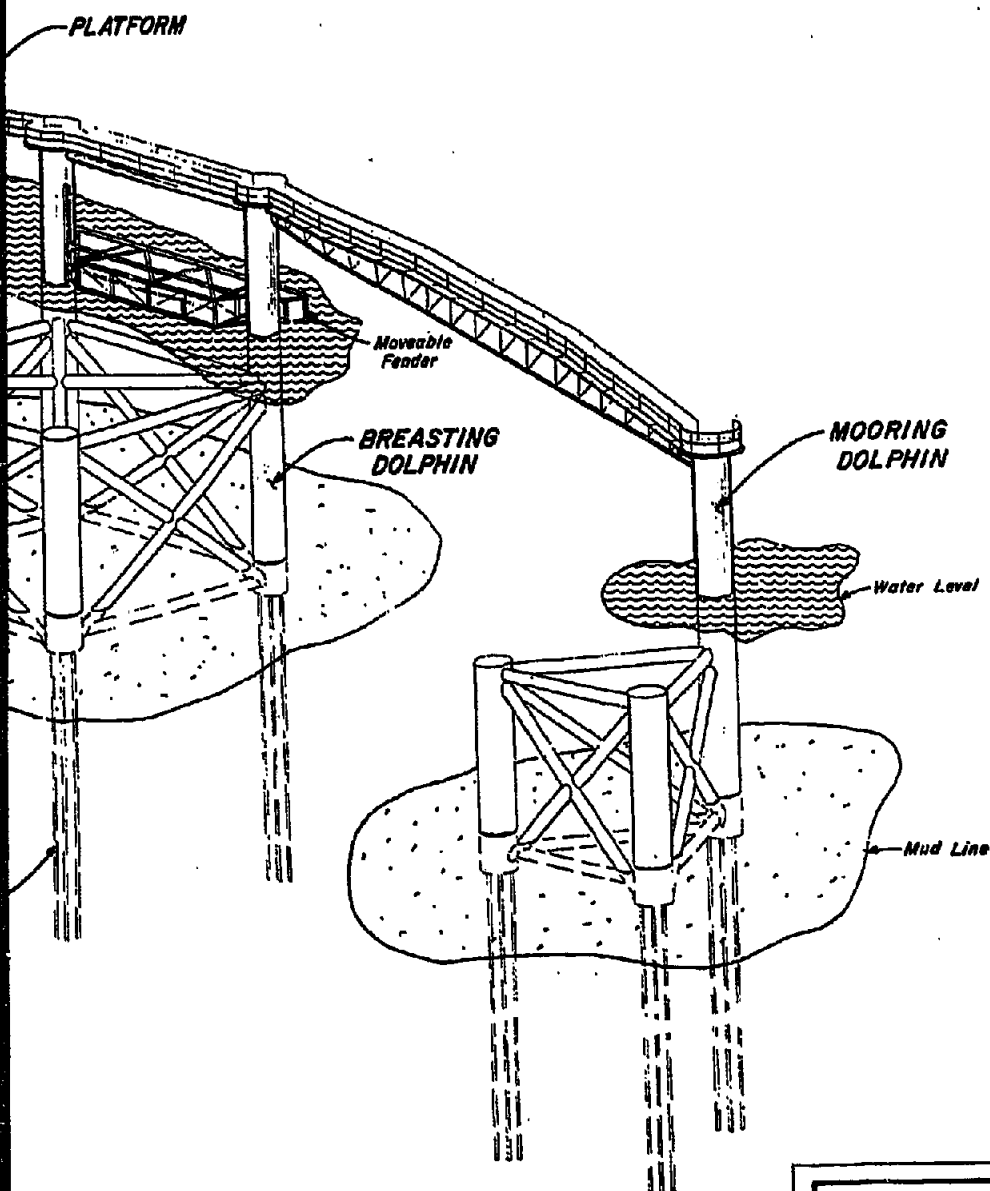
DRIFT RIVER
TERMINAL





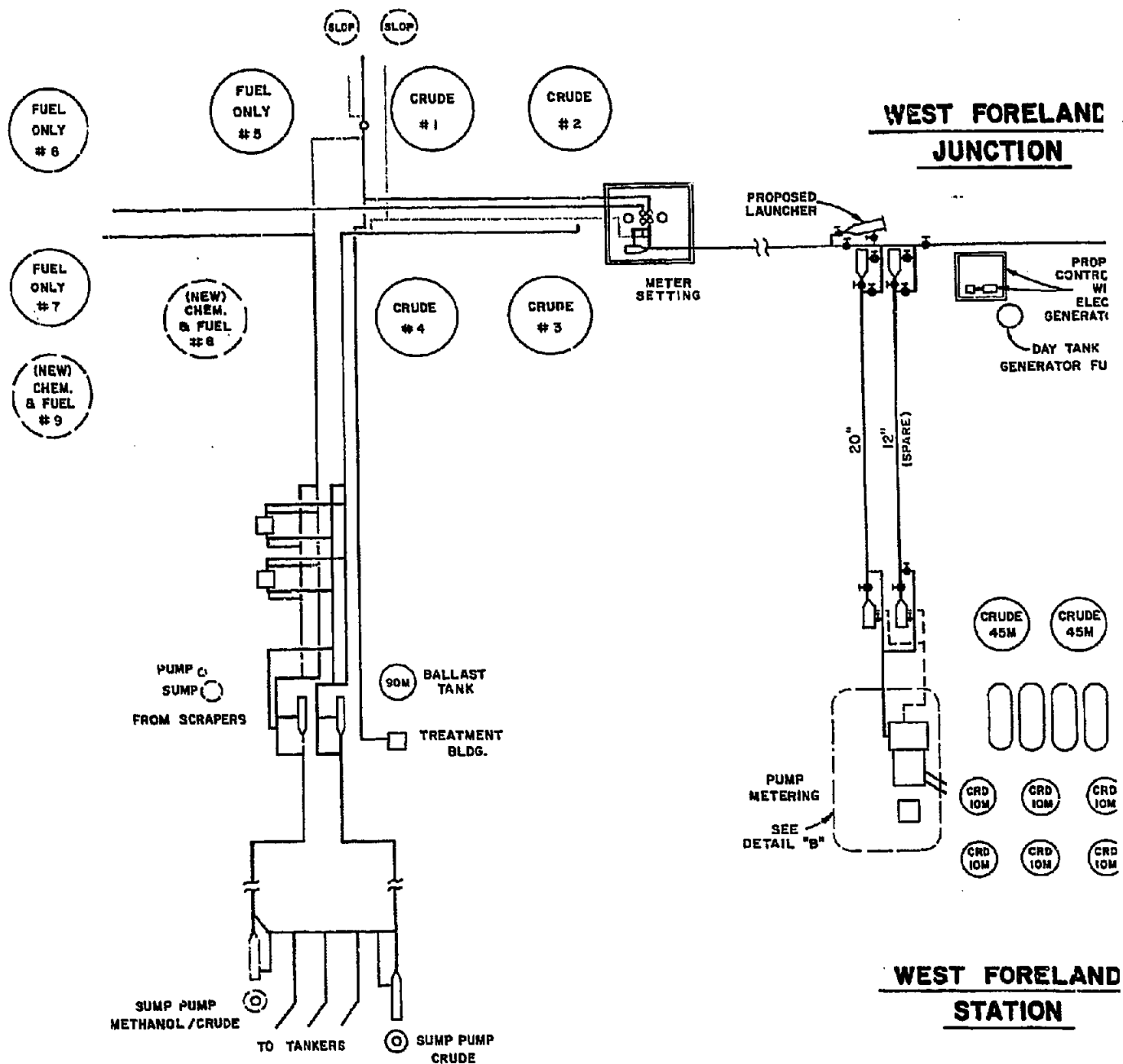


g Arms



COOK INLET PIPE LINE CO.
OFFSHORE FACILITIES

DRIFT RIVER TERMINAL



RELAND TION

PROPOSED
CONTROL BLDG.
WITH
ELECTRIC
GENERATOR/MOTOR

DAY TANK
ENERATOR FUEL

CRUDE
45M

FUEL
TANKS

CRD
10M

CRD
10M

CRD
10M

CRD
10M

RELAND ION

20"

CRD
5M

CRD
10M

CRD
5M

CRD
10M

CRD
10M

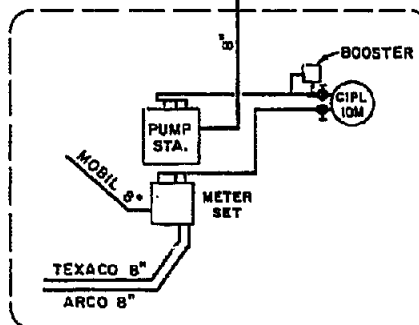
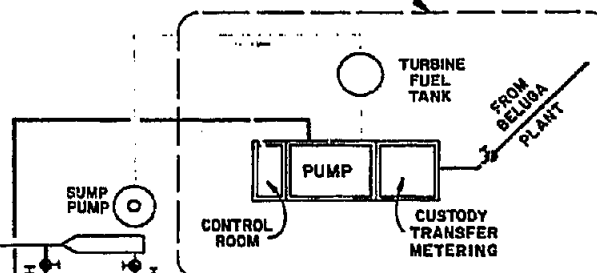
CRD
10M

CRD
10M

CRD
10M

CRD
10M

PROPOSED METHANOL
METERING & PUMPING STATION
SEE DETAIL "C"

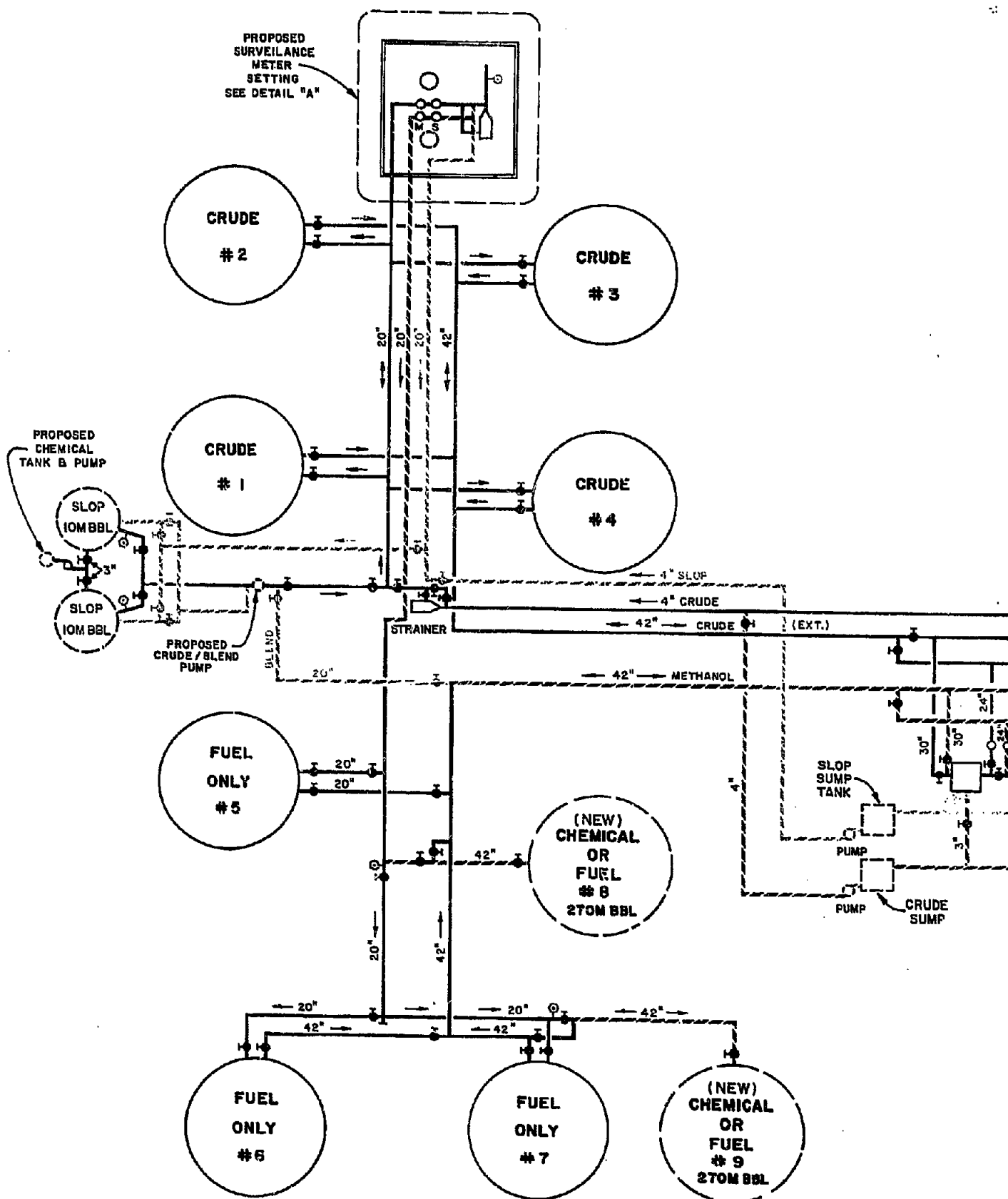


GRANITE POINT STATION





LEGEND









- |— CHECK VALVE
- |— GATE VALVE
- |— INSPECTION CAPACITANCE PROBE
- DRAIN LINES
- CRUDE
- SLOP
- FUEL / CHEMICAL GRADE METHANOL
- CRUDE / METHANOL

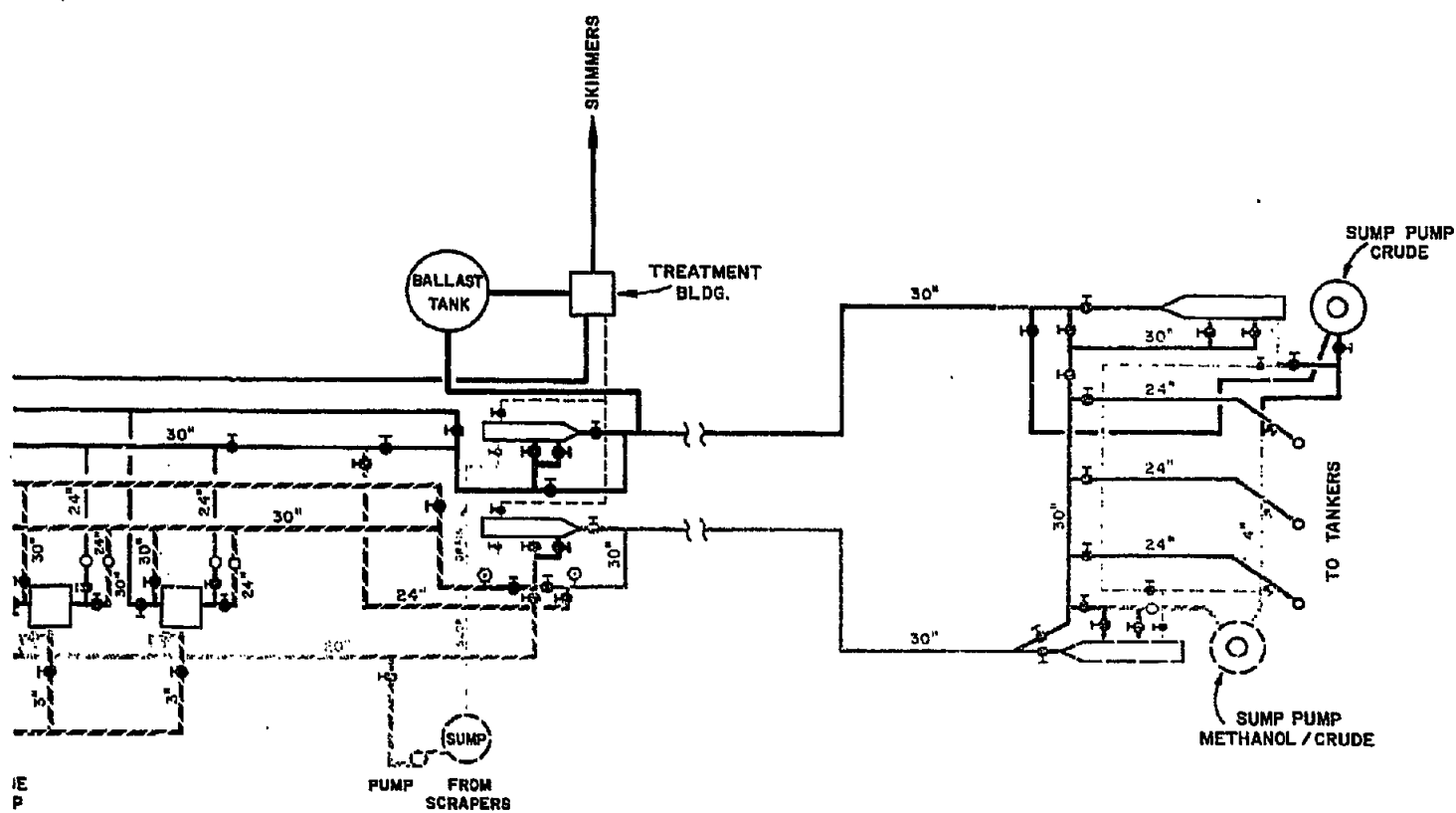
COOK INLET PIPELINE SYSTEM



LEGEND

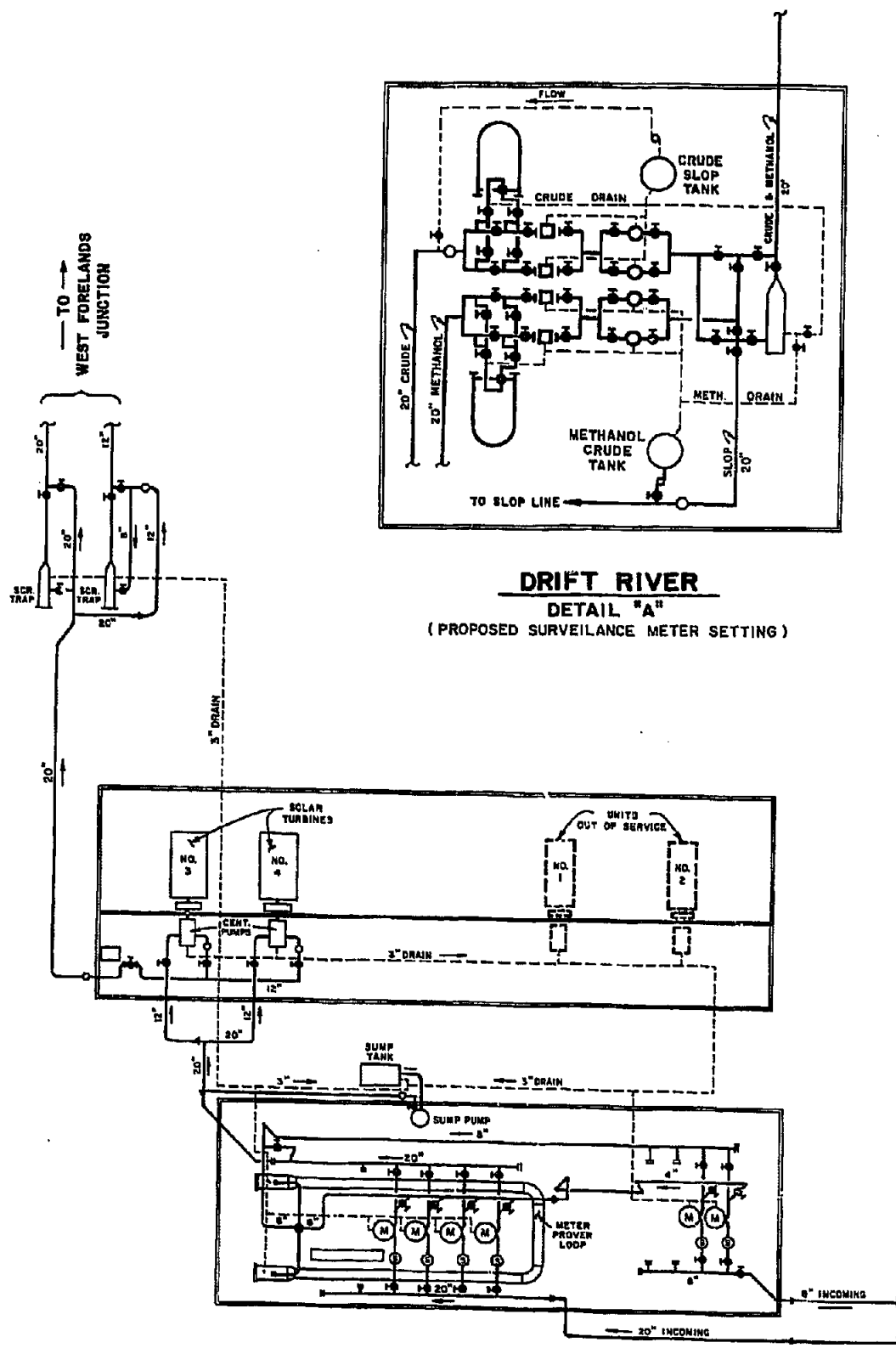
-  CHECK VALVE
-  GATE VALVE
-  INSPECTION CAPACITANCE PROBE
-  DRAIN LINES

- | EXIST. | PROPOSED | |
|---|---|------------------------------|
|  |  | CRUDE |
|  |  | SLOP |
|  |  | FUEL/CHEMICAL GRADE METHANOL |
|  |  | CRUDE / METHANOL |



LOADING PLATFORM

DRIFT RIVER TERMINAL



DRIFT RIVER
DETAIL "A"
 (PROPOSED SURVEILLANCE METER SETTING)

WEST FORELAND
DETAIL "B"
 (CRUDE PUMP STATION)

VARY SPEED TURBINE DRIVERS w/REMOTE SET POINT SECTION, DISCHARGE, AND FLOW RATE CONTROL.

METHANOL TO TURBINES FROM FUEL TANKS

TURBINE METERS

20"

FROM BELUGA PLANT

20"

3500 HP

3500 HP

PUMPS

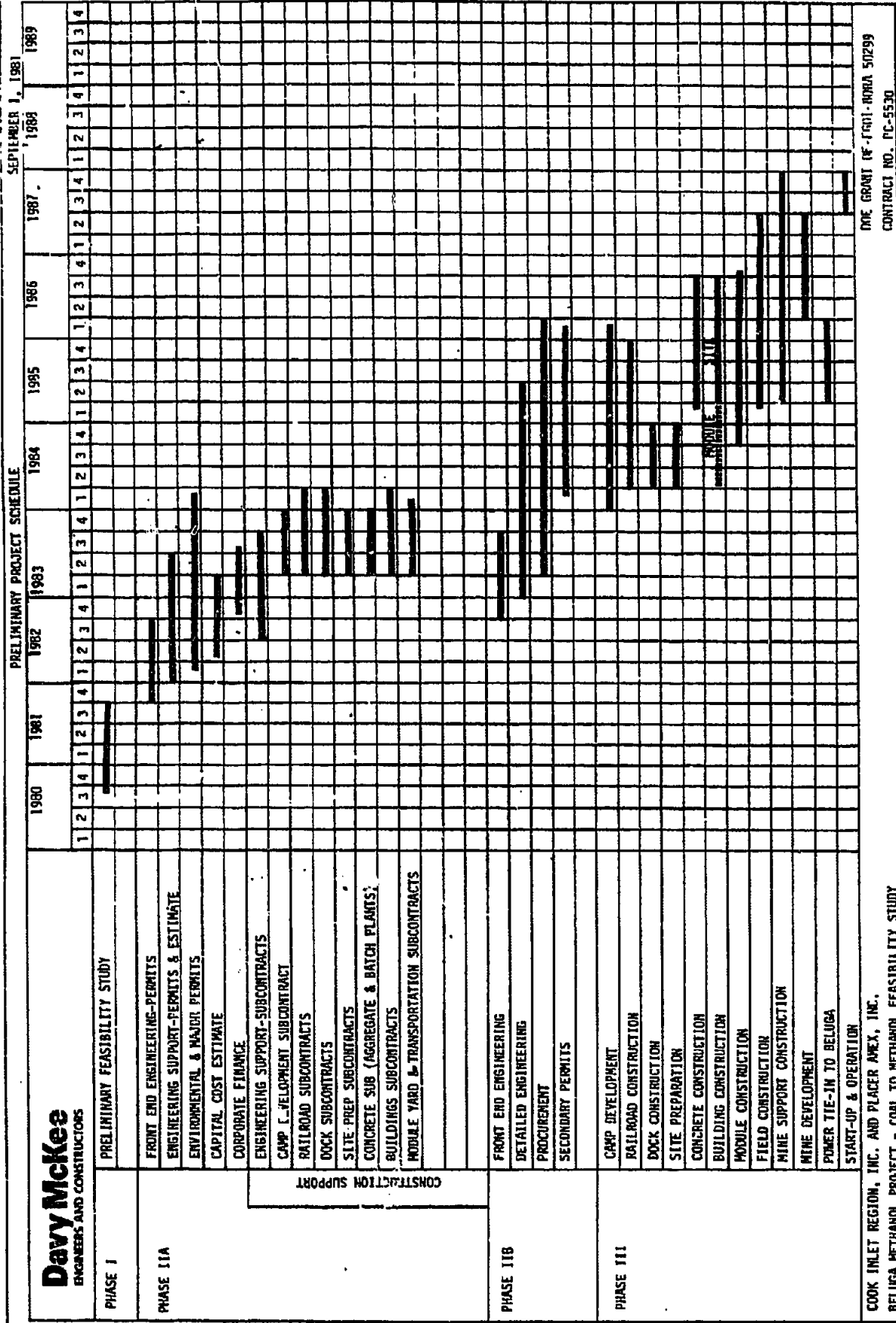
TO CIPL

METHANOL FLOW RATE: 320,000 BPD

STATION DETAILS

GRANITE POINT
DETAIL "D"
(CRUDE PUMP STATION)

APPENDIX "D"
PROJECT SCHEDULE



APPENDIX "E"
LABORATORY TEST REPORT

MOBIL RESEARCH AND DEVELOPMENT CORPORATION
Field Research Laboratory

DATE March 24, 1981

TO D. R. Dunn
MPL, Dallas

c.c. E. L. Jones, FRL
C. L. Murphy, FRL
W. C. Skinner, FRL
K. M. Winston, MPL, Dallas

205-12.2-3125
COOK INLET PIPE
LINE BELUGA METHANOL
STUDY PLACER AMEX

Results of tests on the equilibrium of methanol with crude oil and on the solubility of wax in methanol are attached. In summation, the results and conclusions from the tests are as follows:

1. Anhydrous methanol separates readily from Cook Inlet crude after equilibration at 30, 77 and 120°F.
2. After separation, the methanol contains 6-8% by volume of dissolved oil but the oil contains no methanol.
3. At 30 and 77°F, the liquids formed methanol-in-oil dispersions on shaking, but at 120°F, oil-in-methanol dispersions formed.
4. Small amounts of water in the methanol caused a stable emulsion of methanol-in-oil to form. This emulsion will require the application of a chemical demulsifier to cause separation in a reasonable time.
5. Methanol equilibrated with Cook Inlet Oil at 30, 77, and 120°F did not contain any detectable heavy metals after settling.
6. Diluting separated methanol 1:1 with acidified water and centrifuging in a calibrated tube is an accurate method for measuring the oil content of the methanol.
7. Methanol selectively dissolves a colorless component from paraffin deposits from Cook Inlet oil. Dissolution rates are initially high but decrease to very low rates as the surface of the wax is depleted of the soluble component.

8. Methanol dissolved 7.3% of a wax deposit in one hour at 77°F and 10% in one hour at 120°F. Part of the wax precipitated from the 120°F methanol when it was cooled to 77°F.
9. Capacitance probes or other methods of measuring dielectric constant are good interface detectors for the methanol/oil system. The dielectric constant of methanol is 32.6 and of oil is 2.0.

We hope these results are sufficient to establish the feasibility of sequencing methanol and crude oil in a pipeline. Please advise if you have any questions about the crude.

B. J. Warner

B. J. Warner

ESS

ESSnavely/clm
Attachment

Cook Inlet Pipe Line Beluga
Methanol Study, Placer Amex

March 5, 1981

Work by:

S. C. Birk
J. R. Featherston
M. L. Mathis
R. L. Morris
E. S. Snavely

Report by:

E. S. Snavely

Cook Inlet Pipe Line Beluga Methanol Study Placer Amex

Introduction and Background

Placer Amex Corporation plans to produce methanol from coal in the area of Cook Inlet, Alaska, and has approached Mobil on the feasibility of transporting the methanol by Cook Inlet Pipe to tanker terminal facilities. Mobil Pipe Line requested that FRL study the equilibration and settling of methanol/Cook Inlet crude oil mixtures and the solubility of Cook Inlet paraffin deposits in methanol to aid in establishing the feasibility of pipelining methanol and in planning the pipeline terminal control, storage and separation facilities. This report gives the results of the FRL study.

Results and Conclusions

1. Anhydrous methanol can be interfaced with Cook Inlet crude oil in a pipeline. Methanol at the interface will contain 6-8% oil by volume but the oil will contain no dissolved methanol.
2. Mixtures of anhydrous methanol and Cook Inlet crude separate rapidly after equilibration at 30°, 77°, and 120°F.
3. Small amounts of water cause methanol to form a stable emulsion with Cook Inlet crude but these can be resolved with commercial demulsifiers applied at a concentration of about 200-400 ppm.
4. The oil content of methanol can be measured by diluting the methanol 1:1 by volume with acidified water and centrifuging.
5. Methanol equilibrated with Cook Inlet crude oil at 30°, 77° and 120°F extracts no heavy metals from the crude.
6. Methanol selectively dissolves a colorless component from paraffin deposits from Cook Inlet oil. Dissolution rates are initially high but decrease to very low rates as the surface of the wax is depleted of the soluble component.
7. Methanol dissolved 7.3% of a wax deposition in one hour at 77°F and 10% in one hour at 120°F. Part of the dissolved wax precipitated from the 120°F methanol when it was cooled to 77°F.
8. Capacitance probes or other methods of measuring dielectric constant are good interface detectors for the methanol/oil system. The dielectric constant of methanol is 32.6 and of oil is 2.0. This method can also be used to measure the oil content of methanol provided a correction is made for any water which is present in the methanol. Water in methanol can be measured by the Karl Fischer titration.

Recommendations

1. The pipeline terminal should be equipped with a separation facility for separating methanol/oil mixtures which will form at the methanol/oil interface in the pipeline.
2. The separation facility should have a residence time of six hours minimum and preferably 12 hours.
3. Commercial suppliers (Tretolite, Nalco, C-E Natco) should be requested to supply a chemical demulsifier for methanol/oil emulsions.
4. The separation facility should be equipped so that wax or other solids can be removed.
5. A continuously indicating or recording capacitance probe should be used to detect the methanol/oil interface.

Experiments and Results - Equilibration Studies

The rate of separation of methanol/oil mixtures was measured after equilibration at 30°, 77° and 120°F. Since the oil and methanol were to be subjected to various tests after separation, four replicate mixtures were made up for each temperature.

The separation measurements were made in 100cc graduated prescription bottles. Each bottle contained 50 cc of methanol and 50 cc of oil; these were put in the temperature-controlled environments and were shaken vigorously when the appropriate temperature was achieved. The bottles were then replaced in the temperature chambers to adjust for heat-of-mixing and then shaken again before timing for their separation rates was started. All of the samples except one separated fairly rapidly. In the 30° and 77°F, the interface appeared first near the top of the liquid level, as time passed, the interface dropped toward the original 50 cc level. Appearance of the interface at the top indicated that the liquids formed a dispersion of methanol in oil. In the 120°F test, the interface appeared near the bottom of the bottle and rose with time toward the 50 cc level. This result indicated that an oil-in-methanol-dispersion had formed which was opposite from the dispersions formed at 30° and 77°.

All of the mixtures separated rapidly at first (Figure 1) but slowed after about two hours. After four hours, the 120°F mixtures were very close to the ultimate interfaces. The ultimate interfaces were all below 50 cc indicating that more oil had dissolved in the methanol than methanol had dissolved in the oil. This was verified by analyses of the two layers as described later. Data from the settling tests are given in Table 1.

The specific gravity of methanol and Cook Inlet oil are given in Figure 2. The specific gravity of anhydrous methanol is 0.792 and Cook Inlet oil is 0.8396. Therefore, methanol is expected to rise to the top which is what was observed. An 83% solution of methanol in water has the same specific gravity as Cook Inlet oil and this mixture could not be expected to separate by gravity.

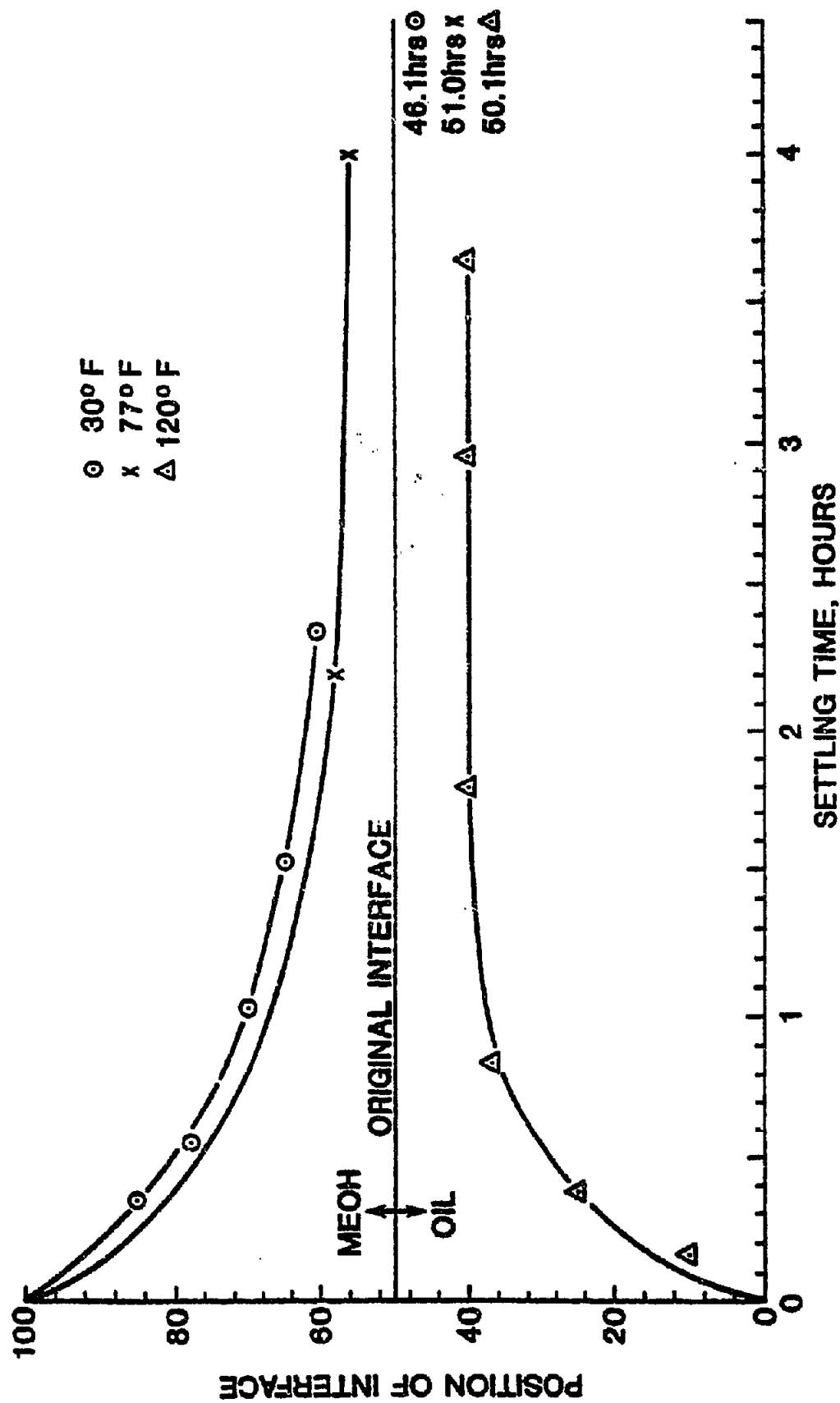


FIGURE 1. SEPARATION OF OIL AND METHANOL EQUILIBRATED AT VARIOUS TEMPERATURES

Table 1

Time to Separate of Cook Inlet Oil and
Anhydrous Methanol Equilibrated
at Various Temperatures.

50 MI Oil, 50 MI Methanol

<u>Temp. °F</u>	<u>Time Hours</u>	<u>Interface, Mls.</u>			
		<u>#1</u>	<u>#2</u>	<u>#3</u>	<u>#4</u>
30	0.35	85	70	85	82
	0.57	78	62	70	60
	1.02	70	58	60	60
	1.52	65	55	60	55
	2.35	60	55	55	55
	46.1	47	44	45	44
77	2.2	58	58	58	No Interface
	4.0	56	56	52	"
	4.7	55	55	52	"
	5.2	55	55	52	"
	6.0	55	55	52	"
	51.0	45	45	--	"
120	0.17	10	29	22	28
	0.38	25	37	33	38
	0.85	37	38	39	40
	1.80	40	40	40	41
	2.97	40	40	40	41
	3.63	40	40	40	41
	4.20	40	40	40	41
	4.97	40	40	40	41
	50.1	44	42	42	43

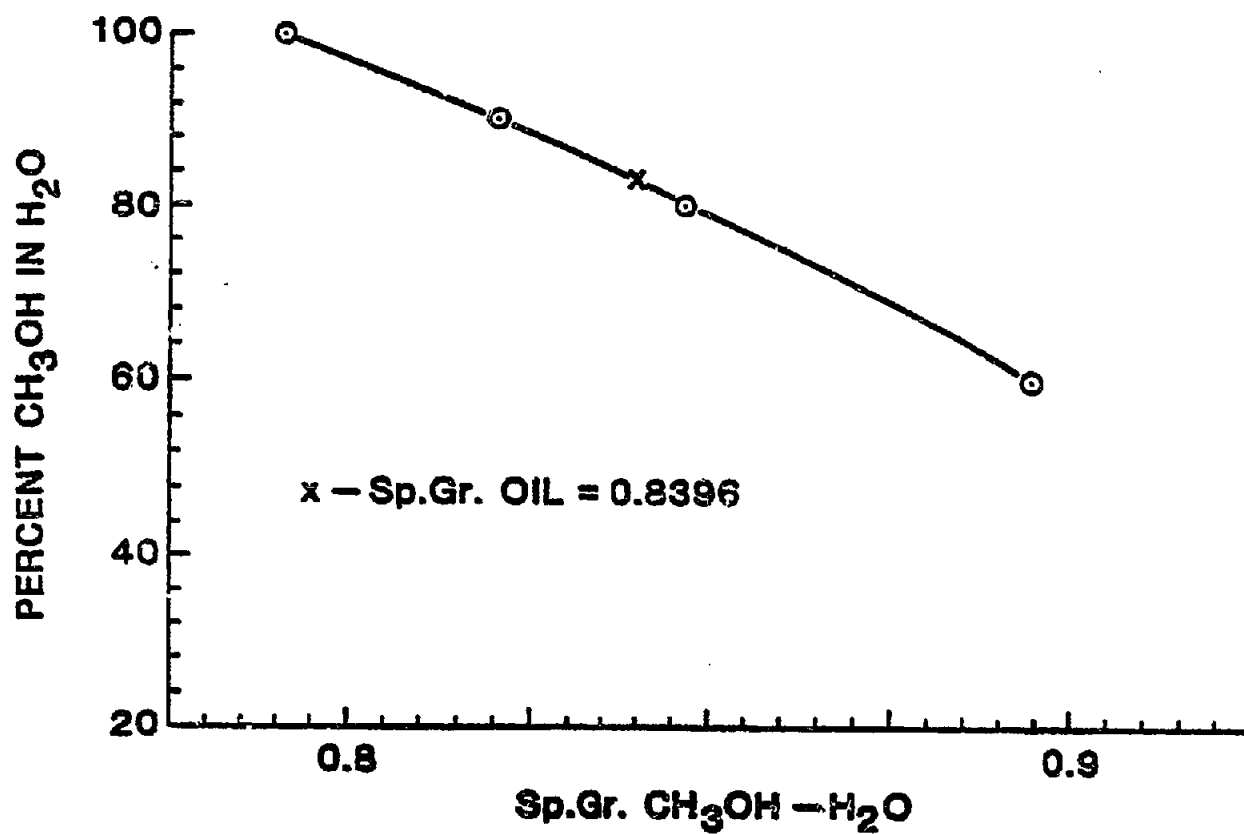


FIGURE 2. SPECIFIC GRAVITY OF METHANOL-WATER SOLUTIONS AND COOK INLET OIL

One of the samples made for equilibration at 77°F would not separate (Table 1). This stable emulsion is believed to have been caused by water absorbed in the methanol from the atmosphere. Later tests in which small amounts of water were deliberately added to the methanol, formed several stable emulsions, but not in every case. Since variable amounts of water could be absorbed by the methanol in a pipeline, it would be advisable to have an effective chemical demulsifier on hand in the event that the interface mixture forms a stable emulsion.

Oil Dissolved in Methanol

After 48 hours, the methanol layer from the equilibration tests was removed and analyzed for oil content. The separated methanol was first centrifuged to measure suspended oil; none was observed. To measure dissolved oil, 25 cc of methanol was diluted with 24 cc of distilled water and one cc of concentrated hydrochloric acid and centrifuged again. This treatment separated dissolved oil from the methanol and the separated oil was measured in the graduated centrifuge tube. It was found that the separated methanol layers contained 6.8% oil at 30° and 77°F and 8.0% at 120°F.

Methanol in Oil

The oil layers separated from the equilibration tests were analyzed for methanol by a gas chromatograph equipped with a mass spectrometer at Allied Analytical Labs, Inc. of Dallas. Methanol could not be detected in the oil indicating that the methanol content of the oil was less than 0.1%.

Metals in Methanol

The methanol separated from the equilibrium tests was analyzed for heavy metals by the following procedure: the methanol was evaporated to dryness and the residue was dissolved in 60 cc of 6M HCl and boiled for 20 minutes. The solution was then diluted to 100 cc with distilled water and analyzed at FRL by an inductively coupled plasma spectrograph. No metals were detected. The limit of detection for most metals by this method is less than one part per million.

Dielectric Constant of Methanol

The dielectric constant of anhydrous methanol and of the methanol layers separated from the equilibration tests were measured with a capacitance bridge and capacitance cell. Results are given in Table 3. A dielectric constant below 33.03 means that oil (dielectric constant about 2.0) is dissolved in the methanol and a dielectric constant above 33.03 means that the methanol contains water (dielectric constant about 80.0). A capacitance probe used as an interface detector in the pipeline would increase in capacitance by 17 times as the flow changed from Cook Inlet oil to anhydrous methanol.

Table 2

Methanol Dissolved in Oil and
Oil Dissolved in Methanol

<u>Temp. °F</u>	<u>Hours after Equilibration</u>	<u>Oil in Methanol, %</u>	<u>Methanol in Oil, %</u>
30	46.1	6.8	0
77	51.0	6.8	0
120	50.1	8.0	0

Trace Metals in Methanol = 0

Oil BS&W = 0

Table 3

Dielectric Constant of Anhydrous Methanol and
Methanol-Oil Solutions for Equilibration Tests

<u>Sample</u>	<u>Dielectric Constant</u>	<u>Oil Content, % Vol.</u>
Anhydrous methanol	33.03	0
30°F methanol	30.64	6.8
77°F methanol	28.60	6.8
120°F methanol	29.62	8.0
99% methanol, 1% water	33.71	0
95% methanol, 2% water	34.39	0
97% methanol, 1% water	35.07	0

Wax Solubility in Methanol

The solubility of paraffin deposits (furnished by Cook Inlet Pipe Line) in methanol was measured by dip tests at 77°F and 120°F. Paraffin was coated onto weighed screens which were reweighed to obtain the amount of paraffin present. The coated screens were attached to arms of a mechanical device that moved the screens up and down about 2 inches at a rate of 20 cycles per minute. Five test tubes filled with methanol were placed so that the paraffin screens moved up and down beneath the surface of the methanol. A screen was removed each hour, dried by blowing with unheated air, and weighed to measure the amount of paraffin dissolved. In the 120°F test, one of the tubes was emptied each hour and refilled with fresh methanol to determine if the methanol was being saturated with dissolved paraffin.

The paraffin dissolved rapidly at first but slowed to a lower rate after one hour (Figure 3). This meant that either the methanol was becoming saturated or a component of the paraffin was dissolved and the rate slowed as the component was depleted from the paraffin coating. The test in which the methanol was changed every hour dissolved no more paraffin than would be expected for that time of exposure (Figure 3 and Table 4); therefore, it was concluded that the methanol selectively dissolved a component of the paraffin. Methanol that dissolved paraffin at 120°F formed a slight precipitate when cooled to 77°F. The methanol that dissolved paraffin at 77°F formed a voluminous white precipitate when evaporated to about half its original volume.

Table 4
Wax Solubility in Methanol

<u>77°F</u> <u>Hrs.</u>	<u>Wax Wt.</u>	<u>Wt. Loss</u>	<u>% Wax Dissolved</u>
1	0.95	0.07	7.3
2	0.63	0.06	9.5
3	0.79	0.11	13.9
4	0.68	--	--
5	0.85	--	--
120°F			
1	0.82	0.0811	10
2	0.62	0.0742	12
3	0.80	0.1043	13
4	0.64	0.0908	14.1
5*	0.75	0.0961	12.8

* Methanol changed every hour.

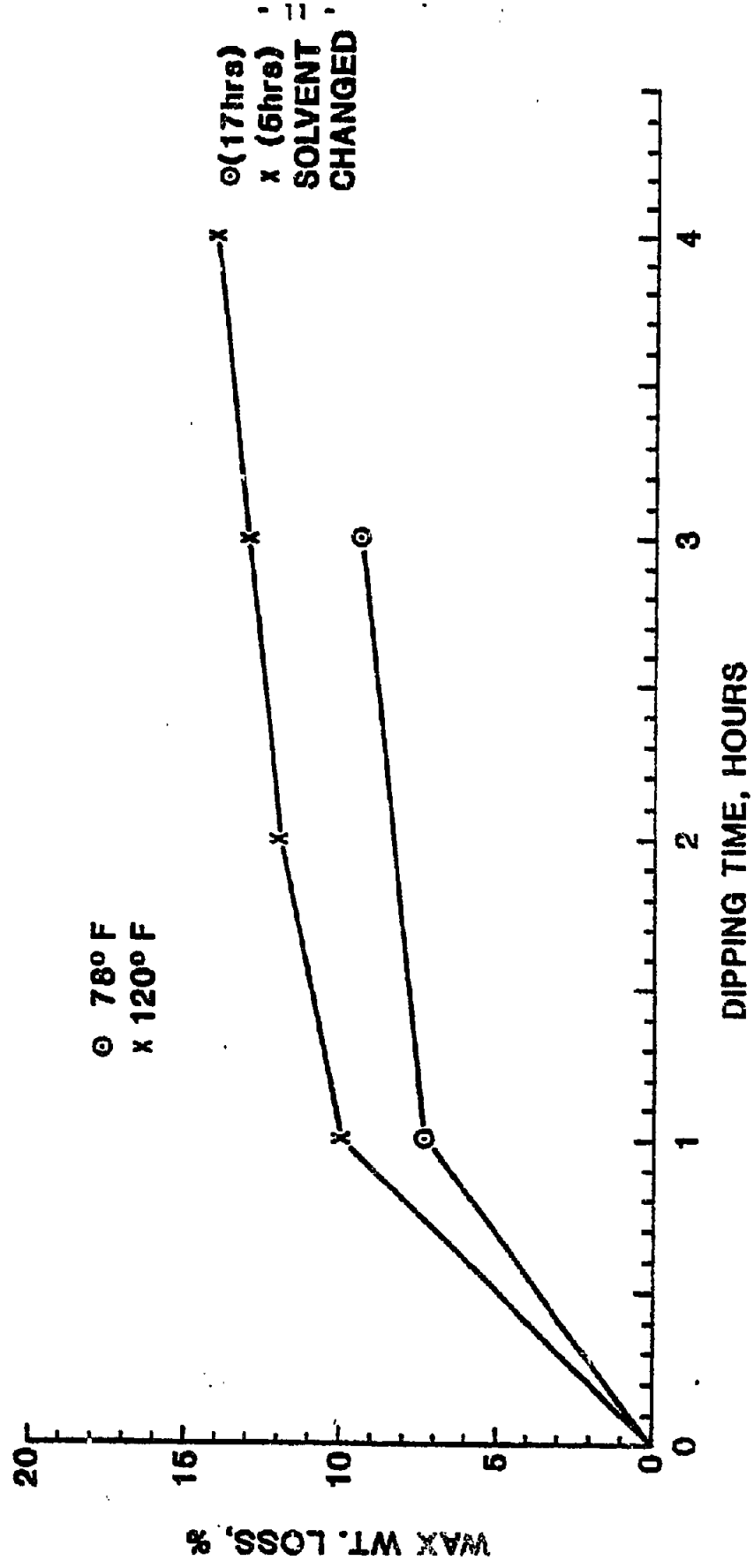


FIGURE 3. RESULTS OF PARAFFIN SOLUBILITY TESTS

CORE LABORATORIES, INC.
DALLAS CHEMICAL LABORATORY
DALLAS, TEXAS 75229
214/350-7893

WATER ANALYSIS

File DCL 816059

Company Mobil Research and Development Corporation Well Name _____ Sample No. _____
Formation _____ Depth _____ Sampled From Produced Water
Location Cook Inlet Field _____ County _____ State Alaska
Date Sampled _____ Date Analyzed April 14, 1981 Analyst J. A. Lutkenhaus

Total Dissolved Solids 26288 mg/L calculated

Sp. Gr. 1.0157 @ 76 °F

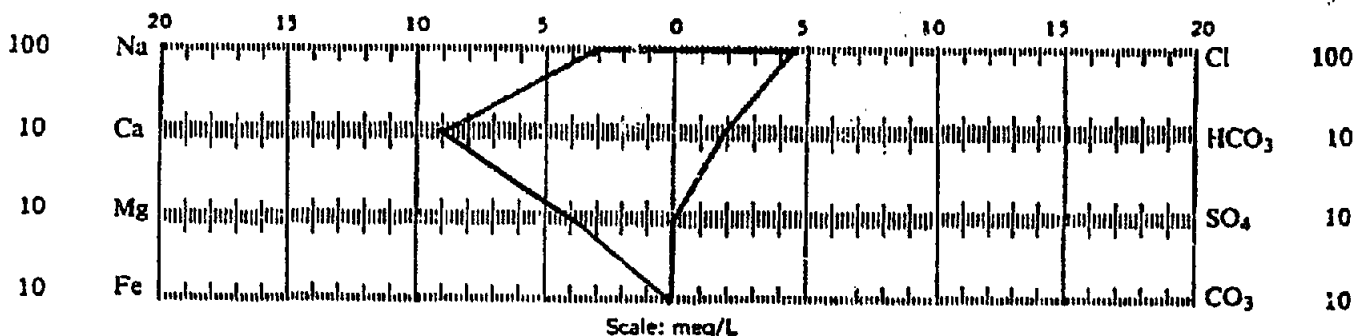
Resistivity 0.2510 ohm-meters @ 76 °F measured

1.0167 @ 20 °C (68°F)

Hydrogen Sulfide Absent

pH 6.80 @ 77 °F

Constituents	meq/L	mg/L	Constituents	meq/L	mg/L
Sodium	<u>323.04</u>	<u>7427</u>	Chloride	<u>435.17</u>	<u>15426</u>
Calcium	<u>91.07</u>	<u>1825</u>	Bicarbonate	<u>18.21</u>	<u>1111</u>
Magnesium	<u>39.48</u>	<u>480</u>	*Sulfate	<u>0.31</u>	<u>14.8</u>
Iron	<u>0.07</u>	<u>2.07</u>	Carbonate	<u>0.0</u>	<u>0.0</u>
* Barium	<u>0.03</u>	<u>2.2</u>	Hydroxide	<u>0.0</u>	<u>0.0</u>



* Gravimetric Analysis

These analyses, opinions or interpretations are based on observations and material supplied by the client to whom, and for whose exclusive and confidential use, this report is made. The interpretations or opinions expressed represent the best judgment of Core Laboratories, Inc. (all errors and omissions excepted), but Core Laboratories, Inc. and its officers and employees, assume no responsibility and make no warranty or representations as to the productivity, proper operation, or profitability of any oil, gas or other mineral well or sand in connection with which such report is used or relied upon.