Manitoba

Action / Route Slip

Date: Aug 30

To: [redacted]

Waskada Field - Omega metering

From: John-

Telephone:

- ☐ Take Action
- ☐ Per Your Request
- ☐ Circulate, Initial and Return
- ☐ For Approval and Signature
- ☐ Make ____ Copies
- ☐ May We Discuss
- ☐ For Your Information
- ☐ Return With Comments or Revisions
- ☐ Draft Reply for Signature
- ☐ Please File

Comments: OMEGA INTENDS TO CALIBRATE TOTAL WATER INJECTION METER @ 11-30 BATTERY SEMI-ANNUALLY, NOT ALL WATER INJECTION METERS AT WELLS.

MG-1298 PS-I-182 8940100671

Manitoba

Energy and Mines | Petroleum

555 — 330 Graham Avenue
Winnipeg, Manitoba, CANADA
R3C 4E3

(204) 945-6577

August 17, 1990

Omega Hydrocarbons Ltd.
1300, 112 - 4th Avenue S.W.
Calgary, Alberta
T2P 0H3

Attention: Mr. R.A. Brekke, P. Eng.
Engineering Supervisor

Dear Sir:

Re: Water Injection Meter Calibration

Your letter dated August 7, 1990 outlining Omega Hydrocarbons' water meter calibration and intermittent injection proposal is hereby acknowledged.

Omega's proposed semi-annual calibration program for the water injection meters exceeds the present regulatory requirements. When a water meter is calibrated, Omega is requested to tag or label the meter. The tag or label should include the date of calibration, the meter serial number and the meter factor. Omega is also requested to notify the Branch when the proration factor exceeds 1.30 for three (3) consecutive months. The notice should include Omega's plans for correction of the metering inaccuracies.

The Branch is satisfied that intermittent injection, though not optimal, should not significantly effect ultimate recovery. Therefore Omega's proposal to use intermittent injection is hereby approved.

The Branch has noted that the accuracy of the Hi-Flow Flotrac meters decreases significantly when injection rates drop below 25-30 m^3/d. Where possible intermittent injection rates into wells with this type of meter should be kept above this level.

If you have any further questions or comments in respect of this matter please contact me at 945-6574.

Yours truly,

John N. Fox
Chief Petroleum Engineeer

JNF:cvs

cc: Waskada

OMEGA - WATER INJECTION METERS 90/08/15

1) INJ. VOLUMES

LOW FLOW METERS AVER 11.9 m^3/D RNG 7 - 19.9 m^3/D

HIGH FLOW METERS AVER 13.8 m^3/D RNG 3.3 - 26 m^3/D

JUNE PRORATION FACTOR INCLUDES SWD @ 1.30-1.25 only

NOTE: SWD VOLUME REPRESENTS 25% OF WATER VOLUME

- improvement in proration factors in JUN/90 to 1.1?

operating age: low flow meters 8.2 - 82 m^3/d
(Warren Sharpe) high flow meters 54 m^3/d - 490 m^3/d
accuracy decreases sharply below 24 m^3/d (150 b/d)

- recognition of replacement cost for valves -

- turbine valves ($1700) susceptable to plugging

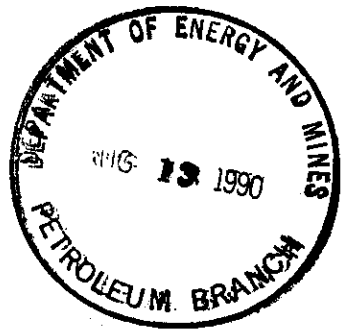
- in accordance with Section 87 of Regulation water inj. valves must be calibrated & tagged or labelled - with date of calibration, meter serial no. & meter factor

bond -- past performance Omega is to advise the Board when proration factors exceed 1.30 for 3 months in a row & recommend plan of action

- the Board is satisfied that treatment injection though not optimal will not significantly effect ultimate recovery

OMEGA
HYDROCARBONS LTD.

1300 SUN LIFE PLAZA III
112 - 4th AVENUE S.W.
CALGARY, ALBERTA, CANADA T2P 0H3
TELEPHONE (403) 261-0743
FAX (403) 264-5691



August 7, 1990

Manitoba Energy and Mines
Petroleum Branch
555 - 330 Graham Avenue
Winnipeg, Manitoba
R3C 3E3

Attention: Mr. J. Fox
Chief Petroleum Engineer

Dear Sir:

RE: Waskada Water Injection System
Meter Calibration Testing Program Results

Omega Hydrocarbons Ltd. has completed its review of the water injection system at Waskada and has successfully implemented changes which have dramatically improved the water injection proration factor. Attachment 1 contains a historical summary of the Waskada water injection proration factor to the end of June 1990.

As discussed in previous correspondence Omega designed and built a meter calibrating system for use in the field. The calibration equipment was bench tested by comparing calibration factors derived using the new equipment with third party calibrated injection meters. Results of the bench tests indicated that the new calibration equipment was capable of producing accurate and repeatable data. The next step in our review was to test the existing injection meters for accuracy outside their specified operating ranges given that the majority of injection well rates are currently below the minimum specified operating rate. Tests were conducted on four separate injection meters. These tests showed that significant metering errors occur at injection volumes lower than the minimum specified flow rate and that operating within the manufacturers' specified operating ranges is essential to achieving the best meter accuracy.

. . . /2

During April 1990 two high pressure turbine meters capable of measuring lower liquid volumes were purchased and installed for field testing. It became apparent very quickly that meter plugging would be a major operating problem with this type of meter. Given that the suspended solids in the injection water are currently less than 10 microns Omega decided to abandon the idea of purchasing new meters and concentrate on improving metering accuracy with the existing meters.

Using the field calibration equipment all existing meters have now been calibrated and repaired. Attachment 2 contains a list of the resulting meter factors. The values range from 0.8370 to 1.2917 with an average meter calibration factor 1.0511. In order to maintain injection rates within the specified meter operating ranges Omega modified its injection strategy from continuous injection to intermittent injection during May and June. From an operational standpoint intermittent injection is acceptable and to date no detrimental effects have been observed in reservoir performance. Henceforth, Omega intends to use intermittent injection on a monthly basis where applicable in order to obtain the most accurate injection volume data.

In conclusion, Omega feels it has resolved the water injection proration factor problem at Waskada and has meter calibration equipment in place to conduct future calibration work. To ensure ongoing injection meter accuracy we plan to continue to calibrate the total injection water meter semiannually and will conduct an annual proration factor review to assess when the individual injection well meters should be recalibrated.

Yours truly,

OMEGA HYDROCARBONS LTD.

R.A. Brekke, P. Eng.
Engineering Supervisor

RB/ns

c.c.: G. Cormack
W. Sharp
D. Boyko
Waskada Production Accounting File

Waskada Historical Injection Proration Factors

	N2O INJ	GAS INJ
JAN 1987	1.19139	1.00000
FEB	1.26205	1.00000
MAR	1.30000	1.00000
APR	1.27806	1.00000
MAY	1.47261	1.00000
JUN	1.28472	1.00000
JUL	1.29204	1.00000
AUG	1.25508	1.00000
SEPT	1.29954	1.00000
OCT	1.56330	
NOV	1.37175	1.00000
DEC	1.34041	1.00000
YEARS AVG.	1.32591	1.00000
JAN 1988	1.30548	1.00000
FEB	1.28496	1.00000
MAR	1.14522	1.00000
APR	0.94969	1.00000
MAY	1.38323	1.00000
JUN	1.16802	1.00000
JUL	1.33022	1.00000
AUG	1.44103	1.00000
SEPT	1.59924	1.00000
OCT	1.35605	1.00000
NOV	1.62632	1.00000
DEC	1.46411	1.00000
YEARS AVG.	1.33780	1.00000

	N2O INJ	GAS INJ
JAN 1989	1.09023	1.00000
FEB	1.21217	1.00000
MAR	1.40472	1.00000
APR	1.21504	1.00000
MAY	1.24432	1.00000
JUN	1.40109	1.00000
JUL	1.61635	1.00000
AUG	1.72118	1.00000
SEPT	1.71597	1.00000
OCT	1.42733	1.00000
NOV	1.63632	1.00000
DEC	2.14933	1.00000
YEARS AVG.	1.48784	1.00000

	N2O INJ	GAS INJ
JAN 1990	1.81952	1.00000
FEB	2.23828	1.00000
MAR	2.17938	1.00000
APR	1.51545	1.00000
MAY	1.34774	1.00000
JUN	1.17895	1.00000
JUL	0.00000	1.00000
AUG	0.00000	1.00000
SEPT	0.00000	1.00000
OCT	0.00000	1.00000
NOV	0.00000	1.00000
DEC	0.00000	1.00000
YEARS AVG.	1.71322	1.00000

Attachment 2

WASKADA WATER INJECTION WELLS
METER CALIBRATION FACTORS

	OLD METER FACTOR	NEW METER FACTOR	INJ RATE m³/MD JUN/90	METER TYPE	INJ VOL. m³/mon JUN/90
13-17-1-25	1.0000	1.1144	16	HI FLOW	111.9
5-20-1-25	1.0000	1.0504	21	HI FLOW	105.0
13-20-1-25	1.0000	1.0369	8.8	LO FLOW	158.8
15-20-1-25	1.0000	1.0367	8.9	LO FLOW	194.9
5-30-1-25	1.0000	1.1159	11.1	LO FLOW	310.4
7A-30-1-25	0.9950	N/A	14.2		92.2
13-30-1-25	1.0360	0.9741	19.9	LO FLOW	114.2
15-30-1-25	1.0000	1.0000	6.8	TURBINE	175.5
5-31-1-25	0.9880	—	—	LO FLOW	—
7-31-1-25	1.0000	1.0660	8.9	HI FLOW	88.9
13-31-1-25	1.0000	1.0906	20.1	HI FLOW	60.4
15-31-1-25	1.0000	1.1503	—	HI FLOW	—
5-32-1-25	0.9988	0.9453	7.0	LO FLOW	154
7-32-1-25	1.0744	1.0522	15.5	LO FLOW	341
13-32-1-25	0.9989	0.9971	7.0	LO FLOW	140
5-13-1-26	1.0100	1.0990	12.5	LO FLOW	124
7-13-1-26	1.0000	0.9222	10.9	LO FLOW	147
13-13-1-26	0.9950	1.0947	—	HI FLOW	—
15-13-1-26	1.0000	1.0820	—	HI FLOW	—
15-14-1-26	1.0000	1.0842	26	HI FLOW	78
7-23-1-26	1.0000	1.0891	25	HI FLOW	125.2
9A-23-1-26(MC)	1.0000	1.0983	—	HI FLOW	
13-23-1-26	1.0000	1.0425	20	HI FLOW	179.9
15-23-1-26	0.9926	0.9431	8.3	LO FLOW	215.6
1-24-1-26(MC)	1.0000	SHUT-IN	—		
5-24-1-26	0.9950	1.1159	1.0	HI FLOW	1.0
7-24-1-26	1.0000	1.0625	—	HI FLOW	—
13A-24-1-26	1.0000	1.0302	11.3	LO FLOW	113.1
15-24-1-26	0.9950	0.8554	—	LO FLOW	—
5-25-1-26	1.0000	N/A	13.5		256.2
7-25-1-26	1.0000	0.8435	15.6	LO FLOW	291.2
13-25-1-26	1.0000	0.9406	1.4	LO FLOW	1.4
15-25-1-26	0.9991	0.9839	15.8	HI FLOW	95
5-26-1-26	0.9894	0.9970	19.9	LO FLOW	337.5
7-26-1-26	1.0500	0.8370	19.6	LO FLOW	274.9
7-27-1-26	1.0000	1.1127	11	LO FLOW	231
7-33-1-26	1.0000	1.2691	10.6	HI FLOW	222.2
13-33-1-26	1.0000	1.0296	6.1	HI FLOW	103
15-33-1-26	0.9857	1.0619	11.5	HI FLOW	80
1-34-1-26(MC)	1.0000	SHUT-IN	—		
5-34-1-26	0.9950	1.0600	9.7	LO FLOW	145
13-34-1-26	1.0526	0.9801	9.8	LO FLOW	157

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	OLD METER FACTOR	NEW METER FACTOR		METER TYPE	
15-34-1-26	1.0000	1.0502	17.9	HI FLOW	53
5-35-1-26	1.0000	1.0916	9.1	LO FLOW	183
13-35-1-26	0.9824	1.1761	3.3	HI FLOW	30
15-35-1-26	0.9974	1.1477	9.3	HI FLOW	112
5-36-1-26	1.0898	1.1227	16.1	HI FLOW	96
7-36-1-26	1.1686	1.0906	12.6	HI FLOW	76
13-36-1-26	1.1015	1.2178	25.1	HI FLOW	125
15-36-1-26	1.0050	1.0289	17.1	HI FLOW	102
7-5-2-25	1.0704	1.0052	0.6	LO FLOW	117
5-8-2-25	1.2285	1.0000	9.4	LO FLOW	240
7-8-2-25	0.9989	0.8710	15.9	LO FLOW	270
13-8-2-25	0.9850	1.0600	8.2	LO FLOW	115
15-8-2-25	1.0000	0.9322	12	LO FLOW	287
5-1-2-26	1.0000	1.1462	20.3	HI FLOW	61
7-1-2-26	1.0268	1.1080	12.4	HI FLOW	62
13-1-2-26	0.9838	1.1197	9.5	HI FLOW	57
15-1-2-26	0.9941	0.9922	6.9	HI FLOW	56
5-2-2-26	0.9680	1.1024	7.5	HI FLOW	90
7-2-2-26	1.0000	0.9919	8.5	HI FLOW	60
15-2-2-26	1.0050	1.1372	4.5	HI FLOW	68
7-3-2-26	0.9986	1.1397	8.2	HI FLOW	82
13-3-2-26	0.9857	1.2917	15.3	HI FLOW	
15-3-2-26	0.9894	N/A	-		—
5-4-2-26	1.0150	1.1020	10	HI FLOW	70
7-4-2-26	0.9771	0.9628	12.7	LO FLOW	292
Average Meter Factor	1.0108	1.0511			
Highest Meter Factor	1.2285	1.2917			
Lowest Meter Factor	0.9680	0.8370			

OMEGA HYDROCARBONS LTD.
1300, 112 - 4TH AVENUE S.W.
CALGARY, ALBERTA
T2P 0H3

Ph#: 261-0743

T R A N S M I T T A L

DATE: August 10, 1990

TO: Manitoba Energy and Mines
Petroleum Branch
555 - 330 Graham Avenue
Winnipeg, Manitoba
R3C 3E3

ATTENTION: Mr. J. Fox
Chief Petroleum Engineer

Dear Sir:

RE: Waskada Water Injection System
Meter Calibration Testing Program Results

Please find enclosed for your files a revised Attachment 2. Please replace the copy that was previously sent to you on August 7, 1990.

Yours truly,

OMEGA HYDROCARBONS LTD.

Nancy Schwindt

Nancy Schwindt
Production Secretary

PLEASE SIGN AND RETURN ONE COPY TO:
OMEGA HYDROCARBONS LTD.
Date Received:_____

Signed:_____

Attachment 2

WASKADA WATER INJECTION WELLS
METER CALIBRATION FACTORS

	OLD METER FACTOR	NEW METER FACTOR	METER TYPE
13-17-1-25	1.0000	1.1144	HI FLOW
5-20-1-25	1.0000	1.0504	HI FLOW
13-20-1-25	1.0000	1.0369	LO FLOW
15-20-1-25	1.0000	1.0367	LO FLOW
5-30-1-25	1.0000	1.1159	LO FLOW
7A-30-1-25	0.9950	0.9950	HI FLOW
13-30-1-25	1.0360	0.9741	LO FLOW
15-30-1-25	1.0000	1.0000	TURBINE
5-31-1-25	0.9880	1.0163	LO FLOW
7-31-1-25	1.0000	1.0660	HI FLOW
13-31-1-25	1.0000	1.0906	HI FLOW
15-31-1-25	1.0000	1.1503	HI FLOW
5-32-1-25	0.9988	0.9453	LO FLOW
7-32-1-25	1.0744	1.0522	LO FLOW
13-32-1-25	0.9989	0.9971	LO FLOW
5-13-1-26	1.0100	1.0990	LO FLOW
7-13-1-26	1.0000	0.9222	LO FLOW
13-13-1-26	0.9950	1.0947	HI FLOW
15-13-1-26	1.0000	1.0820	HI FLOW
15-14-1-26	1.0000	1.0842	HI FLOW
7-23-1-26	1.0000	1.0891	HI FLOW
9A-23-1-26(MC)	1.0000	1.0983	HI FLOW
13-23-1-26	1.0000	1.0425	HI FLOW
15-23-1-26	0.9926	0.9431	LO FLOW
1-24-1-26(MC)	1.0000	SHUT-IN	NO METER
5-24-1-26	0.9950	1.1159	HI FLOW
7-24-1-26	1.0000	1.0625	HI FLOW
13A-24-1-26	1.0000	1.0302	LO FLOW
15-24-1-26	0.9950	0.8554	LO FLOW
5-25-1-26	1.0000	0.9179	HI FLOW
7-25-1-26	1.0000	0.8435	LO FLOW
13-25-1-26	1.0000	0.9406	LO FLOW
15-25-1-26	0.9991	0.9839	HI FLOW
5-26-1-26	0.9894	0.9970	LO FLOW
7-26-1-26	1.0500	0.8370	LO FLOW
7-27-1-26	1.0000	1.1127	LO FLOW
7-33-1-26	1.0000	1.2691	HI FLOW
13-33-1-26	1.0000	1.0296	HI FLOW
15-33-1-26	0.9857	1.0619	HI FLOW
1-34-1-26(MC)	1.0000	SHUT-IN	NO METER
5-34-1-26	0.9950	1.0600	LO FLOW
13-34-1-26	1.0526	0.9801	LO FLOW

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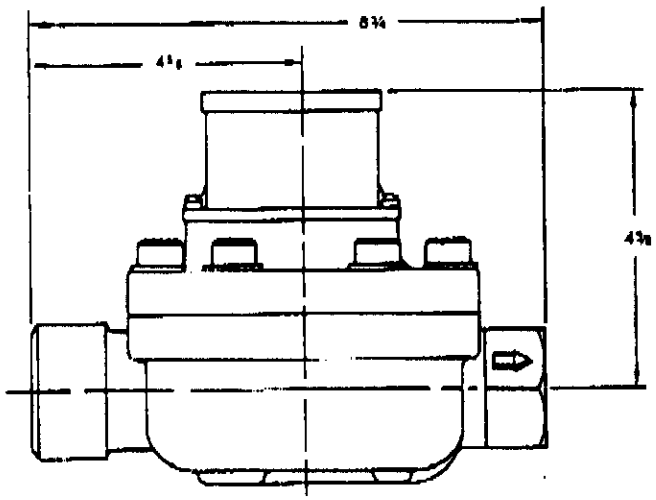
	OLD METER FACTOR	NEW METER FACTOR	METER TYPE
15-34-1-26	1.0000	1.0502	HI FLOW
5-35-1-26	1.0000	1.0916	LO FLOW
13-35-1-26	0.9824	1.1761	HI FLOW
15-35-1-26	0.9974	1.1477	HI FLOW
5-36-1-26	1.0898	1.1227	HI FLOW
7-36-1-26	1.1686	1.0906	HI FLOW
13-36-1-26	1.1015	1.2178	HI FLOW
15-36-1-26	1.0050	1.0289	HI FLOW
7-5-2-25	1.0704	1.0052	LO FLOW
5-8-2-25	1.2285	1.0000	LO FLOW
7-8-2-25	0.9989	0.8710	LO FLOW
13-8-2-25	0.9850	1.0600	LO FLOW
15-8-2-25	1.0000	0.9322	LO FLOW
5-1-2-26	1.0000	1.1462	HI FLOW
7-1-2-26	1.0268	1.1080	HI FLOW
13-1-2-26	0.9838	1.1197	HI FLOW
15-1-2-26	0.9941	0.9922	HI FLOW
5-2-2-26	0.9680	1.1024	HI FLOW
7-2-2-26	1.0000	0.9919	HI FLOW
15-2-2-26	1.0050	1.1372	HI FLOW
7-3-2-26	0.9986	1.1397	HI FLOW
13-3-2-26	0.9857	1.2917	HI FLOW
15-3-2-26	0.9894	1.1326	LO FLOW
5-4-2-26	1.0150	1.1020	HI FLOW
7-4-2-26	0.9771	0.9628	LO FLOW
Average Meter Factor	1.0108	1.0511	
Highest Meter Factor	1.2285	1.2917	
Lowest Meter Factor	0.9680	0.8370	

MODEL 380 LOW FLOW

GENERAL SPECIFICATIONS

Maximum Operating Pressure:	5000 psig SWP 7500 psig test
Flow Range:	1.5 to 15 gpm (water) 4 to 15 gpm (viscosities to 10 csk)
Operating Temperature Range:	32°F to 225°F
Linearity with Flow:	±2%
Pressure Drop:	Less than 50 psi at 15 gpm. 22 psi at 10 gpm, 1.5 psi at 2 gpm
Pipe Connections:	1" female NPT, in-line
Register:	Eight digits Barrels U.S.: 1/1000 Liters: 1/10 Cubic Meters: 1/10,000
Weight:	22 lbs.
Overall Dimensions (with register): Length: Width: Height:	 8.75" 5.75" 6.0"

SIDE VIEW



ORDERING INFORMATION

Type of fluid
Viscosity
Flowing temperature
Line pressure
Flow rate (maximum, minimum, normal)

The ITT Barton standard warranty is available for inspection upon request.

YOUR LOCAL REPRESENTATIVE

ITT Barton Instruments Company
900 S. Turnbull Canyon Road
City of Industry, CA 91749-1882
Tele. (818) 961-2547 Telex: 67-7475

BARTON ITT

DG 11M Litho In U.S.A.

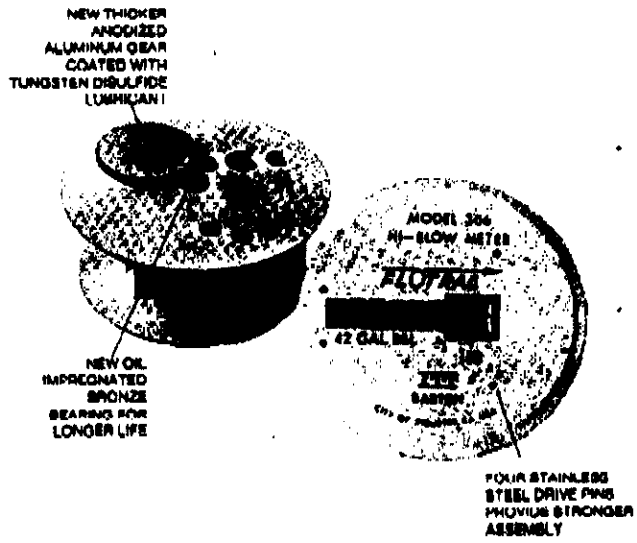
MODEL 306

GENERAL SPECIFICATIONS

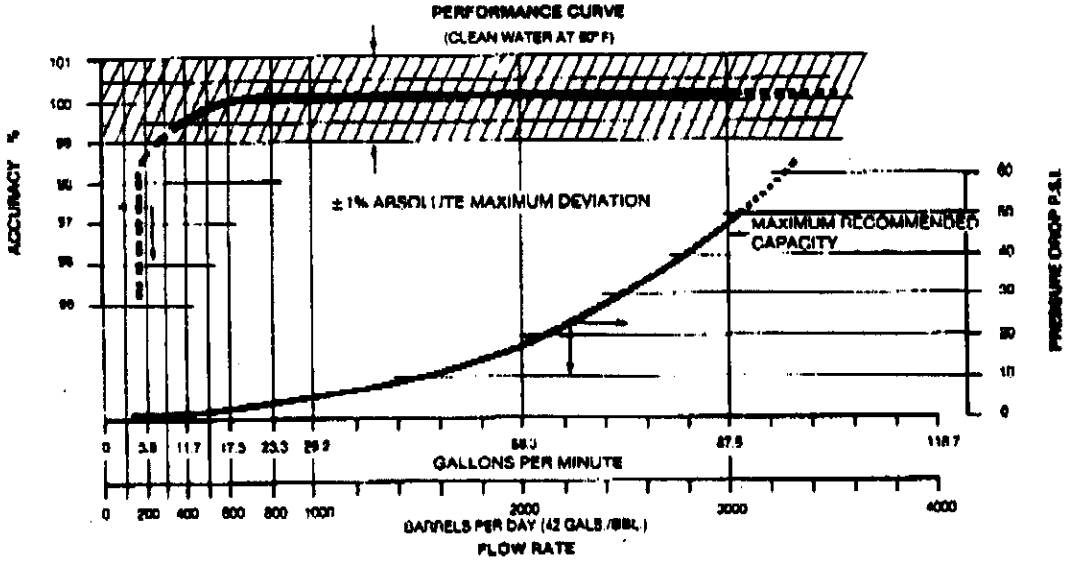
Operating Presure Range	5000 psig SWP 7500 psig Test
Capacity	10 to 90 GPM
Operating Temperature Range	32°F to 200°F
Viscosity	10 CSK, Max.
Accuracy	±1.0% of reading over 9:1 flow range
Pipe Connections	1" female NPT, inline
Register	Eight digits Barrels U.S.: 1/100 Liters: 1 Cubic Meters: 1/1000
Weight	22 lbs
Overall Dimensions *(with register)*:	
Length	8.75"
Width	5.75"
Height	6.0"

Note: Outline dimensional drawings are available upon request.

Register now also available in cubic meters and liter readouts.



PERFORMANCE SPECIFICATIONS



ORDERING INFORMATION

- ☐ Flow Rate: Maximum, Minimum, Normal
- ☐ Line Pressure
- ☐ Process Liquid
- ☐ Registration Units
- ☐ Flowing Temperature

The ITT Barton standard warranty is available for inspection upon request.

YOUR LOCAL REPRESENTATIVE

ITT Barton Instruments Company
900 S. Turnbull Canyon Road
City of Industry, CA 91749-1682
Tele. (818) 961-2547 Telex: 67-7475

DG 11M Litho in U.S.A.

BARTON ITT

Manitoba

Energy and Mines Petroleum

555 — 330 Graham Avenue
Winnipeg, Manitoba, CANADA
R3C 4E3

(204) 945-6577

February 14, 1990

Omega Hydrocarbons Ltd.
1300, 112 - 4th Avenue S.W.
CALGARY, AB T2P 0H3

Attention: Mr. R.A. Brekke, P. Eng.
Engineering Supervisor - Manitoba

Dear Richard:

Re: Water Injection Meter Calibration Testing Program

I have reviewed your letter dated January 23, 1990 regarding the proposed calibration program for the Waskada water injection meters. I agree it is a reasonable approach to try and improve the accuracy of measuring individual well injection volumes.

I have some concerns with the accuracy of calibration factors established at operating conditions outside the design range for the meters and offer the suggestion that a field test of the recalibrated meters may increase confidence in the accuracy of the calibration tests.

As we discussed, I think there is some merit in installing, on a test basis, a meter on the group injection line at a satellite(s) upstream of the injection header. This meter could then be used to cross-check the accuracy of the re-calibrated individual injection well meters.

I will be in Waskada February 20 for a meeting between the Waskada producers, representatives of the Regional Municipalities of Brenda and Arthur and the Branch. If possible at that time, I would like to witness a calibration test.

Please submit the results of the calibration tests on the sample set of meters when completed and your proposed plan of action.

Yours sincerely,

ORIGINAL SIGNED BY
JOHN N. FOX

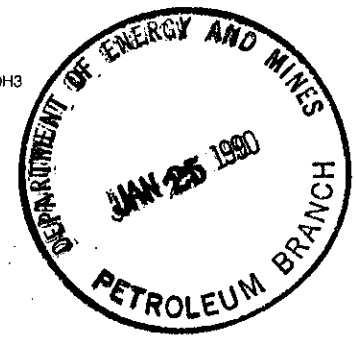
John N. Fox
Chief Petroleum Engineer
Petroleum Branch

JNF:dah

cc: Waskada Office

OMEGA
HYDROCARBONS LTD.

1300 SUN LIFE PLAZA III
112 - 4th AVENUE S.W.
CALGARY, ALBERTA, CANADA T2P 0H3
TELEPHONE (403) 261-0743
FAX (403) 264-5691



January 23, 1990

MANITOBA ENERGY AND MINES
Petroleum Branch
555 - 330 Graham Avenue
Winnipeg, Manitoba
R3C 3E3

Attention: Mr. J. Fox
Chief Petroleum Engineer

Dear John:

Re: Waskada Water Injection System
Meter Calibration Testing Program

As you are aware the Manitoba Petroleum Branch has requested that Omega Hydrocarbons Ltd. calibrate all of the individual water injection meters within the Waskada field and that a calibration schedule be established to ensure ongoing meter accuracy. To date Omega has designed a system to calibrate the existing water injection meters using our own field staff and is currently assembling the equipment. During the process of preparing for a field wide calibration test it was determined that some of the existing meters were initially oversized to accomodate the fill up phase of the pressure maintenance projects.

Omega has reviewed various alternatives to rectify this problem and proposes the following, 1) to conduct calibration tests on a sample set of existing meters to determine their level of accuracy outside the desired operating range; if the results are acceptable to all parties calibration testing would be expanded to all the injection meters 2) if the results are unacceptable the existing meters would be calibrated for their specified operating ranges and the current injection strategy would be modified from continous injection to intermitent injection to stay within the appropriate operating ranges. It is anticipated that it will take until the end of March 1990 to complete this project.

. . . . / 2

After comparing the 1989 reservoir injection pattern pressure data with the corresponding cumulative voidage replacement ratios Omega is confident that the injected volumes measured to date have been accurate. The total injected water volume at Waskada is metered and is calibrated on a semiannual basis. Therefore, any inaccuracies which currently exist in the system occur at the individual injection well meters and are being addressed.

Given the aforementioned information Omega Hydrocarbons Ltd. appreciates your cooperation in reaching both a satisfactory and a timely solution to improving the water injection proration factor at Waskada. Any input or comments you may have with regard to this letter are welcomed.

Yours very truly,

OMEGA HYDROCARBONS LTD.

R.A. Brekke, P. Eng.
Engineering Supervisor - Manitoba

c.c.: W. Sharp
D. Boyko
Waskada Production Acct. File
Waskada Petroleum Branch Office

- RICHARD BREKKE

→ reasonably accurate outside the rge. – BARTON FLOTRAC both low & high flow meters – within rge ± 2%
– outside rge ± 5%

– have checked equipment against shop calibrated meter

→ in Jan. ≈ 13000 m³ injected of which 2800 m³ into SWD's

– will consider installation of group inj. wells upstream of satellite

– not calibrated since installed

- Omega calibration procedure - total injected volume method
  these meters calibrated semi-annually
- meter accuracy - oversized

Omega Proposal

1/ determine level of accuracy of existing meters outside their design operating range.

2/ if above unacceptable - propose to go to intermittent injection

Discussion

- I doubt there is a consistent calibration factor outside a meters operating range - proved with plot

- suggest calibration of SWD well meters on 7-18 & 1-30 during 60% of injected vol.

- slugging of injected wtr - not good engineering practice & may result in reduced volumetric sweep eff.
  i) gravity forces - water to percolate down through oil
  ii) disruption of pressure distribution & streamlines
- however, literature says significant changes in flow rate > 5-10 times required to affect a

small changes in vol. sweep eff.

- at this stage in life of waterflood - fill-up & water breakthrough having occurred I don't think it will have a serious effect on recovery

- suggestion to try & improve monitoring the installation of a group inj. water upstream of the injection header of a satellite - perhaps test out individual inj. well water accurately in field by installing a meter at a high flow & low flow satellite

- some info on specific water types
TS&D, Melita supplies & calibrates meters
522-3238

1989 PRORATION FACTORS

	PRODUCTION			INJECTION	
	PRORATION FACTOR	WTR VOL	WIR	PRORATION FACTOR	WTR VOL
JAN				1.090	17390.2
FEB				1.212	14782.8
MAR				1.405	21066.4
APR				1.215	17675.1
MAY				1.244	19684.9
JUN				1.401	21036.3
JUL	1.48	18593	1.88	1.616	21159.1
AUG	1.361	19078	1.83	1.721	17372.1
SEP	1.214	16661	1.71	1.716	15109.5
OCT	1.364	17508	1.83	1.427	15288.4
NOV	1.563	16810	1.69	1.656	15512
DEC					

11-30-1-25 Battery

- all produced water is pumped from the 11-30 battery to the inj. wells

- WSW wells 1-30 + 11-29

Inj pumps 2 - 125 HP Wheatley's
1 - 150 HP National

Metering
- battery produced wtr.
- meter on wsw's
- meter on inj. pump discharge

Attachment No.

WASKADA WATER INJECTION SUMMARY FOR :November 1989

WELL LOCATION	UN-PRORATED INJECTION VOLUME (m^3)	HOURS ON	AVERAGE SURFACE PRESSURE (kPag)	PRORATED INJECTION VOLUME (m^3)	#	WELL LOCATION	UN-PRORATED INJECTION VOLUME (m^3)	HOURS ON	AVERAGE SURFACE PRESSURE (kPag)	PRORATED INJECTION VOLUME (m^3)
13-17-1-25 WPM	15.856	72	1400	26.3	#	5-36-1-26 WPM	72.164	552	5187	119.5
5-20-1-25 WPM	41.582	384	6319	68.9	#	7-36-1-26 WPM	62.649	456	2632	103.8
13-20-1-25 WPM	70.951	384	4644	117.5	#	13-36-1-26 WPM	88.243	624	4977	146.2
15-20-1-25 WPM	65.229	360	3747	108.0	#	15-36-1-26 WPM	89.162	720	2827	147.7
5-30-1-25 WPM	140.353	576	4246	232.5	#	7-5-2-25 WPM	0.000	0	0	0.0
7A-30-1-25 WPM	56.812	336	6671	94.1	#	5-8-2-25 WPM	66.870	216	8211	110.8
13-30-1-25 WPM	93.814	696	1055	155.4	#	7-8-2-25 WPM	156.132	504	4067	258.6
15-30-1-25 WPM	2.459	24	6000	4.1	#	13-8-2-25 WPM	96.627	552	661	160.0
5-31-1-25 WPM	0.000	0	0	0.0	#	15-8-2-25 WPM	123.801	456	16	205.0
7-31-1-25 WPM	0.000	0	0	0.0	#	5-1-2-26 WPM	71.414	624	5712	118.3
13-31-1-25 WPM	71.149	188	5308	117.8	#	7-1-2-26 WPM	38.466	600	4104	63.7
15-31-1-25 WPM	0.000	0	0	0.0	#	13-1-2-26 WPM	47.908	432	6067	79.3
5-32-1-25 WPM	60.387	600	2356	100.0	#	15-1-2-26 WPM	33.127	456	4074	54.9
7-32-1-25 WPM	180.392	696	4276	298.8	#	5-2-2-26 WPM	37.660	456	6921	62.4
13-32-1-25 WPM	83.797	480	2330	138.8	#	7-2-2-26 WPM	38.339	528	6955	63.5
16-11-1-26 WPM	0.000	0	0	0.0	#	15-2-2-26 WPM	26.732	288	2983	44.3
5-13-1-26 WPM	0.000	0	0	0.0	#	7-3-2-26 WPM	50.447	600	5224	83.6
7-13-1-26 WPM	147.016	528	1095	243.5	#	13-3-2-26 WPM	84.311	696	1917	139.6
13-13-1-26 WPM	0.000	0	0	0.0	#	15-3-2-26 WPM	40.003	576	4483	66.3
15-13-1-26 WPM	0.000	0	0	0.0	#	5-4-2-26 WPM	19.320	168	2829	32.0
15-14-1-26 WPM	0.000	0	0	0.0	#	7-4-2-26 WPM	137.101	648	3393	227.1
7-23-1-26 WPM	0.000	0	0	0.0	# *	9A-23-1-26 WPM	0.000	0	0	0.0
13-23-1-26 WPM	98.934	456	5905	163.9	# *	1-24-1-26 WPM	0.000	0	0	0.0
15-23-1-26 WPM	0.000	0	0	0.0	# *	1-34-1-26 WPM	0.000	0	0	0.0
5-24-1-26 WPM	0.000	0	0	0.0	# SWD	7-18-1-25 WPM	1,558.227	720	0	2580.8
7-24-1-26 WPM	0.000	0	0	0.0	# SWD	1-30-1-25 WPM	3,882.300	720	0	6430.2
13A-24-1-26 WPM	49.227	120	6880	81.5	# SWD	7-11-2-26 WPM	164.000	54	0	271.6
15-24-1-26 WPM	0.000	0	0	0.0	#					
5-25-1-26 WPM	75.624	216	56	125.3	#					
7-25-1-26 WPM	72.124	264	263	119.5	#	TOTALS:	9,365.030			15511.5
13-25-1-26 WPM	0.672	24	0	1.1	#					
15-25-1-26 WPM	0.000	0	0	0.0	# *	DENOTES MISSISSIPPIAN INJECTOR				
5-26-1-26 WPM	138.414	648	341	229.3	# SWD	DENOTES SALT WATER DISPOSAL WELL				
7-26-1-26 WPM	164.223	576	1763	272.0	#					
7-27-1-26 WPM	142.882	624	3142	236.7	#					
7-33-1-26 WPM	73.535	600	4768	121.8	#					
13-33-1-26 WPM	31.510	480	3505	52.2	#					
15-33-1-26 WPM	64.557	624	5767	106.9	#					
5-34-1-26 WPM	99.929	624	3515	165.5	#					
13-34-1-26 WPM	84.947	648	3593	140.7	#					
15-34-1-26 WPM	59.985	408	3329	99.4	#					
5-35-1-26 WPM	99.109	576	2387	164.2	#					
13-35-1-26 WPM	18.372	168	8943	30.4	#					
15-35-1-26 WPM	76.186	432	8311	126.2	#					

WASKADA WATER INJECTION SUMMARY FOR :November 1989

			HRS ON
SOURCE WATER:	11-30-1-25 WPM	0.0	0
	ENRON TRANSFER	-1355.5	

TOTAL SOURCE WATER = -1355.5 m^3 --- (1)

TOTAL PRODUCED WATER @11-30-1-25 WPM = 16867.0 m^3 --- (2) PROD WTR + INVENTORY (3)

TOTAL SOURCE WATER = -1355.5 m^3 metered on-lease tot.

TOTAL WATER INJECTED = 15511.5 m^3 --- (1+2)

PRORATION FACTOR = 15511.5 / 9365.030 ~ WIW + SWD wells

= 1.656321

OPENING LEASE TANK INVENTORY = 264.8 m^3

CLOSING LEASE TANK INVENTORY = 207.5 m^3

LEASE TANK H2O INVENTORY BALANCE = 57.3 m^3 --- (3)
(opening - closing)

TOTAL FIELD PRODUCED WATER = 16809.7 m^3 --- (2-3)

WATER INJECTED INTO LAm WATERFLOODS = 6228.9 m^3

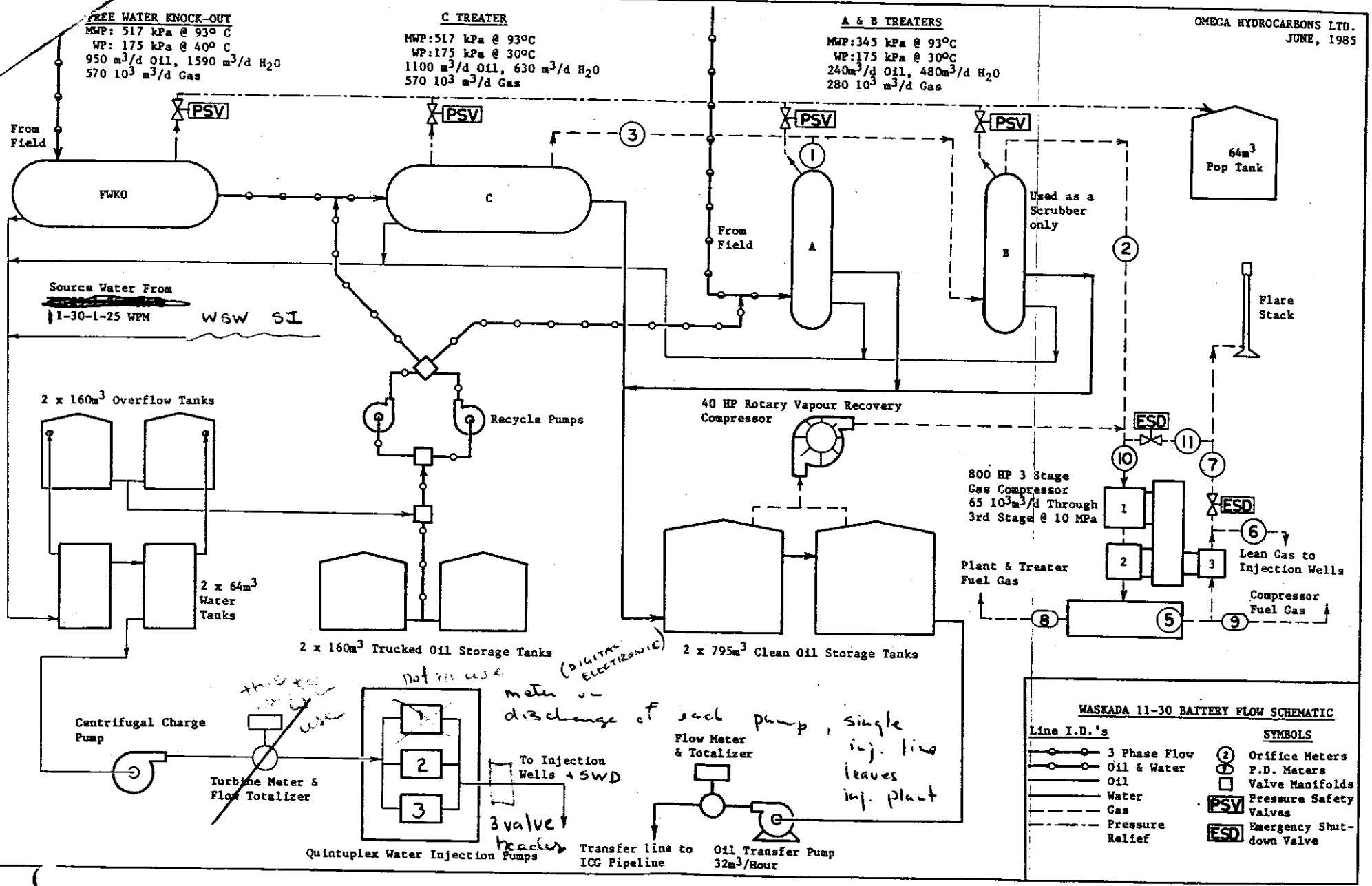
WATER INJECTED INTO MC WATERFLOODS = 0.0 m^3

WATER INJECTED INTO SWD WELLS = 9282.6 m^3

---

metering @ SWD wells critical - 60% of wtr vol

OMEGA HYDROCARBONS LTD.
JUNE, 1985



JOHN GOLDSWORTHY, OF THE CITY OF REGINA, MANITOBA LAND SURVEYOR,
AND SAY THAT I DID PERSONALLY SUPERINTEND THE SURVEY

HYDROCARBONS
TELEPHONE: (204) 673-3828 P.O. BOX 130, WASKADA, MANITOBA ROM 2E0

March 3rd, 1989.

Department of Energy & Mines,
Petroleum Branch,
Box 222,
Waskada, Manitoba,
ROM 2EO.

Attention: Ian McGregor
Petroleum Inspector

Dear Sir:

Re: Battery Modifications

As per your letter of January 10, 1989 I am enclosing updated battery and water injection plans for 11-30-1-25 location.

The water, oil and gas flowlines have been drawn on separate schematics for clarity.

Also enclosed is an equipment list and capacities located at 11-30-1-25 Battery.

Yours truly,

Stan Nafe,
Plant Foreman.

SN/sw

attachment/8

OMEGA WASKADA
OIL PRODUCTION

Treating System:

Free Water Knock-out (north) (horizontal):

Larsen and D'Amico
Serial #T4939
Volume - 75.5m
Size - 12' x 36'
Maximum Pressure - 50 psi
Working Pressure - 37 psi @ 90°F

Free Water Knock-out (south) (horizontal):

C.E. Natco
Serial #LM1967
Volume
Size
Maximum Pressure - 75 psi @ 93°C
Working Pressure - 36 psi @ 35°C

Horizontal Treater:

C.E. Natco
Serial #L-8-165
Volume
Size - 2,438mm x 9,144mm
Maximum Pressure - 75 psi
Working Pressure - 30 psi @ 36°C

Vertical Treater:

C.E. Natco
Serial #L-8-157
Volume
Size - 2,438mm x 8,382mm
Maximum Pressure - 345 kPa @ 93°C
Working Pressure - 220 kPa @ 44°C

Gas Boot:

Constructed on site
Volume - 25 Bbls.
Size - 30' x 30'
Working Pressure - 2 ozs.

Storage:

2 - 5,000 Bbl. production tanks
5 - 1,000 Bbl. emulsion tanks
3 - 500 Bbl. emulsion tanks
1 - 400 Bbl. pop tank
1 - 40 Bbl. pop tank (satellite)

Pumping:

2 - 5 H.P. Robbins & Meyers moyno recycle pumps
Maximum capacity - 12m³/hr. each
Working capacity - 10m³/hr. each

Lykes:

Tank Farm:

Length - 190 ft.
Width - 98 ft.
Height - 4 ft.

Metering:

Shipping oil - I.C.G. Unit:

Bi-Rotor
Minimum Capacity - 320 L/minute
Maximum Capacity -1,600 L/minute

2 - pumps - 20 H.P. - 1,730 R.P.M.
Maximum Capacity - 33m³/hour each
Working Capacity - 24m³/hour each

OMEGA WASKADA
WATER INJECTION

Inlet:

Maximum Capacities:

Battery Produced Water		1,000m³/day
11-30-1-25 Source Well		250m³/day
	Sub-total	1,250m³/day
Other - 11-22-1-26		250m³/day
	Total	1,500m³/day

Working Capacities:

Battery Produced Water		650m³/day
11-30-1-25 Source Well		170m³/day
	Sub-total	820m³/day
Other - 11-22-1-26		0m³/day
	Total	820m³/day

Storage:

2 - 1,000 Bbl.	Overflow Tanks	159.0m³
2 - 400 Bbl.	Skim Tanks	63.6m³
1 - 400 Bbl.	Suction Tanks	63.6m³
	Total Storage Capacities	286.2m³

Injection Pumps:

2 - 150 H.P. Nationals
Working Capacities - 1 @ 800m³/day
Maximum Capacities - (x2) 1,000m³/day — 800m³/day

1 - 125 Wheatley
Capacities
Maximum Capacities - 500m³/day — 500m³/day

Sub-total 1,200m³/day

Other:

1 - 100 H.P. National Pump
Maximum Capacity — 800m³/day

Disposal Wells:

Maximum Capacity:

1-30-1-25 - 250 + m³/day
7-11-2-26 - 60 + m³/day

Working Capacity:

1-30-1-25 - 170m³/day
7-11-2-26 - 0m³/day

attachment/2

..etering:

Battery Produced Water
Source Well
Disposal Wells
Individual Injection Wells

Overflow provisions are provided from the skimmer tanks plus the suction tank to the overflow tanks.

Alarm Systems:

Connected to the Process Alarm System which alarms Local or to Remote Radio System.

Locations of Alarms:

High Level Suction Tank - tank height - 5m
- alarm height - 4.20m

High Level Overflow Tank - tank height - 5m
- alarm height - 2.40m

High Water Sump Level

Emergency Shut-down on Injection Pumps

OMEGA WASKADA
GAS GATHERING SYSTEM

Pressure Relief Valves:

Horizontal Treater - Maximum Pressure - 50 psi (344 kPa)

Vertical Treater - Maximum Pressure - 50 psi (344 kPa)

Free Water Knock-out - South - Maximum Pressure - 50 psi (344 kPa)
- North - Maximum Pressure - 50 psi (344 kPa)

Storage:

1 - 400 Bbl. pop tank

Flare Pit - Height - 10 ft.
Width - 70 ft.
Length - 30 ft.

Metering:

Orifice run (chart drive) located in Gas Plant
Orifice run (chart drive) located on each Treater

Compressor:

Located in Vapour Recovery Unit
40 H.P. unit
Working Pressure - 210 kPa @ 80°C

Separator:

Bennitt & Emmott Ltd.
Maximum Working Pressure - 97 kPa
Maximum Temperature - 121°C
Working Pressure

attachment/3

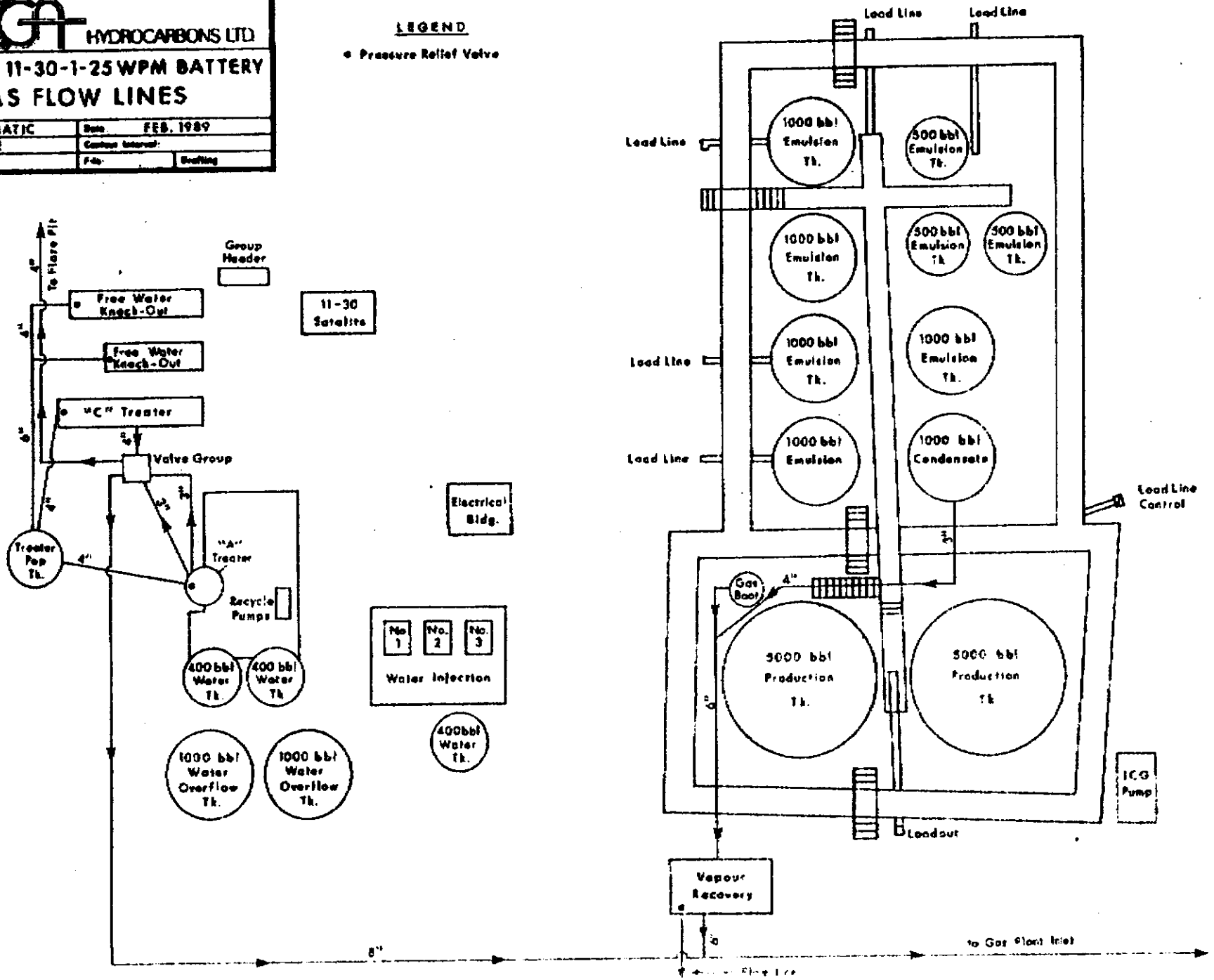
OMEGA HYDROCARBONS LTD

WASKADA 11-30-1-25 WPM BATTERY
GAS FLOW LINES

Scale:	SCHEMATIC	Date:	FEB. 1989
By:	S. NAPE	Contour Interval:	
Revised:		File:	Drafting

LEGEND

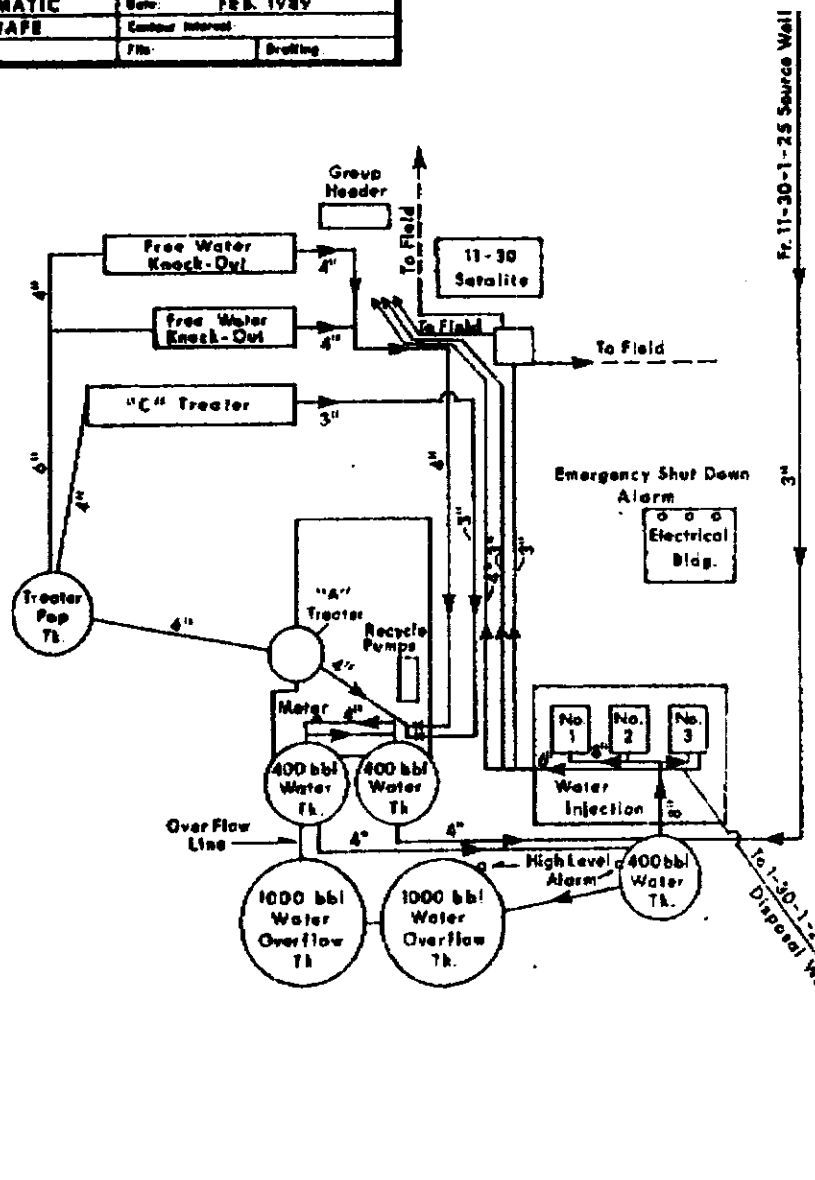
● Pressure Relief Valve

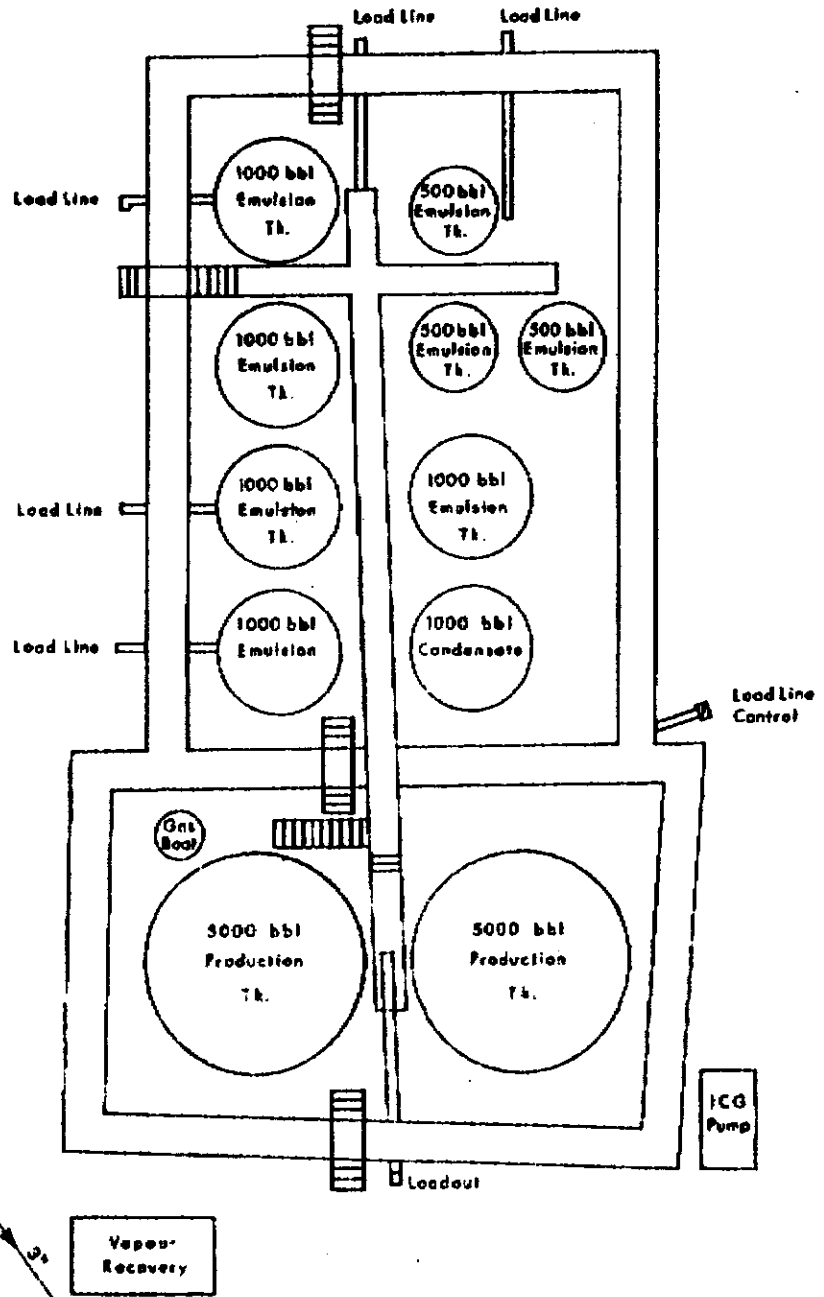


OMEGA HYDROCARBONS LTD.

WASKADA 11-30-1-25 WPM BATTERY
WATER FLOW LINES

Scale:	SCHEMATIC	Date:	FEB. 1989
By:	S. NAFE	Contour Interval	
Revised:		File:	Drafting



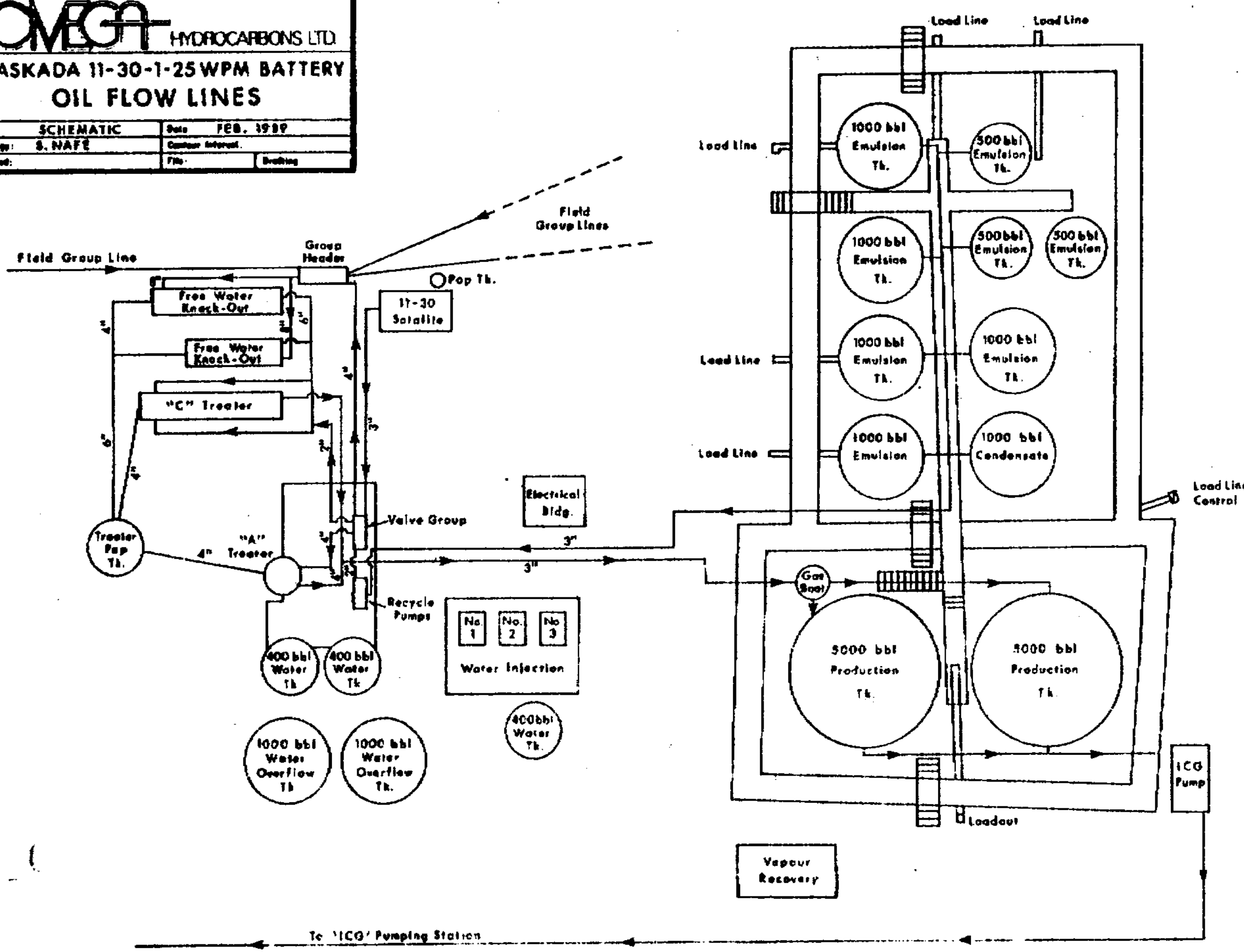


OMEGA HYDROCARBONS LTD.

WASKADA 11-30-1-25 WPM BATTERY

OIL FLOW LINES

Scale: SCHEMATIC	Date: FEB. 1989		
Geology: S. NAFE	Contour Interval:		
Revised:	File:	Drafting	



OMEGA
HYDROCARBONS LTD

1300 SUN LIFE PLAZA III
112 - 4th AVENUE S.W.
CALGARY, ALBERTA, CANADA T2P 0H3
TELEPHONE (403) 261-0743

May 27, 1988

MANITOBA PETROLEUM BRANCH
555 - 300 Graham Avenue
Winnipeg, Manitoba
R3C 4E3

Attention: Mr. Bob Dubreuil
Chief Petroleum Engineer

Dear Sir:

Re: Waskada Proration Factors

This letter is in response to your concerns regarding the proration factors in the Waskada field. After a thorough review of our operational procedures and production accounting system we have identified three possible causes for the prorationing problems; 1) meter calibration 2) water cut determination and 3) lease tank production.

During November and December 1987 all the test satellite meters at Waskada were recalibrated by Raybern Meter & Controls Ltd. Several of the meters were found in poor working order and have subsequently been repaired. As shown in Attachment 1 the sum of the oil and water proration factors has shown a marked improvement since the recalibration program was completed. Omega intends to maintain the accuracy of the satellite meters by recalibrating each meter on a semi annual basis. To ensure measurement accuracy at the 11-30-1-25 WPM Battery the oil sales meter and the total water production meter will continue to be recalibrated on a monthly basis and a quarterly basis, respectively.

Water cut determinations at the test seperators and at the lease tank wells have historically been a problem at Waskada due to wellbore slugging and tight emulsions. Wellbore slugging has been minimized by endeavouring to pump off the production wells. Several different methods of breaking the emulsions at Waskada have been tried but regardless of the amount of heat and/or chemicals used we have found that on some wells a certain portion of the sample has not broken. This portion has been classified 50/50 oil and water. Recent tests performed on this tight emulsion indicate that the split should be nearly 100% water and this change has been instituted.

. . . / 2

In our review of the existing production accounting system it was noted that production from the lease tank wells are assumed to be measured or 100% accurate while the tied in wells are prorated. We have commenced work on three projects to verify the accuracy of the recorded production for the lease tank wells. This includes a review of water cut procedures, trucking from a wellsite sales tank and additional measurement at the Battery level.

By August of this year Omega believes that it will be in a position to assess the strategies that have been implemented and to determine if further action is required. If you have any questions or comments please feel free to contact Mr. Richard Brekke in our Calgary office.

Yours truly,

OMEGA HYDROCARBONS LTD.

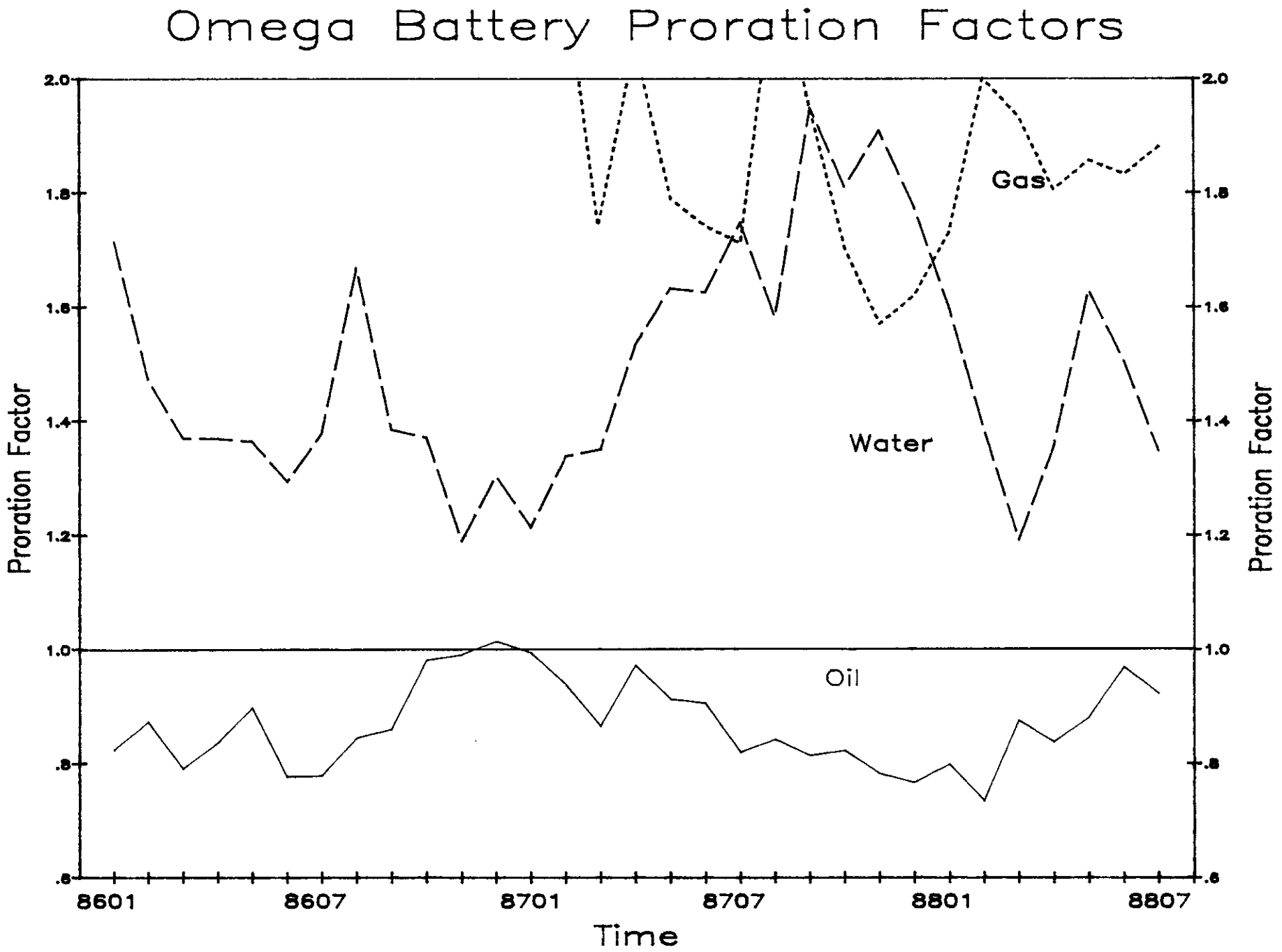
G. A. Cormack
Manager, Production Operations

c.c.: W. Sharp
R. Brekke
D. Boyko/D. Sharp
Waskada Production Accounting File

WASKADA PRORATION FACTOR HISTORY

****

	OIL	H20	GAS	TOTAL FLUID
JAN 1986	0.82366	1.71506	2.35718	2.53872
FEB	0.87276	1.47369	2.33496	2.34645
MAR	0.79002	1.36987	2.45664	2.15989
APR	0.83575	1.36909	2.49678	2.20484
MAY	0.89712	1.36402	2.58715	2.26114
JUN	0.77541	1.29364	2.47377	2.06906
JUL	0.77622	1.37837	2.38955	2.15659
AUG	0.84445	1.66901	2.56436	2.51346
SEPT	0.84745	1.39623	2.42509	2.24368
OCT	0.98063	1.37094	2.72868	2.35159
NOV	0.99061	1.19023	2.57198	2.18084
DEC	1.01444	1.40440	2.30147	2.41884
YEARS AVG.	0.87088	1.41621	2.47397	2.28709
JAN 1987	0.99331	1.21389	2.03963	2.20720
FEB	0.93748	1.33884	2.17620	2.27632
MAR	0.86417	1.35148	1.74081	2.21565
APR	0.92706	1.53557	2.06348	2.46263
MAY	0.91199	1.63305	1.79272	2.54504
JUN	0.90475	1.62545	1.73849	2.53020
JUL	0.81856	1.74834	1.71070	2.56690
AUG	0.84251	1.58203	2.20027	2.42454
SEPT	0.81279	1.66123	1.94851	2.47402
OCT	0.82278	1.81050	1.69580	2.63328
NOV	0.78130	1.90973	1.57403	2.69103
DEC	0.76530	1.77619	1.62016	2.54149
YEARS AVG.	0.86517	1.59886	1.85840	2.46403
JAN 1988	0.79862	1.59908	1.73097	2.39770
FEB	0.73380	1.38368	2.00379	2.11748
MAR	0.87521	1.19226	1.93197	2.06747
APR	0.83658	1.35435	1.80453	2.19093
MAY				
JUN				
JUL				
AUG				
SEPT				
OCT				
NOV				
DEC				
YEARS AVG.	0.81105	1.38234	1.86782	2.19339


Omega Battery Proration Factors
2.0
1.8
1.6
1.4
1.2
1.0
.8
.6
Proration Factor
Gas
Water
Oil
8601
8607
8701
8707
8801
8807
Time

Manitoba

Energy and Mines | Petroleum

555 — 330 Graham Avenue
Winnipeg, Manitoba, CANADA
R3C 4E3

(204) 945-6577

April 19, 1988

Omega Hydrocarbons Ltd.
1300, 112 - 4th Avenue S.W.
CALGARY, AB T2P 0H3

Attention: Mr. Gordon Cormack
Manager, Production Operations

Re: Proration Factors - Waskada Battery

Attached is a graph showing reported proration factors for oil, gas and water for your Waskada battery in Lsd. 11 of Section 30-1-25 (WPM). Continued deterioration of these factors would suggest unsatisfactory production measurement practices and/or facilities.

Because production from different Units and non-unit wells is commingled prior to measurement, the indicated inaccuracies in production measurements give rise to serious correlative rights concerns. Further, such measurement inaccuracies make it virtually impossible to optimize reservoir management. For these reasons, improved production measurement in your Waskada Field operations is considered to be a necessary priority.

You are therefore requested to proceed with any and all steps necessary to improve production measurement to an acceptable level and to report to this office prior to June 1, 1988, the results of your actions and a specific plan to ensure continued acceptable production measurement.

Yours sincerely,

L.R. Dubreuil
Chief Petroleum Engineer
Petroleum Division

LRD:dah

cc: Waskada Office

Omega Battery Proration Factors

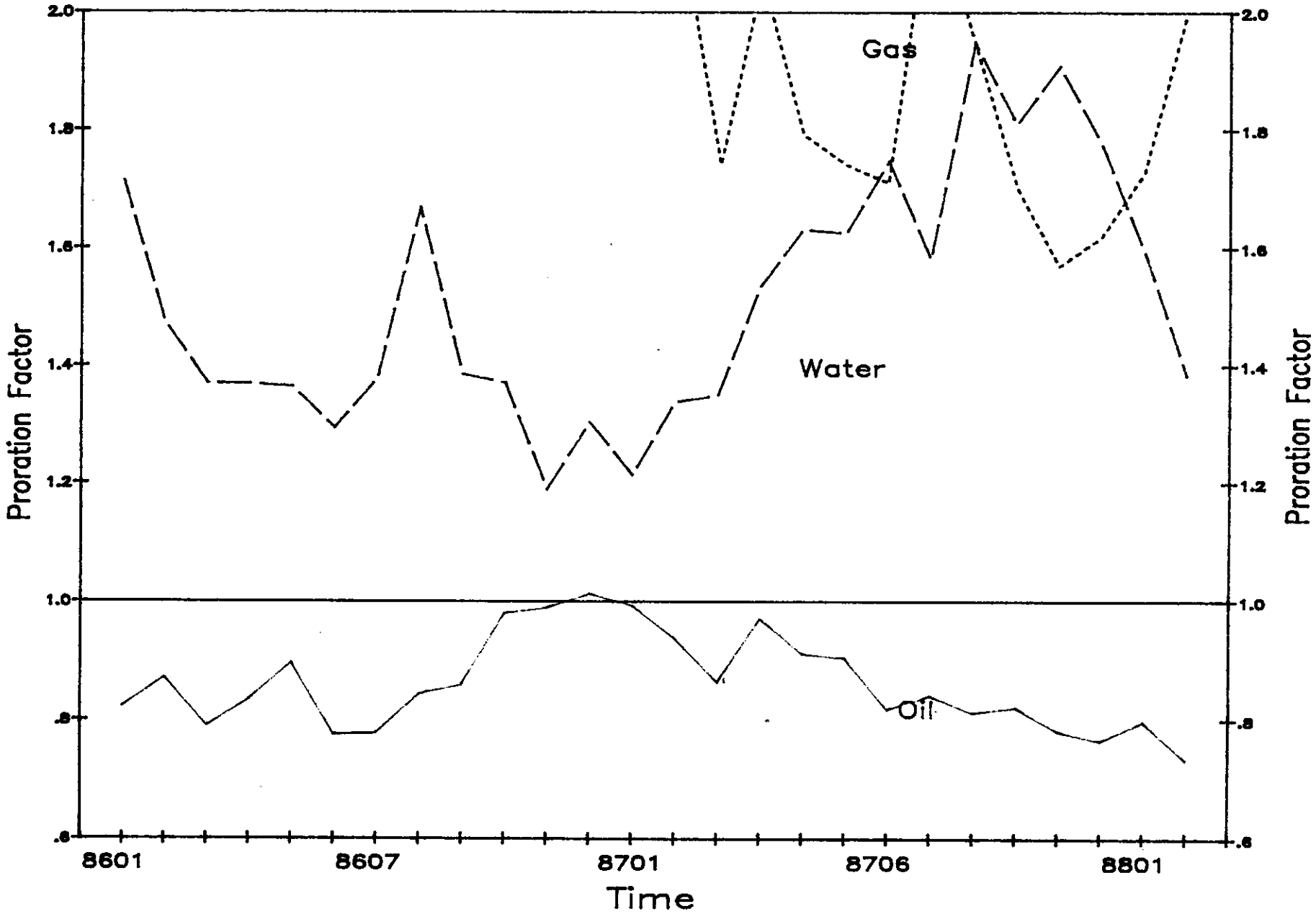


Table No. 1

Omega Waskada 11-30-1-25 (WPM)

Proration Factors

1986	Oil	Water
January	.823658	1.715062
February	.872757	1.473688
March	.790002	1.369867
April	.835750	1.369085
May	.897116	1.364023
June	.775412	1.293644
July	.778221	1.378368

Omega Proration Factors

	O	G	W
Jan 88	~~.798622~~ ~~.76530~~	~~1.930972~~ ~~1.620161~~	~~1.599076~~ ~~1.776188~~
Dec 87	.76530	1.620161	1.776188
Nov	.781298	1.574028	1.909727
Oct	.822782	1.695800	1.810499
Sept	.812792	1.948511	1.661236
Aug	.842512	2.200270	1.582030
Jul	.818563	1.710701	1.748335
Jun	.904753	1.738492	1.625446
May	.911992	1.792717	1.633048
Apr	.927063	2.063483	1.535569
Mar	.864169	1.746806	1.351479
Feb	.937484	2.176199	1.338838
Jan	.993310	2.039627	1.213888

Feb 88	.733798	2.003793	1.383677

Exxon 15-9 Battery
Proration Factors

	O	G	W
Feb	1.011329	1.101399	1.038853
Jan	.983103	1.280835	1.182848
Dec 87	.966398	1.465580	1.140167
Nov	.983690		1.161275
Oct	1.047568	1.544872	1.051442
Sept	0.995328	1.377778	.895918
Aug	.930861	1.211538	1.008161
July	.978748	1.460208	1.045546
Jun	1.023821	1.550877	1.060850
May	1.028121	1.479495	.923281
Apr.	1.014367	1.391566	1.079519
Mar	.979607	2.163265	1.046072
Feb	.896133	2.190104	1.712655
Jo	.944344	3.498442	1.457404