

ALASKA LEGISLATURE COMMITTEE FILES, 1989-1990 8672
6457 SENATE RESOURCES

867

TESTIMONY OF MARK NECESSARY
Tesoro Alaska Petroleum Company

Before the
Senate Resource Committee
and
Senate Special Committee on Oil & Gas

September 20, 1990
Fairbanks, Alaska

"Economic Consequences of a Shut Down of the
Trans Alaska Pipeline"

BACKGROUND

Tesoro Alaska employs two hundred Alaskans and operates a 80,000 BPD refinery north of Kenai, Alaska producing motor fuels, jet fuels, heating oils, propane and other petroleum products that are distributed throughout the state of Alaska. Tesoro also produces residual fuel oil which is exported to the Far East. Approximately 85% of Tesoro's crude oil feedstock is Alaska North Slope (ANS) [45,000 BPD ANS is obtained from the State of Alaska under the current royalty oil contract].

Tesoro's crude oil storage capacity is approximately 900,000 barrels which represents approximately 10 days of operation. The typical inventory provides five days of operation which coincides with the frequency of oil tanker deliveries from Valdez.

EFFECTS OF ALYESKA PIPELINE SHUTDOWN

A. Planned Shutdowns

In the event adequate notice is provided (at least sixty days notice) it is possible to replace the ANS with other crude oils; however there are considerable limitations on the types of crude oil that can be processed at Tesoro's refinery which was expanded and modernized in the mid 1980's to specifically handle ANS.

B. Unplanned Shut Downs [Any shutdown occurring with less than sixty days notice].

The total economic impact to Tesoro Alaska and the State of Alaska would increase as the duration of the shutdown increases as well as the time of year of the shutdown. I have provided three scenario's that illustrate potential economic impacts of a shutdown.

No. 1: A shutdown of five (5) days in June.

Expected Effects:

1. Shortage of at least 350,000 bbls to Tesoro necessitating reduction in refinery throughput from 80,000 bbls/day to 50,000 bbls/day with all downstream units reduced to minimum thruputs causing a shortage of refined products that would potentially prevent meeting contractual commitments for all products.
2. There is a real possibility of a shutdown within 10 days depending on vessel availability and congestion at Valdez. (Tesoro actually ran out of ANS crude after the Exxon Valdez accident and had to substitute ANS with one cargo of Cook Inlet crude.)
3. The refinery would also be subject to costs associated with delays incurred by vessels already scheduled to lift refined products (Tanker costs approximately \$20,000 per day).

No. 2: A shutdown of fifteen (15) days in April.

Expected Effects:

1. Shortage of at least 1,050,000 bbls necessitating reduction of throughputs from 80,000 to 50,000 for 5 to 8 days and shutdown of the refinery on the 8th day following termination.
2. A shutdown of TAPS for 15 days would cause major supply problems on the west coast as well as Alaska. It is expected that these supply problems could cause the duration of shutdown to be as much as 30 days as the earliest foreign crude could be obtained would be in the 30-45 day range.
3. Weekly operating costs during a shut down would be in the range of \$500,000.
4. Reduction of jet fuel product availability to the Anchorage Airport from the current levels of 12-15,000 bbls/day which would have potentially permanent impact for some air freight operations.
5. There would be even more costly interruptions in the marine vessel schedules which would cause demurrage claims as referenced in the first scenario.

6. Significant cost exposure for freeze protection at the refinery with potential equipment damage related to cold weather shutdowns.
7. Real potential for state wide gasoline shortages for all grades of gas.

No. 3: A shutdown of thirty (30) days at any time.

Expected Effects:

1. A shortage of at least 2,100,000 bbls resulting in a reduction of thruputs to 50,000 bpd for 8 days and a total refinery shutdown thereafter
2. The shutdown would be expected to continue for 30 - 45 days with a minimum cost in the range of 1.8 to 2.7 million dollars at the refinery alone.
3. A 30 day shutdown of the pipeline would have permanent effects on our crude supply and transportation system. A loss of 1.8 mbd for any length of time would cause major supply problems on the entire U.S. West Coast. There would be a resultant scramble for crude oil and products in the Pacific Rim. Tesoro's ability to compete for the remaining available supplies would be affected by the increasingly difficulties in getting shippers to operate in Alaska. The ultimate effect expected is that we would have to pay higher than market prices to cover our needs.
4. There would be a reduction of gasoline in excess of 400,000 bbls; 500,000 bbls of jet fuel; 200,000 bbls of diesel and two complete cargos of fuel oil exports to the Far East.
5. If the interruption occurred in the winter there could be high costs associated with freeze protection as well as increased hazards in starting the refinery after supplies are reestablished.

CONCLUSION

The statewide petroleum product shortages would have a major negative impact on Alaska's economy in general and would especially hit the air transportation market hard. Tesoro would be faced with the potential of a vast increase in operating costs that would in no way be offset by revenues. It should be noted that Tesoro's interruption could also impact the retail availability of gasoline thruout the state at Tesoro, 7-11, and several of the other major retailers in Alaska.

STATE OF ALASKA

DEPARTMENT OF REVENUE

OFFICE OF THE COMMISSIONER

STEVE COWPER, GOVERNOR

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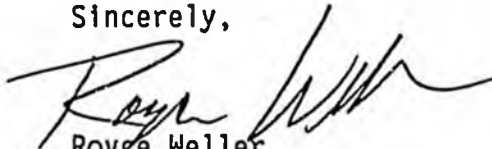
September 13, 1990

The Honorable Bettye Fahrenkamp
Alaska State Senate
119 N. Cushman St., Suite 201
Fairbanks, Alaska 99702

Dear Senator Fahrenkamp:

The enclosed narrative was prepared for your hearing scheduled September 20th. Chuck Logsdon, senior petroleum economist, will also be available to address any technical questions you, other committee members or staff may have.

Sincerely,



Royce Weller
Assistant Commissioner

RW/sp

Enclosure

90-120

DEPARTMENT OF REVENUE COMMENTS CONCERNING OIL PRODUCTION—REVENUE
CONSEQUENCES OF DISRUPTION AND MONITORING ADEQUACY

Disruption

From time to time there have been disruptions in production flow through the pipeline. The causes are varied; scheduled or unscheduled maintenance, the grounding of the EXXON VALDEZ, regulatory disputes over air quality and the invasion of Panama. Because oil production from the North Slope is in decline due to the decline in the mammoth Prudhoe Bay field, these disruptions cannot be made up quickly. As a result, any disruption in the flow of oil down the pipeline has negative impacts on the amount of ANS moved to market and therefore reduces State revenues. Assuming production of 1.8 million bbl/day and \$15/bbl wellhead value, total disruptions in pipeline throughput would cost the State \$6.75 million per day, \$47.25 million per week, or \$205.9 million per month.

This negative impact does not include the indirect impact of production disruption on the TAPS pipeline tariff. The fewer the number of barrels that flow through the pipeline, the larger the cost per barrel to ship the oil from the North Slope to Valdez. Because the taxpayer can deduct the cost of pipeline transportation to arrive at the wellhead value, this reduces the production tax and the State's royalty value. It is estimated that the 1989 disruption in output caused by the EXXON VALDEZ accident plus unexpected adverse summer operating conditions added nearly \$.20/bbl to the cost of shipping oil off the North Slope in 1990 since Alyeska is allowed to capture the increased cost against barrels shipped in the following year.

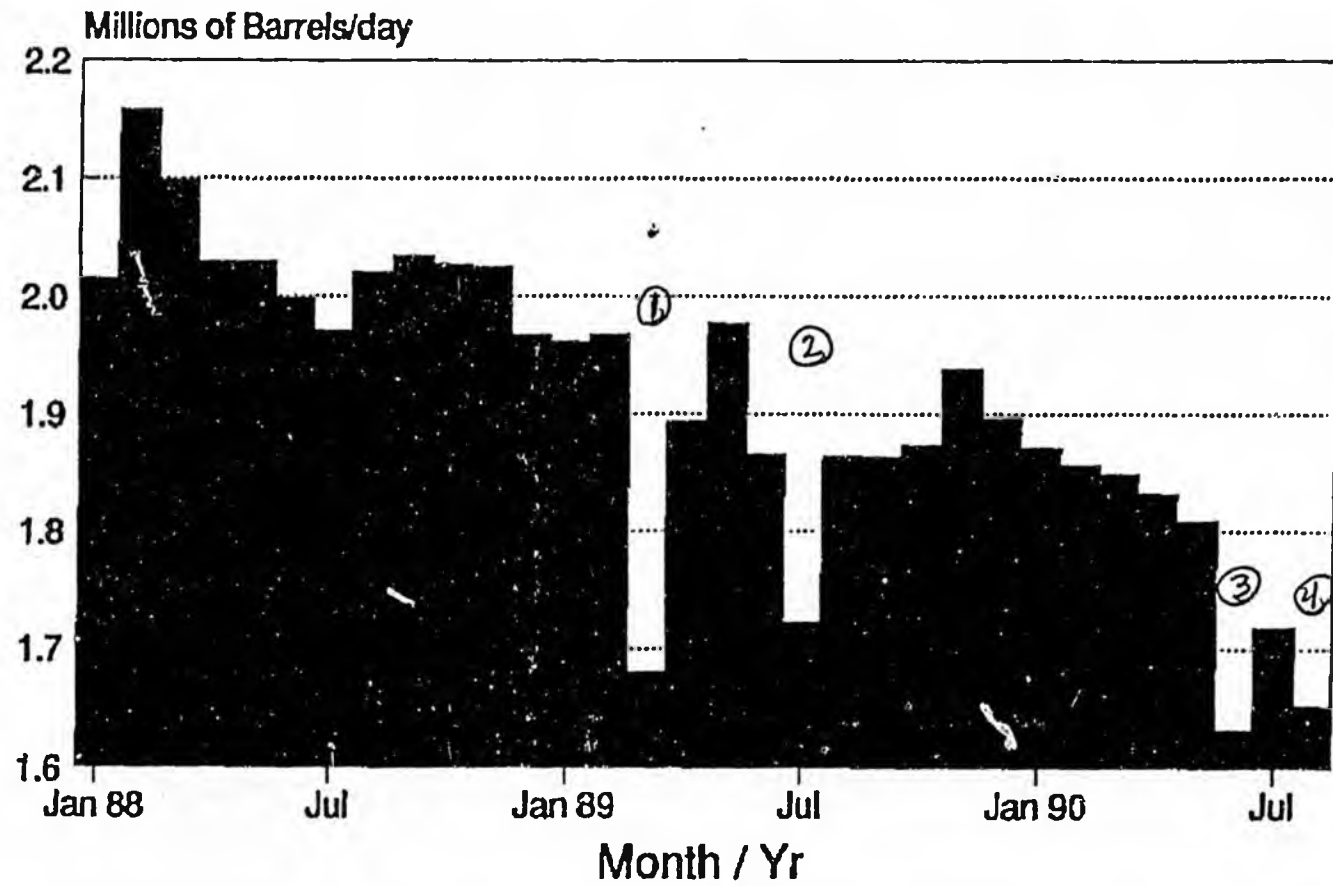
Monitoring

The Department of Revenue reconciles the reported amount of taxable oil production with the production allocation reports used by the oil field operators to allocate production among working interest owners. These production amounts are also compared with the production reported by the oil field operators to the Alaska Oil and Gas Conservation Commission (Form 10-405). This reconciliation occurs as the production tax is received on a monthly basis. The tax is due one month after the month in which the oil is produced so the Department has current information on oil production on a one month lagged basis.

In contrast, the oil and gas corporate income tax (extraction factor) is reconciled to production statistics on an annual basis. The production source data, however, is the same.

Both audit divisions can, and often do supplement the above data with current oil production information held by the Department of Natural Resources Division of Oil and Gas.

Alaska North Slope Oil Production



Source: Alaska Department of Revenue

Note: August 1990 is preliminary data

ANS Production

Month	Millions of Barrels per Day
Jan 88	2.015
Feb	2.158
Mar	2.099
Apr	2.030
May	2.030
Jun	1.998
Jul	1.971
Aug	2.021
Sep	2.035
Oct	2.027
Nov	2.025
Dec	1.967
Jan 89	1.952
Feb	1.968
Mar	1.680
Apr	1.894
May	1.977
Jun	1.866
Jul	1.722
Aug	1.864
Sep	1.864
Oct	1.874
Nov	1.939
Dec	1.896
Jan 90	1.871
Feb	1.857
Mar	1.849
Apr	1.832
May	1.809
Jun	1.632
Jul	1.718
Aug	1.652

Note: August 1990 is preliminary data

9/6/90 11:45am

 FAX TRANSMITTAL MEMO
 TO: Royce Weller
 DEPT: _____ FAX #: 965-2389
 FROM: Chuck /Phyllis PHONE: 277-5627
 CO: _____ FAX #: 278-5026
 Post-It brand fax transmittal memo 7671

NO. OF PAGES
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**Expected and Historical Crude Oil Prices
For Alaska North Slope Crude and OPEC Marker
In 1989 constant \$/barrel**

Fiscal Year	Low Scenario		Mid Scenario		High Scenario	
	Saudi Lt Ras Tanura	ANS at Wellhead	Saudi Lt Ras Tanura	ANS at Wellhead	Saudi Lt Ras Tanura	ANS at Wellhead
1990	16.18	11.80	16.33	12.15	16.37	12.46
1991	15.35	10.90	16.95	12.83	17.95	14.54
1992	14.91	11.26	17.08	13.78	17.93	15.24
1993	14.49	11.04	17.19	13.95	18.26	16.65
1994	14.37	11.13	17.34	14.29	18.48	16.61
1995	14.26	11.06	17.49	14.41	18.69	17.03
1996	14.18	11.21	17.68	14.75	18.98	17.68
1997	14.10	11.41	17.85	15.17	19.28	18.37
1998	14.03	11.44	18.02	15.44	19.57	18.84
1999	13.96	11.35	18.20	15.63	19.88	19.27
2000	13.87	11.07	18.38	15.46	20.19	19.33
2001	13.83	10.83	18.53	15.45	20.50	19.49
2002	13.72	10.51	18.58	15.42	20.81	19.78
2003	13.61	10.16	18.63	15.42	21.12	20.07
2004	13.50	9.71	18.68	15.44	21.45	20.39
2005	13.38	9.11	18.73	15.50	21.77	20.80
2006	13.27	8.15	18.78	15.55	22.10	21.15
2007	13.16	6.40	18.83	15.53	22.44	21.51
2008	13.06	3.61	18.88	15.51	22.78	21.85
2009	12.95	4.19	18.93	15.47	23.13	22.25
2010	12.84	4.50	18.97	15.38	23.48	22.61

**Simulated Oil Production
(Millions of barrels/day)**

Low Scenario

	Prudhoe	NGL's	Kuparuk	Millne Point	Endicott	Lisburne	West Sak	North Star	Niakuk	Pt McIntyre	Total ANS	Cook Inlet	Total Alaska
1989	1.48	0.06	0.30	0.00	0.10	0.04	0.00	0.00	0.00	0.00	1.97	0.00	1.97
1990	1.32	0.04	0.29	0.02	0.10	0.04	0.00	0.00	0.00	0.00	1.80	0.00	1.80
1991	1.17	0.04	0.26	0.03	0.10	0.04	0.00	0.00	0.00	0.00	1.63	0.00	1.63
1992	1.07	0.04	0.24	0.03	0.09	0.04	0.00	0.00	0.00	0.00	1.49	0.00	1.49
1993	0.98	0.03	0.22	0.03	0.07	0.04	0.00	0.00	0.00	0.00	1.36	0.00	1.36
1994	0.95	0.03	0.18	0.02	0.06	0.03	0.00	0.00	0.02	0.05	1.34	0.00	1.34
1995	0.85	0.03	0.15	0.02	0.06	0.03	0.00	0.00	0.02	0.05	1.20	0.00	1.20
1996	0.76	0.03	0.13	0.02	0.05	0.03	0.00	0.00	0.02	0.05	1.07	0.00	1.07
1997	0.64	0.03	0.11	0.01	0.05	0.03	0.00	0.00	0.02	0.04	0.79	0.00	0.79
1998	0.54	0.02	0.10	0.01	0.04	0.02	0.00	0.00	0.02	0.04	0.67	0.00	0.67
1999	0.46	0.01	0.08	0.01	0.04	0.02	0.00	0.00	0.02	0.04	0.56	0.00	0.56
2000	0.38	0.01	0.07	0.00	0.04	0.02	0.00	0.00	0.02	0.04	0.48	0.00	0.48
2001	0.32	0.01	0.06	0.00	0.03	0.02	0.00	0.00	0.01	0.04	0.42	0.00	0.42
2002	0.28	0.01	0.05	0.00	0.03	0.01	0.00	0.00	0.01	0.03	0.36	0.00	0.36
2003	0.24	0.01	0.04	0.00	0.03	0.01	0.00	0.00	0.01	0.03	0.31	0.00	0.31
2004	0.20	0.01	0.04	0.00	0.02	0.01	0.00	0.00	0.01	0.03	0.26	0.00	0.26
2005	0.16	0.01	0.03	0.00	0.02	0.01	0.00	0.00	0.01	0.03	0.20	0.00	0.20
2006	0.12	0.00	0.03	0.00	0.02	0.01	0.00	0.00	0.01	0.02	0.15	0.00	0.15
2007	0.08	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.02	0.10	0.00	0.10
2008	0.04	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.02
2009	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.02
2010	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.02

**Simulated Oil Production
(Millions of barrels/day)**

Mid Scenario

	Prudhoe	NGL's	Kuparuk	Milne Point	Endicott	Lisburne	West Sak	North Star	Niakuk	Pt McIntyre	Total ANS	Cook Inlet	Total Alaska
1989	1.48	0.05	0.30	0.00	0.10	0.04	0.00	0.00	0.00	0.00	1.97	0.000	1.969
1990	1.33	0.05	0.27	0.02	0.10	0.04	0.00	0.00	0.00	0.00	1.83	0.041	1.873
1991	1.22	0.05	0.27	0.03	0.11	0.04	0.00	0.00	0.00	0.00	1.71	0.037	1.750
1992	1.11	0.04	0.25	0.03	0.11	0.04	0.00	0.00	0.00	0.00	1.57	0.034	1.607
1993	1.06	0.04	0.22	0.03	0.09	0.04	0.01	0.00	0.00	0.00	1.48	0.030	1.512
1994	0.97	0.03	0.19	0.03	0.08	0.04	0.01	0.00	0.02	0.06	1.42	0.027	1.447
1995	0.89	0.03	0.16	0.02	0.07	0.03	0.02	0.00	0.02	0.06	1.31	0.024	1.330
1996	0.82	0.02	0.14	0.02	0.07	0.03	0.02	0.00	0.02	0.06	1.20	0.022	1.221
1997	0.73	0.02	0.12	0.02	0.07	0.03	0.02	0.00	0.02	0.06	1.08	0.020	1.104
1998	0.67	0.02	0.10	0.01	0.07	0.03	0.04	0.00	0.02	0.06	1.00	0.018	1.022
1999	0.62	0.02	0.09	0.01	0.06	0.02	0.04	0.00	0.02	0.05	0.92	0.016	0.935
2000	0.56	0.01	0.07	0.01	0.05	0.02	0.06	0.05	0.02	0.05	0.90	0.014	0.911
2001	0.52	0.01	0.06	0.00	0.05	0.02	0.06	0.06	0.02	0.04	0.83	0.013	0.842
2002	0.45	0.01	0.05	0.00	0.04	0.02	0.08	0.06	0.02	0.04	0.76	0.012	0.774
2003	0.40	0.01	0.04	0.00	0.04	0.01	0.08	0.06	0.01	0.03	0.69	0.012	0.706
2004	0.36	0.01	0.04	0.00	0.03	0.01	0.11	0.05	0.01	0.03	0.65	0.009	0.663
2005	0.33	0.01	0.03	0.00	0.03	0.01	0.10	0.04	0.01	0.03	0.59	0.009	0.603
2006	0.29	0.01	0.03	0.00	0.03	0.01	0.15	0.03	0.01	0.03	0.58	0.008	0.588
2007	0.25	0.00	0.02	0.00	0.02	0.01	0.15	0.03	0.01	0.02	0.52	0.007	0.528
2008	0.21	0.00	0.02	0.00	0.02	0.01	0.15	0.03	0.01	0.02	0.47	0.006	0.478
2009	0.19	0.00	0.02	0.00	0.02	0.01	0.15	0.02	0.01	0.02	0.43	0.006	0.437
2010	0.16	0.00	0.01	0.00	0.01	0.01	0.14	0.02	0.00	0.02	0.38	0.005	0.388

**Simulated Oil Production
(Millions of barrels/day)**

High Scenario

	Prudhoe	NGL's	Kuparuk	Milne Point	Endcott/Lisburne	West Sak	North Star	Niakuk	Pt Mcfatrye	Total ANS	Cook Inlet	Total Alaska
1989	1.48	0.06	0.30	0.00	0.10	0.04	0.00	0.00	0.00	1.97	0.000	1.969
1990	1.34	0.05	0.30	0.02	0.11	0.04	0.00	0.00	0.00	1.87	0.041	1.908
1991	1.25	0.06	0.31	0.03	0.13	0.04	0.00	0.00	0.00	1.81	0.037	1.851
1992	1.15	0.06	0.30	0.04	0.12	0.04	0.00	0.00	0.00	1.70	0.034	1.732
1993	1.10	0.05	0.27	0.04	0.10	0.04	0.01	0.00	0.00	1.61	0.030	1.635
1994	1.06	0.05	0.23	0.03	0.09	0.04	0.01	0.00	0.03	1.67	0.027	1.701
1995	0.96	0.05	0.20	0.02	0.09	0.04	0.03	0.00	0.03	1.55	0.024	1.575
1996	0.89	0.04	0.17	0.02	0.08	0.04	0.04	0.00	0.03	1.45	0.022	1.474
1997	0.88	0.04	0.17	0.02	0.10	0.04	0.05	0.00	0.03	1.46	0.020	1.482
1998	0.79	0.04	0.15	0.02	0.09	0.03	0.07	0.00	0.02	1.33	0.018	1.346
1999	0.73	0.02	0.13	0.01	0.08	0.03	0.08	0.00	0.02	1.20	0.016	1.220
2000	0.66	0.02	0.11	0.01	0.07	0.03	0.09	0.08	0.02	1.19	0.014	1.199
2001	0.61	0.01	0.09	0.01	0.07	0.02	0.08	0.12	0.02	1.13	0.013	1.142
2002	0.55	0.01	0.08	0.01	0.06	0.02	0.10	0.12	0.02	1.05	0.012	1.057
2003	0.50	0.01	0.07	0.00	0.06	0.02	0.10	0.12	0.02	0.95	0.012	0.965
2004	0.44	0.01	0.06	0.00	0.05	0.02	0.12	0.11	0.01	0.88	0.009	0.892
2005	0.41	0.01	0.05	0.00	0.04	0.02	0.12	0.09	0.01	0.80	0.009	0.806
2006	0.36	0.01	0.05	0.00	0.04	0.02	0.17	0.08	0.01	0.77	0.008	0.779
2007	0.31	0.01	0.04	0.00	0.03	0.01	0.17	0.06	0.01	0.67	0.007	0.681
2008	0.26	0.01	0.04	0.00	0.03	0.01	0.17	0.05	0.00	0.61	0.006	0.614
2009	0.24	0.01	0.03	0.00	0.02	0.01	0.17	0.04	0.00	0.56	0.006	0.564
2010	0.22	0.01	0.03	0.00	0.02	0.01	0.21	0.04	0.00	0.55	0.005	0.551

SHORT TERM SHUTDOWNS

ALYESKA WANTS			D.E.C. WANTS	D.N.R. WANTS	O.P.S. WANTS
D.E.C. OPPOSES	D.N.R. OPPOSES	O.P.S. OPPOSES			
<p>Alyeska free to shut down on a temporary basis under state law.</p>			<p>Basis: Unlawful discharge of "oil" on lands of state</p> <p>Means: --injunctive relief</p>	<p>Basis: noncompliance with stipulations attached to R.O.W. lease or R.O.W. statute</p> <p>Means: --hearing on revocation or suspension --suspension before hearing in an emergency</p>	<p>Basis: same as D.N.R. and when there are hazardous safety conditions</p> <p>Means: --same as D.N.R. --cease and desist order for hazardous safety conditions</p>

LONG TERM SHUTDOWNS

Alyeska may not "abandon" or permanently discontinue" use without APUC approval based upon a finding that continued service is not required by the public convenience and necessity.

May be basis to prevent under both state and federal R.O.W. leases

Means:
--injunctive relief for violation of APUC notification; ROW leases

SENATE RESOURCES COMMITTEE
AND
SENATE SPECIAL COMMITTEE ON OIL AND GAS

JOINT HEARING

SEPTEMBER 20, 1990
9AM TO 4PM

NOEL WIEN LIBRARY, FAIRBANKS

PART II

SUBJECT: "MEASURING PIPELINE THROUGHPUT FOR THE PURPOSE OF
DETERMINING REVENUE."

WITNESSES SCHEDULED: JAMES EASON, DIRECTOR, DIVISION OF OIL &
GAS, ALASKA DEPARTMENT OF NATURAL
RESOURCES

BLAIR WONDZELL P.E., SENIOR PETROLEUM
ENGINEER, ALASKA OIL AND GAS CONSERVATION
COMMISSION

TOM CHAPMAN, PETROLEUM MEASUREMENT AND
CUSTODY TRANSFER TECHNICAL EXPERT.

Discussion Notes of
James E. Eason, Director
Division of Oil and Gas
Alaska Department of Natural Resources

Before the
Senate Resources Committee
and
Senate Special Committee on Oil and Gas

September 20, 1990

Are Present Methods of Measuring Throughput for the
Purpose of Determining Revenue Adequate?

(Afternoon Session)

1. The discussion of metering and volume accounting can be divided into three principal categories. First, are the meters and other hardware of acceptable quality? In a purely technical sense, can they do the job? Second, assuming that the meters are up to the job, are they maintained, monitored, calibrated and used in a correct fashion? Are the numbers properly collected and reported? Third and last, does the state understand and interpret the reported numbers in a correct fashion? Do AOGCC, DNR and DOR really understand the reports?
2. Are the meters and hardware up to job? While I have not personally reviewed the specifications of the meters used on the North Slope, I have no reason to believe that the best available equipment was not used. There was (and still is) too much at stake not to start with the best available equipment. The diverse ownership interests in the various fields and various pipelines on the North Slope result in a self-policing system in this regard. As a reminder, though, a meter that is designed to be accurate within one tenth of one percent should not be expected to be any more accurate than that design standard.
3. Are the meters being properly maintained and calibrated? Again, there is self policing in this regard, as well as regular monitoring by the AOGCC. The lease owners, purchasers, shippers, pipeline owners and the state are all interested in maintaining the integrity of the system. Too many parties use the metering results to allow any room for discrepancy. AOGCC is responsible for monitoring and surveillance of the metering on the state's behalf. I have no reason to believe that both the pipeline companies and the AOGCC are not doing a good job.
4. Does the state understand and audit the volume and metering reports that are filed each month? I can only speak to the reports that DNR receives in conjunction with its royalty accounting functions and those reports that are filed with the AOGCC that we in DNR also use. I have

every belief that AOGCC understands the reports that it receives and which we also review. We understand the volume and metering reports that are filed with the Division in conjunction with the monthly royalty reports. When questions arise, we consult with AOGCC and the producers to reconcile the specific concern. Extensive research conducted in association with the ongoing Amerada Hess royalty litigation has confirmed that there is not a volume accounting problem with respect to royalty oil. There are no orphan barrels, lost barrels or pirated barrels.

5. The respective AOGCC, DNR and DOR monthly volume numbers need not and will not be the same. Each agency has different standards and policies it uses to perform its functions. The AOGCC statutes and regulations, the DNR lease and the DOR statutes and regulations do not read the same. All parties involved should agree on the volume of material that comes out of the ground each month--although even there, there is a disagreement over whether to label certain liquids oil or gas. All parties can also agree on the volume number that each meter reads at the end of a day or a month. However, each agency follows its own path with respect to its own volume accounting in between the meter and the wellhead, and with respect to any adjustments that are made to the meter readings.
6. There are valid reasons why different volume numbers are reported to the different agencies. The produced volume, the volume subject to royalty and the volume subject to tax are not the same volume. AOGCC is concerned with a gross volume while DNR is interested in the net volume subject to royalty. Listed below are a few of the reasons why the "produced" volume figures for each of the agencies will not be the same.
 - a) One agency may label the fluid oil while a second agency may label the same fluid gas. A third agency may label the same fluid

NGLs. In this instance, the three agencies' net oil figure for the month will not be the same.

- b) Fuel use in the field is also treated differently by the agencies. DNR allows free fuel use for lease operations--no royalty is due on those hydrocarbons and they are not included in the totals for royalty obligations. AOGCC on the other hand has to include fuel use in its reservoir voidage figures since it represents produced (but not royalty reportable) hydrocarbons.
- c) Each agency uses its own labels and names for the fluids produced and reported in the fields. NGLs are a good example of this difference. The NGL totals may show up in the oil, gas or NGL column depending on the company, the agency and the reporting year. Just because the labels are different does not mean that one or the other is wrong.
- d) The crude oil topping plant output is also treated differently by the agencies. A portion of the output is not royalty bearing, but AOGCC is certainly interested in accounting for all the fluid that leaves the plant in order to correctly calculate reservoir voidage.
- e) Gas and liquids that are reinjected are not subject to royalty, yet these fluids show up on the appropriate AOGCC reports. Fluid losses in the field are also accounted for differently by DNR and the AOGCC.
- f) Each of the agencies has its own statutes, regulations and policies that it follows in accounting for oil and gas production. For royalty purposes, DNR also has to abide by the oil and gas lease contracts. Until all three agencies follow the exact same rules, the volume figures will always be different.

7. The oil that leaves Pump Station #1 is metered and accounted for. Likewise, the oil that leaves and returns to TAPS at the GVEA connection is metered and accounted for. We do not believe that there is a metering or volume accounting problem. Extensive auditing and independent accounting done in conjunction with the Amerada Hess litigation have confirmed that the numbers do make sense. If we thought that there was a problem, we would be doing something about it.
8. In order to be able to verify the reported figures, should the state install its own meters at Pump Station #1? The answer is obvious to me--NO. To do the job right we would have to install meters for each separate field and this would involve a lot of meters. It would take 16 separate LACT meters just to replicate the existing meter configuration at Pump Station #1. Having two meters at each field would be like having two watches on one arm. The numbers would never exactly match. Constantly checking and monitoring the accuracy of the existing meters is by far the better approach to proper volume accounting.
9. Metering and correct volume accounting are important issues, and we treat them seriously. The figures are desk audited every month. If there are problems identified, we take steps to correct them. There are provisions for more extensive audits to be performed for DNR by the Department of Revenue in conjunction with major royalty or net profit share lessee audits. Any problems identified during those audits can be addressed at that time.
10. Future commingling of production and shared production facilities will complicate the upstream accounting for oil and gas, but the meters at the point of tendering and the point of tendering itself will not change.

11. For the most part, downstream of the point of tendering we are not concerned with metering. We are interested in the meters at the GVEA connection since return oil is measured at that point. We are also concerned with downstream losses if they affect royalty value.

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STATE OF ALASKA

ALASKA OIL AND GAS CONSERVATION COMMISSION

STEVE COWPER, GOVERNOR

3001 PORCUPINE DRIVE
ANCHORAGE, ALASKA 99501-3192
PHONE: (907) 279-1433
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(907) 276-7542

SEP 18 1990

September 14, 1990

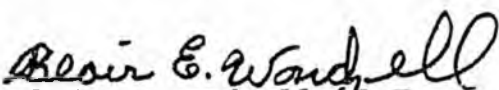
The Honorable Bettye Fahrenkamp
The State Senate
Chair, Senate Resources Committee
119 N Cushman St Ste 201
Fairbanks, AK 99701

Dear Senator Fahrenkamp:

Enclosed is the testimony which I will summarize orally before the Senate Resources Hearing to be held in Fairbanks on September 20, 1990.

On behalf of the Commission, I thank you for this opportunity.

Sincerely,


Blair E Wondzell, P.E.
Sr Petroleum Engineer

jo/A.BEW.019-13

encl

Testimony of Blair E Wondzell
before the
SENATE RESOURCES COMMITTEE
Senate Special Committee on Oil and Gas
Hearing
September 20, 1990
Noel Wien Library, Fairbanks

WHY THE ALASKA OIL AND GAS CONSERVATION COMMISSION IS CONCERNED
WITH OIL MEASUREMENT.

The Alaska Oil and Gas Conservation Commission (AOGCC) is charged by statute to protect correlative rights and to prevent physical waste of hydrocarbons upstream of the sales meter. Physical waste can occur from blowouts, failure of surface equipment, or poor reservoir management.

In this case, reservoir means the porous underground formation in which hydrocarbons have accumulated. Recovery of hydrocarbons from a reservoir (at field depletion) may be 30-50% of the hydrocarbons initially in place. The recovery is dependent on formation characteristics (permeability, homogeneity, faulting, etc.); fluid properties (viscosity, gas-oil ratio); and reservoir management.

Reservoir management consists, in part, of making decisions on such items as well spacing, completion techniques, production rates, injection fluid type and rates, injection well pattern, and production of wells having high gas and/or water rates. An essential part of reservoir management is relating the reservoir volume of produced fluids to injected fluids to determine net reservoir voidage. This can be correlated to the increase or drop in reservoir pressure.

Produced fluids consist of the water, oil, and gas removed or produced from the reservoir, but measured at surface (standard) conditions. Alaska Statute 31.05.170(4) and regulation 20 AAC 25.570(34) prescribe standard conditions as a pressure base of 14.65 psia and a temperature base of 60°F. AS 31.05.030 Powers and duties of the Commission...(d)(6) "may require gauging or other measurements of oil and gas to determine the quality and quantity of oil and gas produced."

The Commission needs to know the volume of oil, gas, and water removed from and/or added to the reservoir in order to help ensure efficient reservoir management. This data can be compiled from the summation of individual well gauges times the appropriate days between gauges, or from a field "master" gauge (lease measurement). The master gauge is the Lease Automatic Custody Transfer meter (LACT), such as those located at Pump Station No. 1 (PS#1). By monitoring the meters at PS#1, we have accurate oil production figures to use for reservoir voidage calculations, and the Departments of Natural Resources and Revenue can use the figures for royalty and revenue tax respectively. Therefore, we choose to monitor the LACT meters to obtain produced oil volumes.

Specifically, we monitor the metering and oil quality testing equipment and procedures to ensure that they comply with the American Petroleum Institute's (API) Manual of Petroleum Measurement Standards (MPMS). The metered volume of oil is based on utilizing the appropriate temperature and pressure correction factors in the correct equations, and the API gravity, sediment, and water content are obtained by properly conducted API certified methods. Our confirmation of LACT metering accuracy is routinely furnished to the Department of Natural Resources, Division of Oil and Gas.

WHY THERE IS A NEED TO CONFIRM METERING ACCURACY.

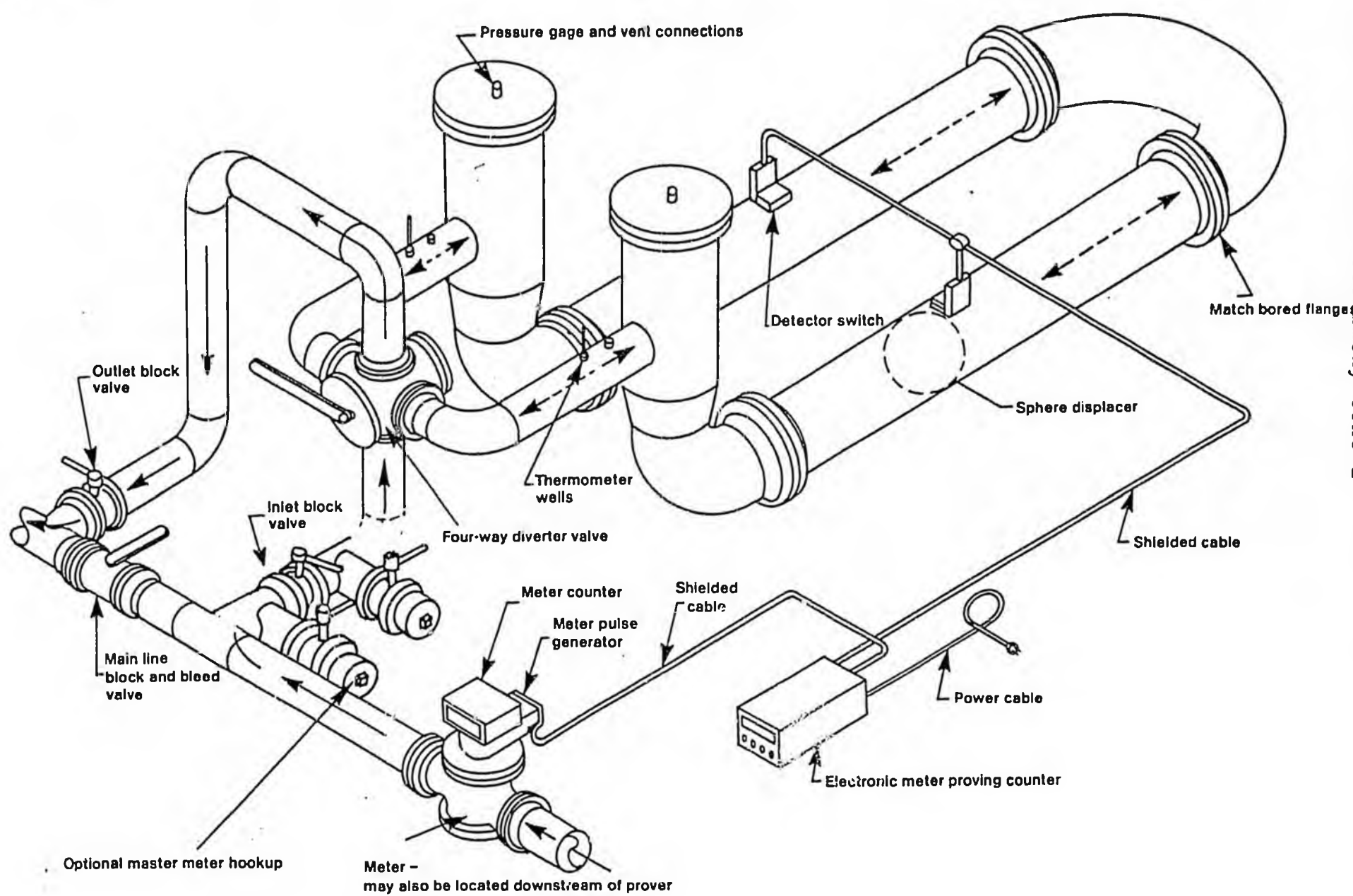
Liquid meters pass fluid through a housing in which a rotating wheel either measures the amount of fluid which passes through the housing (a positive displacement -- PD -- meter); or it measures the velocity of fluid passing through a conduit of known cross-sectional area (a turbine meter). Gas volumes are frequently measured by passing the gas through an orifice (in an orifice meter) which represents a significant reduction in the internal cross-sectional area of the meter run; the drop in pressure can be related to flow rate and thence volume.

AOGCC representatives witness the examination and calibration of the gas meters; however, most of our efforts are directed toward the liquid meters.

Liquid meters are rotating devices with movable parts which are designed to measure liquids of various specific gravities at various temperatures and pressures. To correct the meter reading for inaccuracies in the meter, slippage due to fluid viscosity, and effects of temperature and pressure, it is necessary to compare metered volume to an actual volume. This comparison is done with a meter prover to result in a meter factor which is the ratio of actual volume to metered volume.

In Alaska (with minor exceptions), all meter provers are "U"-shaped "pipe" provers -- a section of pipe fabricated in the shape of a "U" which varies from 4" O.D. at Amoco's East Foreland facilities to 24" O.D. at Alyeska's PS#1 at Prudhoe Bay. Please see Figure 1, page 3. These provers are equipped with a sphere which can move end-to-end in the prover. In the process, the sphere trips micro switches which start and stop a counter connected to the operating meter. The known volume between the switches is compared to the metered volume to obtain a meter (correction) factor which, when multiplied by the metered volume, results in an actual volume.

The volume of the prover between the switches is determined by a procedure described as "water drawing the prover". The inside of the prover is carefully cleaned and filled with water. The water is removed (drawn) from the prover as the sphere travels between the two micro switches; the water is caught and measured in vessels



- 3 -

Fig. 1 - Typical bidirectional U-type sphere meter prover

having volumes certified by the U.S. Bureau of Standards. The volume of the shells of the prover and of test vessels and the volume of fluid (in this case water) contained in the prover and test vessels, are corrected for temperature and pressure. Typical calculations and AOGCC checks are shown in APPENDIX I, Alyeska Pipeline Certificate of Volume, Certificate No. 12, Date 04-19-88, Valdez Terminal - Master Prover.

Normally three runs are made, and three volumes obtained. The first two runs must be repeatable to within 0.02% (API MPMS 4.2.6.19). The third run should be at a different rate, usually 20% higher or lower to check for test system bias (leaks). The Commission regulation, 20 AAC 25.230(e)(1), requires that "water drawing of provers utilized for certification of custody transfer meters" must be consistent with API's "Manual of Petroleum Measurement Standards."

Once a certified volume of the prover has been obtained, the prover can be used to prove meters; i.e., determine the meter factor which is the correction factor by which the metered volume is multiplied to obtain the corrected volume at standard conditions, that is, adjusted for temperature and pressure. The meter factor is obtained by correcting the base prover volume for temperature and pressure effects on the shell of the prover and on the fluid in the prover, divided by the meter reading obtained, corrected for temperature and pressure of the fluid, while the sphere in the prover was traveling between the switches. The meter factors are normally near one when correcting metered volumes which are expressed in barrels. (In APPENDIX II, the meter factors obtained are 1.0039, 1.0036 and 1.0034.)

In Alaska, oil at low volume installations (Cook Inlet fields) is measured by positive displacement meters. At high volume installations such as the North Slope, it is measured by turbine meters. The meters are proved at least once a day at PS#1; several times a week at Kuparuk and Endicott; weekly at Milne Point; and once a month at Swanson River and the Cook Inlet onshore locations at Granite Point, West Foreland, and East Foreland.

The Commission witnesses meter provings at all LACT locations that meter oil subject to state royalty and severance tax. We try to visit high volume facilities such as PS#1 every month, versus every quarter for Cook Inlet facilities. Copies of field inspection reports of metering facilities and the daily PS#1 throughput reports for the Prudhoe Oil Pool are sent to Ed Park of DNR's Royalty Audit Section. On a monthly basis, I check the meter factor calculations and LACT volumes for one day for all LACT meters at all North Slope fields, and on a quarterly basis for the Cook Inlet area fields.

METER FACTORS FOR NORTH SLOPE OIL FIELDS

Meter factors are obtained by dividing the corrected prover volume by the corrected meter volume. The prover volume is obtained by water-drawing the prover into certified containers. Those used by Alyeska in Alaska are of 225 gallons, five gallons, and one gallon capacity (other sizes are probably available).

The big 24" diameter Prudhoe Oil Pool prover at PS#1 has a capacity of 150 barrels (actually 149.80676 barrels). To water-draw that prover with Alyeska's certified vessels would require 27 fillings of the 225-gallon vessel, 43 fillings in the five-gallon vessel, and three fillings in the one-gallon vessel. Because of the large number of fillings, the possibility of mistakes increases. Because of the long time involved to water-draw the prover, fluctuation affecting the shells of the vessels and the volume of fluids would contribute to inaccuracies.

Additionally, a prerequisite for a water draw is that the inside of the prover be absolutely clean. This is especially difficult with the large volume provers.

Alyeska used a master prover as an alternate to water-drawing their big provers.

Each year Alyeska moves their 11-barrel portable prover and a large tank of water to the East Metering building at the Valdez terminal. The meter and water are moved into the building a few days before the water draw so that the temperatures of the prover and the water can stabilize. Representatives from the owner companies and the AOGCC are invited to witness the water draw. Either two or three runs are made, depending on the repeatability with the previous "official" volume. If a new official volume is obtained, three runs are made -- two at a high rate and one at a low rate to ensure there is no bias, such as leaks.

The portable prover is trailer-mounted. Annually, after the water draw at Valdez, it is moved to PS#1 and placed inside the metering building. It is hooked up so that warm crude oil flows through the prover to stabilize the prover temperature. The particular crude oil (Prudhoe Oil Pool, Lisburne, etc.) is that which normally flows through the prover to be certified.

The volume of the portable prover is a nominal 11 barrels; the Prudhoe Oil Pool prover is 150 barrels. The portable prover can not directly prove or certify the volume of the 150-barrel prover. However, mounted on the portable prover skid is a 4" A.O. Smith P.D. (positive displacement) meter which is used as a master meter.

The portable prover is used to obtain a meter factor for the master meter, appropriately corrected for temperature and pressure. The master meter is then used to determine (certify) the volume of the large prover.

Blair E Wondzell testimony cont'd

The volumes and calculations, including our checks, for this type of certification are shown in APPENDIX II, Alyeska Pipeline, Certificate of Volume, Certificate No. 12, Pump Station No. 1-24". During these operations and the pre-operation warm-up period, the fluid flowing through the portable prover is the same as the fluid flowing through the prover which is to be certified; this ensures both are at similar temperatures, and there is no difference in fluid viscosity or vapor pressure.

To obtain corrected meter volumes at PS#1, and the other North Slope LACT installations, the necessary sequence is as follows:

1. Calibrated vessels, 225, 5, and 1 gallon volumes are certified by the U.S. Department of Commerce, National Bureau of Standards.
2. The volume of Alyeska's portable prover is certified by a water draw.
3. The portable prover is trailered north and placed in the PS#1 metering building; it is hooked up so the appropriate crude oil flows through the prover.
4. The 4" A.O. Smith PD master meter correction factor is obtained by utilizing the portable prover.
5. The volume of the large (operational) prover is determined by using the master meter.
6. The meter (correction) factor for a particular LACT meter (lease sales) is obtained by proving with the operational prover.
7. The LACT meter readings are corrected by applying the meter factor and the appropriate pressure and temperature correction factors. See APPENDIX III Meter Volume Calculations for an example of the equations used to determine meter factors and metered volumes (gross standard volumes).

APPENDIX IV is a copy of the 06/30/90 Meter Proof Reports for each of the three ARCO and three BPX meters at PS#1 which measure Prudhoe Oil Pool crude oil. Also, for each operator there is a summary sheet which shows the total corrected volume through their meters on 06/30/90.

APPENDIX V lists some of the metering problems found by AOGCC personnel.

Orifice Meter

As the fluid approaches the orifice the pressure increases slightly and then drops suddenly as the orifice is passed. It continues to drop until the "vena contracta" is reached and then gradually increases until at approximately 8 diameters downstream another maximum pressure point is reached. The decrease in pressure as the fluid passes thru the orifice is a result of the increased velocity of the gas passing thru the reduced area of the orifice. When the velocity decreases as the fluid leaves the orifice the pressure increases and tends to return to its original level. All of the pressure loss is not recovered because of friction and turbulence losses in the stream. The pressure drop across the orifice (h in Fig.) increases when the rate of flow increases. When there is no flow there is no differential. The differential pressure is proportional to the square of the velocity, it therefore follows that if all other factors remain constant, then the differential is proportional to the square of the rate of flow.

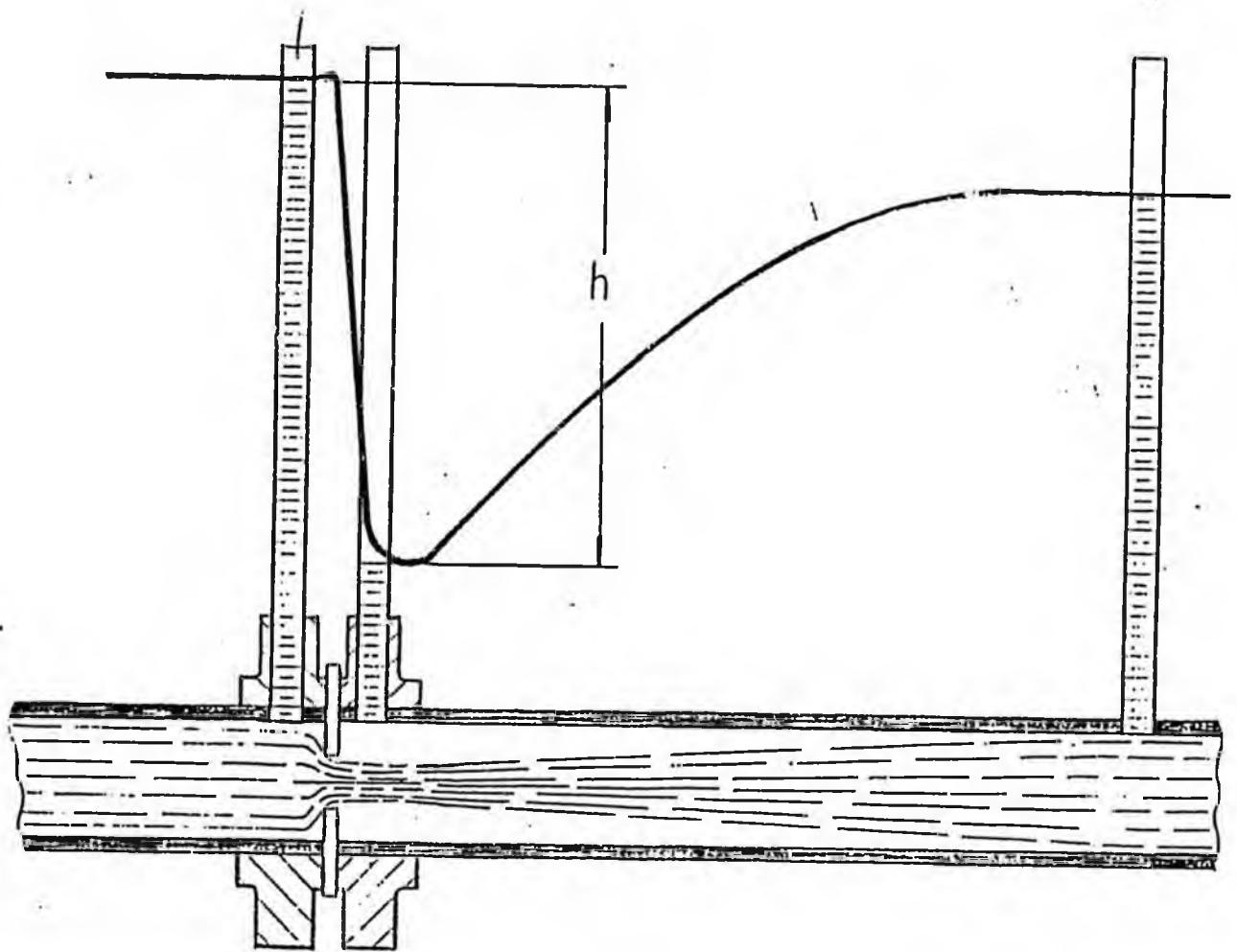
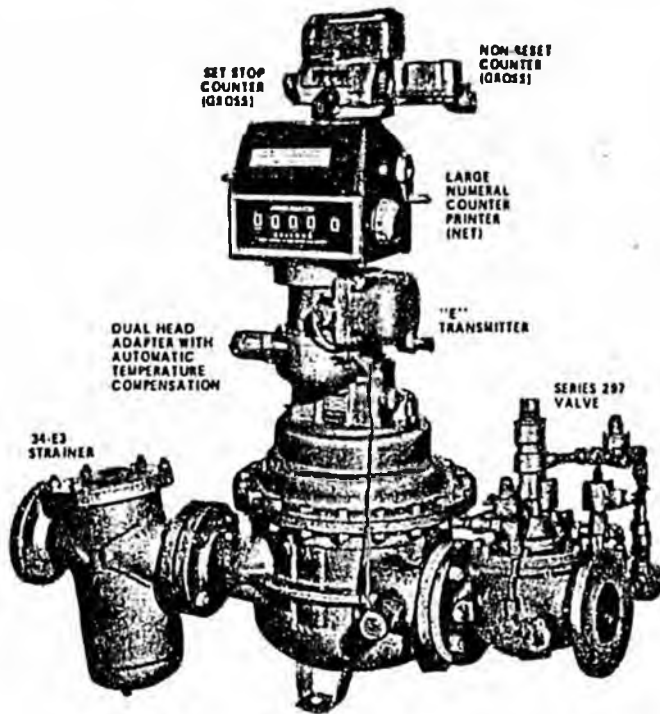


FIGURE 2
TYPICAL ORIFICE FLOW PATTERN
(FLANGE TAPS SHOWN)

3" 150 lb. FLANGED METERS and ACCESSORIES

October 1968

3" 150 lb. FLANGED METERS and ACCESSORIES



**MODEL E3-S1
METER WITH
ACCESSORIES**

SPECIFICATIONS

	Nominal Rated Capacity (Standard Trim Meter)			
	Available Registration			
	U.S. Gallons Per Minute	Imperial Gallons Per Minute	Dekaliters Per Minute	Barrels Per Hour
Maximum	400	350	165	600
Minimum	80	70	30	120

WORKING PRESSURE 150 PSI..... 10.5 Kg Cm2.....(E3-S1 and A1)
275 PSI..... 20.2 Kg Cm2.....(E3-S3)

FLANGES..... 3" 150 lb. USASA B16.5

MATERIALS OF CONSTRUCTION*

	Standard Trim**	All Iron Trim	LPG Trim
Outer Housing and Cover	Fabricated Steel	Fabricated Steel	Fabricated Steel
Inner Unit Housing, Cover, Rotor and Block	Cast Iron	Cast Iron	Cast Iron
Bearings	Stainless Steel	Stainless Steel	Stainless Steel with Phenolic Retainers
Pins and Rollers	Stainless Steel	Stainless Steel	Stainless Steel
Cam Shaft and Gears	Steel	Steel	Steel
Blades	Anodized High Tensile Aluminum Alloy with Stainless Steel Wear Strips	Close grained Cast Iron	Anodized High Tensile Aluminum with Stainless Steel Wear Strips
Bushings	Sintered Iron	Sintered Iron	Rulon
Packing Gland***	Steel & Thiokol	Steel & Thiokol	Steel & Thiokol

*Internal meter parts are treated with ARMORLOY, a SOLID FILM LUBRICANT with certain corrosion resistant properties.

**Includes No-brass Trim.

*** Steel and teflon glands also available.

The E3 Series are double case Rotary Positive Displacement Meters designed for use on all petroleum products and for many chemical and industrial applications. The E3-S1 and E3-S3 models are straight-through type meters. The E3-A1 and E3-A3 models are 90° angle type meters. The S1 and A1, are designed for 150 PSI and the S3 and A3 for 275 PSI operating pressures.

Meters and accessory items described in this bulletin are suitable for use in 3" meter systems with nominal maximum flow rates of 400 GPM.

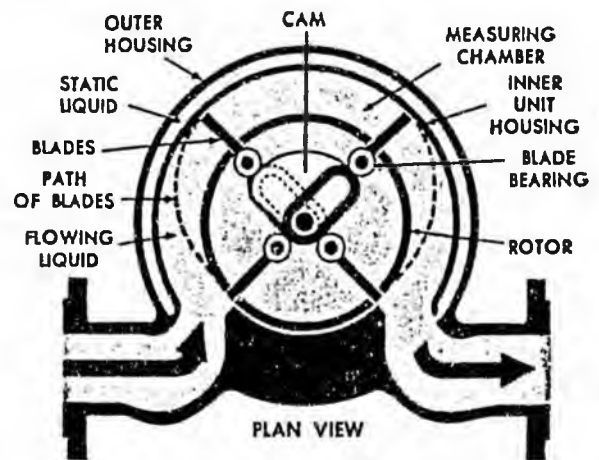
With the Smith meter principle, flow of liquid is literally undisturbed while it is being metered. This principle results in both low hydraulic and low mechanical loss through the meter. Low pressure loss is important from the standpoint of minimum power consumption in a pump pressure system and allows maximum obtainable flow rates in a gravity system. Low mechanical loss contributes to overall reduced pressure drop and assures GREATER ACCURACY over varying flow rates as slippage in a liquid seal meter is a function of pressure loss due to mechanical friction. Low pressure drop due to streamlined flow and minimum of mechanical friction results in long life and low maintenance, assuring SUSTAINED ACCURACY.

APPLICATIONS

Petroleum -- Product Pipe Lines, Crude Oil Pipe Lines; Blending Operations Transport Truck Loading, Tank Car and Barge Loading, L. P. G. and Asphalt Services.

Industrial -- Petrochemical, Chemical, Paints, Fats, Oils, Fertilizers.

PRINCIPLE OF OPERATION



The rotor, which revolves on stainless steel bearings, has four evenly spaced slots. The slots control the position of two blades that are at right angles to each other. As liquid flows through the meter, the rotor and blades revolve around a fixed cam. Ball bearings fixed to the blades roll around the cam, causing the blades to move radially. The successive movement of the blades, outward toward the case wall, forms a measuring chamber of precise volume between the blades, the rotor, the case wall, the cover, and the bottom of the case. A continuous series of these closed chambers is produced, four for each revolution of the rotor. Neither the blades nor the rotor contact the stationary walls of the measuring chamber.

Drawing reflects straight-through meter. Port location of angle meters and does not change this basic principle of operation

ADJUSTMENT

Dry, accessible calibration is made in extremely fine increments with any A. O. Smith adjustment device. These adjustment devices are protected from dirt and foreign matter, and may be sealed against unauthorized tampering. E3 Series meters supplied with standard manual calibrators provide adjustment in increments of 1/20th of 1%. The following devices are optionally available for specific installation or operational requirements: ATC (Automatic Temperature Compensation), ATG (Automatic Temperature Compensation with gravity selection), "G" Calibrator (for reverse flow), Dummy calibrator (direct drive) and AMR (wide correction range, non-pulsing output).

FIGURE 3

Smith Meters

an Operation of the
Flow Measurement & Control Division
Geosource Inc.

Technical Paper 103A

Turbine Meters for Liquid Measurement

Philip D. Baker and Raymond J. Kalivoda

Introduction

The purpose of this paper is to examine the application of Turbine Meters for liquid flow measurement. The focus will be on petroleum service, but the principles can be applied to other industrial, chemical and commercial applications. To accomplish this objective, the basic design and operation of Turbine Meters and factors influencing their performance, will be discussed.

History

The Turbine Meter is not a new flow measurement device. Records indicate that in 1886 the first patent for a Turbine Meter was issued. In 1914 a patent was granted for a Turbine Meter which related flow rate to frequency. However, it was not until the 1950's the Turbine Meter was developed into a precise flow measurement transducer. With the development of jet engines and liquid propellant rockets, the need arose for an accurate, fast responding meter that could be used on exotic fuels and oxidizers at extreme temperatures. The Turbine Meter met this need. It was soon applied to many other industrial flow measuring applications.

Turbine Meters began to be applied extensively in the Petroleum Industry in the mid-1960's. Since publication of API Standard 2534 "Measurement of Liquid Hydrocarbon by Turbine Meter Systems" in March, 1970, the Turbine Meter has gained broad acceptance for custody transfer of petroleum liquids such as liquefied petroleum gases (LPG's), light distillates and light crude oils, primarily at large petroleum storage and transfer terminals.

Types of Meters

Fluid flow meters can in general be classified as either Positive Displacement or Inference Type Meters. Positive Displacement (P.D.) Meters measure volumetric flow *directly* by continuously separating (isolating) a flow stream into discrete volumetric segments and counting them. Inference meters *infer* volumetric flow rate by measuring some dynamic property of the flow stream. Turbine Meters fall in this latter category.

Some of the most common examples of inference meters are orifice plates, flow nozzles, venturis and pilot tubes, all of which infer flow rate from differential pressure measurements. Other types of meters infer flow rate from the measurement of: mechanical force, flow area, electro-magnetic force, speed of sound, magnetic resonance, vortex shedding, drag, swirl, etc.

Basic Assumptions

Turbine Meters infer flow rate from the measurement of rotational movement (angular velocity) of a bladed rotor or impellor suspended in the flow stream. Thus, two levels of inference (basic assumptions) are necessary to obtain volumetric flow rate from a Turbine Meter:

First Assumption:

Volumetric Flow Rate \propto Ave. Stream Velocity

Second Assumption:

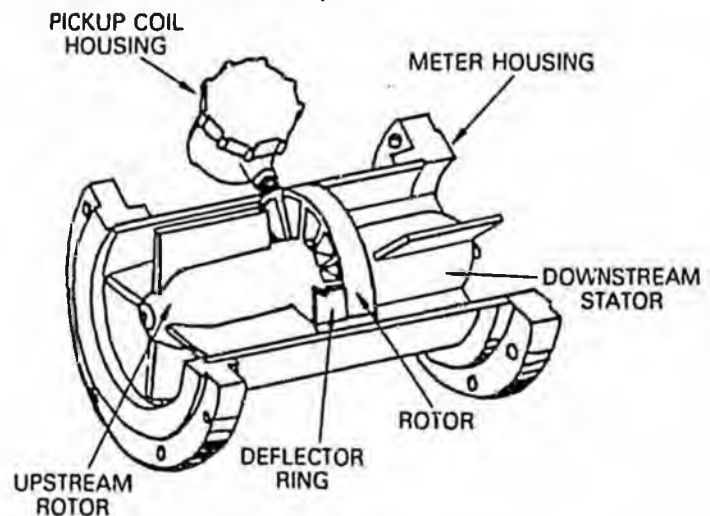
Ave. Stream Velocity \propto Rotor Angular Velocity

The degree to which these two basic assumptions are correct determines the accuracy of the Turbine Meter. The subsequent discussion on meter accuracy is centered about these two assumptions and the influence the various design, installation and application variables have on their validity.

Construction

The construction details of a typical Turbine Meter are described at this point as an aid to understanding the Turbine Meter operation and accuracy discussions that follow. There are three basic sub-assemblies in a conventional Turbine Meter (see Figure 1):

1. Housing Sub-assembly
2. Internal Parts Sub-assembly
3. Detector Sub-assembly.



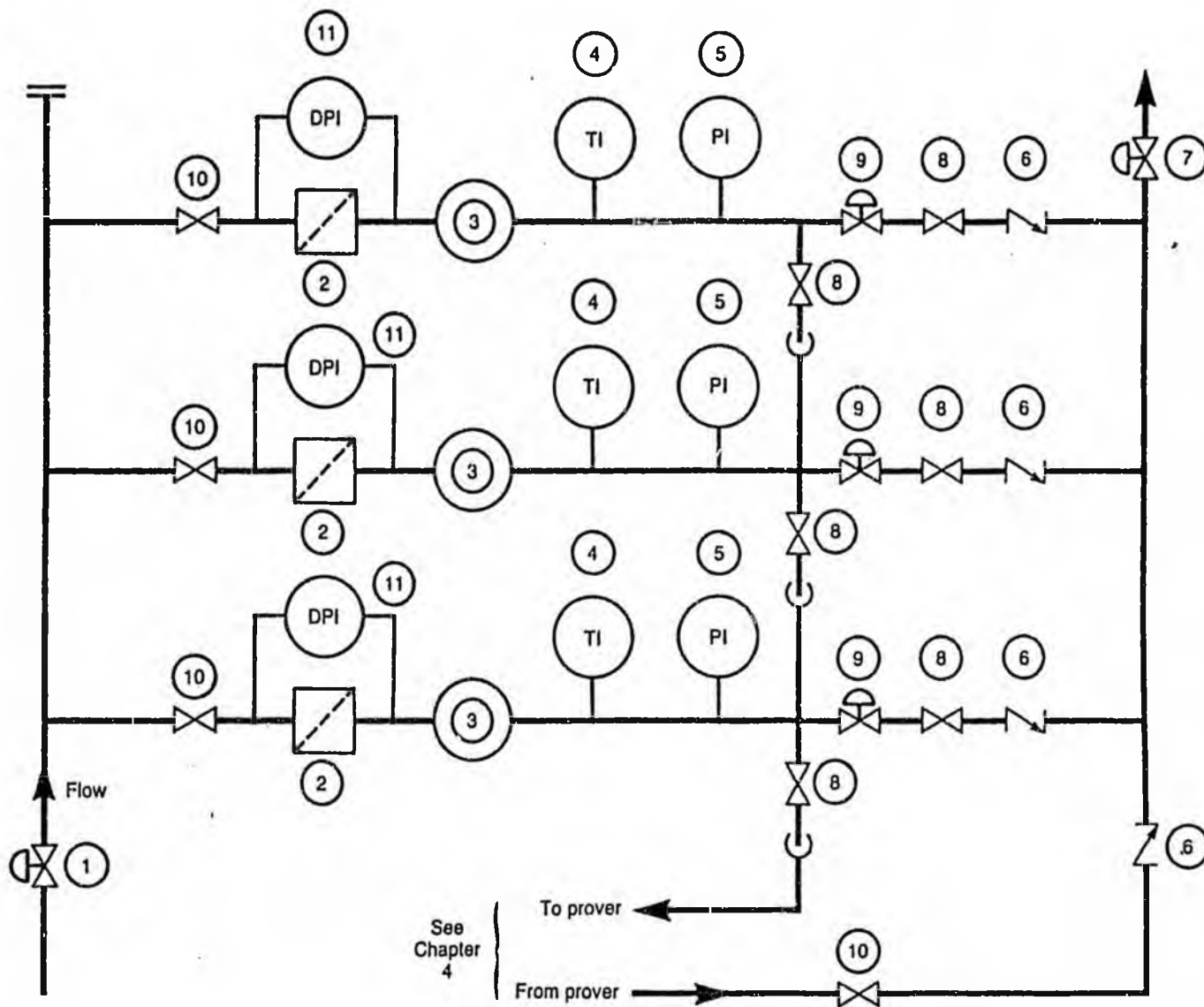
Typical Turbine Meter Assembly
Figure 1

Housing Sub-assembly

The Housing Sub-assembly is normally constructed of a flanged pipe spool in sizes from 1/4" to 24", with pressure ratings from 150 lb. to 2,500 lb. ANSI (275 to 6,000 PSI W.P.) for flow rates up to 60,000 BPH.

Materials are selected to be compatible with the product being handled and the ambient conditions. Since usually only the pipe spool comes in contact with the fluid, the flanges (being non-wetted) generally need not be compatible with the fluid. Thus carbon steel flanges are normally used with an alternative, such as stainless steel, only used for corrosive atmospheres or low temperature applications.

A deflector ring of the same material as the housing is used with a rimmed rotor to prevent the flow stream from impacting on the rotor rim and to provide a smooth flow transition into the rotor area.



- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Pressure-reducing valve—manual or automatic, if required. 2. Filter, strainer, and/or vapor eliminator (if required) for each meter or whole station. 3. Displacement meter. 4. Temperature measuring device. 5. Pressure measuring device. | <ol style="list-style-type: none"> 6. Check valve, if required. 7. Control valve, if required. 8. Positive-shutoff double block-and-bleed valves. 9. Flow control valve, if required. 10. Block valve, if required. 11. Differential pressure device, if required. |
|--|--|

Note: All sections of the line that may be blocked between valves shall have provisions for pressure relief (preferably not to be installed between the meter and the prover).

Figure 5—Typical Schematic Arrangement of Meter Station With Three Displacement Meters *or Turbine*

FIGURE 5

CERTIFICATE NO. 12

DATE 04-19 19 88

THIS IS TO CERTIFY THAT THE PROVER DESCRIBED BELOW WAS CALIBRATED TO ESTABLISH A VOLUME FOR PROVING METERS.

PIPE PROVER

LOCATION: VALDEZ TERMINAL - MASTER PROVER

DISTANCE BETWEEN DETECTOR SWITCHES: --

BI-DIRECTIONAL: YES UNI-DIRECTIONAL: --

STRAIGHT: -- U-BEND: YES TYPE OF DISPLACER: SPHERE

TYPE OF CALIBRATION: WATER DRAW YES MASTER METER --

CALIBRATING FLUID WATER

AVERAGE VOLUME BETWEEN DETECTOR SWITCHES CORRECTED FOR TEMPERATURE AND PRESSURE IS 11.11819 BARRELS AT 60°F. AND ATMOSPHERIC PRESSURE. VOLUME SHOWN FOR BI-DIRECTIONAL PROVER IS FOR A ROUND TRIP.

OTHER INFORMATION:

TEST NO. 1 - VOLUME	<u>11.11884</u>	<u>② 55 BPH</u>
TEST NO. 2 - VOLUME	<u>11.11771</u>	<u>⑥ 55 BPH</u>
TEST NO. 3 - VOLUME	<u>11.11802</u>	<u>① 41 BPH</u>
TEST NO. 4 - VOLUME	<u> </u>	<u> </u>
AVERAGE VOLUME:	<u>11.11819</u>	<u>BBL</u>

THE VOLUMES SHOWN HAVE BEEN CORRECTED IN ACCORDANCE WITH PROVISIONS OUTLINED IN SECTION II OF API STANDARD 1101.

REMARKS: this volume was determined using the New Volumes Determined by NBS For master crans. As per revised procedures this becomes the new Official Volume for 1988 certification. All gauges were dead weight tested and Electronic Thermometer certified against NBS Thermometers were used.

SIGNED BY: [Signature] Alyeska Pipeline FOR: R. L. Fritz (SIP)

SIGNED BY: B.W. McConkey / ARCO PIPELINE Co. FOR: [Signature] / ARCO

SIGNED BY: Blaire B. Wood / ACGCC FOR: [Signature] / ACGCC

ALYESKA PIPELINE SERVICE COMPANY
 PROVER CALIBRATION - WATER DRAW METHOD

CALIBRATION NO: 12

DATE: 04/19/88

*****CERTIFIED TEST MEASURES *****

SHEET NO. 5

PROVER SERIAL NO.: MDP-175

SIZE: 12

: SIZE : 1 GAL : 5 GAL : 225 GAL :
 : CU-IN : 231.61 : 1154.93 : 51966.62 :
 : SCR.NO. : 5484 : 5483 : 5482 :

NO.	DIR	PRESS	TEMP.	CU-IN	CU-IN	CU-IN	TEMP	11.2.3	302 SS	@ 60 F	DEG-C	DEG-C	INCEASUR	TPROVER									
5A	R/L	47	57.5	51966.62	189.00	52155.62	57.7	0.999984	0.999986	52154.06	14.17	14.28	999.2035	999.2193									
				1154.93	(6.50)	1148.43	57.5	1.000000	0.999980	1148.41		14.17	999.2193										
				231.61	3.50	235.11	57.5	1.000000	0.999980	235.11		14.17	999.2193										
				231.61	6.50	238.11	57.5	1.000000	0.999980	239.11		14.17	999.2193										
				231.61	10.50	242.11	57.6	0.999992	0.999983	242.10		14.22	999.2114										
TOTAL											54019.38	TOTAL											54017.79
5B	L/R	49	57.8	51966.62	40.00	52006.62	58.0	0.999984	0.999988	52005.16	14.33	14.44	999.1797	999.1956									
				1154.93	(1.00)	1153.93	57.9	0.999992	0.999985	1153.90		14.39	999.1876										
				231.61	4.00	235.61	57.8	1.000000	0.999983	235.61		14.33	999.1956										
				231.61	12.00	243.61	57.8	1.000000	0.999983	243.61		14.33	999.1956										
				231.61	1.00	232.61	58.0	0.999984	0.999988	232.60		14.44	999.1797										
TOTAL											53872.38	TOTAL											53870.88

PROVER VOLUME CALCULATION :

WITNESSED BY:
 TOTAL VOLUME CU-IN @ 60F : 107889
 WATER COMP. FACTOR : 0.999848
 CORR. FACTOR FOR STEEL : 0.999949
 : CU-IN : GAL : BARRELS :
 CORRECTED PROVER VOL. : 107867 : 466.96 : 11.11802

Michael S. Kopp / APSC
B. W. McConkey / ARCO PIPE LINE CO.
Belgin E. Wood / ARCO
Robert H. Frye (SRPCC)
Kenneth D. Williams (ARCO)
B. Thomas H. Green ARCO

U.S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

Gaithersburg, Maryland

JFH: gk
775
TN 241384
7752604

March 28, 1988

REPORT OF CALIBRATION

Submitted by: Alyaska Pipeline Service Company
Anchorage, Alaska

Seal No. 5482

Reference: Purchase Order No. 8027034 dated 3-21-88

Item: 225 gallon vessel (Graduated Neck Type)

Maker: Seraphin (maker #8229)

Material: Stainless Steel

Assumed Cubical Coefficient of Expansion, 0.0000265 per degree Fahrenheit

With the vessel described above, in a standing position and a reference attitude established by leveling the (attached levels), and when drained for 30 seconds after cessation of the main flow, the volume of water delivered is as follows:

Scale Reading*	Volume Delivered at 60°F (U.S. Gal)**	Volume Delivered at 60°F (in ³)	Estimated Uncertainty (in ³)
0	224.9637	51966.62	± 4.80

The volume stated above is the average of 6 Calibration runs.

A scale division, between -300 and +300 is, as established by separate test, equivalent to 10 in³.

The position of the graduated scale was not moved as part of the calibration procedure.

*The scale reading is determined by the intersection of the horizontal plane, tangent to the bottom of the meniscus.

**The volume established is based on the density of water (reference available upon request). A U.S. gallon is equivalent to .003785412 m³ or 231 in³.

For the Director,

ORIGINAL SIGNED BY

Dr. Hratch G. Semerjian

Dr. Hratch G. Semerjian

Chief, Chemical Process Metrology Division

Center for Chemical Engineering

National Engineering Laboratory

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

Gaithersburg, Maryland

JFH: gk
775
TN 241384
7752604

March 28, 1988

REPORT OF CALIBRATION

Submitted by: Alyeska Pipeline Service Company
Anchorage, Alaska

Seal No. 5483

Reference: Purchase Order No. 8027034 dated 3-21-88

Item: 5 gallon vessel (Graduated Neck Type)

Maker: Seraphin (maker #20026)

Material: Stainless Steel

Assumed Cubical Coefficient of Expansion, 0.0000265 per
degree Fahrenheit

With the vessel described above, in a standing position and a reference attitude established by leveling the (plane of the supporting base), and when drained for 10 seconds after cessation of the main flow, the volume of water delivered is as follows:

Scale Reading*	Volume Delivered at 60°F (U.S. Gal)**	Volume Delivered at 60°F (in ³)	Estimated Uncertainty (in ³)
0	4.99969	1154.93	± 0.30

The volume stated above is the average of 10 Calibration runs.

A scale division, between -10 and +10 is, as established by separate test, equivalent to 1 in³.

The position of the graduated scale was not moved as part of the calibration procedure.

*The scale reading is determined by the intersection of the horizontal plane, tangent to the bottom of the meniscus.

**The volume established is based on the density of water (reference available upon request). A U.S. gallon is equivalent to .003785412 m³ or 231 in³.

For the Director,
ORIGINAL SIGNED BY
Dr. Hratch G. Semerjian

Dr. Hratch G. Semerjian
Chief, Chemical Process Metrology Division
Center for Chemical Engineering
National Engineering Laboratory

U.S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

Gaithersburg, Maryland

JFH: gk
775
TN 241384
7752604

March 28, 1988

REPORT OF CALIBRATION

Submitted by: Alyeska Pipeline Service Company
Anchorage, Alaska

Seal No. 5484

Reference: Purchase Order No. 8027034 dated 3-21-88

Item: 1 gallon vessel (Graduated Neck Type)

Maker: Seraphin (maker #19996)

Material: Stainless Steel

Assumed Cubical Coefficient of Expansion, 0.0000265 per
degree Fahrenheit

With the vessel described above, in a standing position and a reference attitude established by leveling the (plane of the supporting base), and when drained for 10 seconds after cessation of the main flow, the volume of water delivered is as follows:

Scale Reading*	Volume Delivered at 60°F (U.S. Gal)**	Volume Delivered at 60°F (in ³)	Estimated Uncertainty (in ³)
0	1.00265	231.61	± 0.14

The volume stated above is the average of 7 Calibration runs.

A scale division, between -10 and +10 is, as established by separate test, equivalent to 1 in³.

The position of the graduated scale was not moved as part of the calibration procedure.

*The scale reading is determined by the intersection of the horizontal plane, tangent to the bottom of the meniscus.

**The volume established is based on the density of water (reference available upon request). A U.S. gallon is equivalent to .003785412 m³ or 231 in³.

For the Director,

ORIGINAL SIGNED BY

Dr. Hrach G. Semerjian

Dr. Hrach G. Semerjian

Chief, Chemical Process Metrology Division

Center for Chemical Engineering

National Engineering Laboratory

Form 0050

OWNER		STARTING TEMP. (AVG.) (PROVER TANK ONLY)		CERTIFIED CONTAINERS USED								SHEET 5 OF	
LOCATION		ATMOSPHERIC TEMP.		NOMINAL SIZE						CALIBRATION NUMBER			
NAME OF PROVER		SERIAL NUMBER		VOLUME CU. IN.						12			
CALIBRATION MEDIUM		TYPE OF PROVER		NOMINAL SIZE		SERIAL NUMBER				DATE 4/19/88			
FILL NO.	DIR. OF RUN	AVERAGE PROVER PRESSURE PSIG	CAN VOLUME CU. IN.	SCALE READING		ACTUAL QUANTITY READING CU. IN.	AVG. TEMP. PROVER	AVG. TEMP. LIQUID DRAWN	TEMP. DIFF.	TEMP. CORRECTION FACTOR	ADJUSTMENT FOR 30° SS	VOL. ADJ. TO 60° F AT CAL. PRESS.	
				ABOVE ZERO + CU. IN.	BELOW ZERO - CU. IN.								
5A		48.5	225	18.9			57.5	57.7					
			5		-6.5			57.5					
			1	3.5				57.5					
			1	6.5				57.5					
			1	10.5				57.6					
<hr/>													
5B		48.5	225	4.0			57.8	58.0					
			5		-1.0			57.9					
			1	4.0				57.8					
			1	12.0				57.8					
			1	1.0				58.0					
REMARKS									RUN NO. 1	RUN NO. 2	RUN NO. 3	RUN NO. 4	
TOTAL VOLUME AT 80 DEG. F. AND CALIBRATING PRESSURE (NOT CORRECTED FOR PRESSURE EFFECTS)													
WATER COMPRESSIBILITY FACTOR (CALIBRATING PRESSURE TO ATMOSPHERIC)													
PRESSURE CORRECTION FACTOR FOR STEEL (CALIBRATING PRESSURE TO ATMOSPHERIC)													
PROVER VOL. @ 60 DEG. F. AND ATM. PRESS.													
FINAL TOTAL AVERAGE PROVER VOLUME AT 60 DEG. F. AND ATMOSPHERIC PRESSURE									CU. IN.	GALS.	BBL.		
WITNESS:			WITNESS:			WITNESS:							
FOR:			FOR:			FOR:							

Alaska Pipeline Service Co

WATER DRAW 4/19/88

Valdez Marine Terminal

12" Portable Prover, Bi-Directional 5N MDP 175 I.D. 12.250", WT = 0.875

FILL No.	DIR OF-FILL	AVG PROVER PRESS PSIG	CAN VOL CU. IN.	SCALE READING		ACTUAL QUANTITY CU. IN.	AVG PROVER TEMP °F	AVG MEAS. TEMP °F	TEMP DIFF °F	TEMP CORR FACTOR	ADJUSTMENT FOR 302.91	VOL. ADJ. TO 60°F AT CAL. PRESS.
				ABOVE ZERO + CU. IN.	BELOW ZERO - CU. IN.							
			601									
5A		48.5	225 51966.62	189		52,153.62	57.5	57.7	+0.2	0.999984	0.9999856	52154.034
			5 1154.93		-6.5	1,148.43	"	57.5	-	-	0.9999802	1,148.407
			1 231.61	3.5		235.11	"	57.5	-	-	0.9999802	235.105
			1 231.61	6.5		238.10	"	57.5	-	-	0.9999802	238.105
			1 231.61	10.5		242.11	"	57.6	+0.1	0.999992	0.9999829	242.104
												54017.755
5B		48.5	225 51966.62	40		52006.62	57.8	68.0	+0.2	0.999984	0.9999875	52005.138
			5 1154.93		1.0	1153.93	"	57.9	+0.1	0.999992	0.9999853	1153.904
			1 231.61	4.0		235.61	"	57.8	-	-	0.9999826	235.606
			1 231.61	12.0		243.61	"	57.8	-	-	0.9999826	243.606
			1 231.61	1.0		232.61	"	58.0	+0.2	0.999984	0.9999875	232.603
												53870.857
												107,888.61

TOTAL VOLUME @ 60° AND CALIBRATING PRESS (NOT CORRECTED TO "0" PSIG) 107,888.61

WATER COMPRESSIBILITY FACTORS (CALIBRATING PRESSURE TO "0" PSIG) $CPL = \frac{P}{T}$ = 1.0001552PRESSURE CORRECTION FACTOR FOR STEEL (CALIBRATING PRESS TO "0" PSIG) $CPS = 1 + (P/D) \cdot E$ = 1.0000528

FINAL PROVER VOLUME = 107,866.29 cu in; 466.95364 gal; 11.117944 Bbls (1)

(Using Computer Print out Press) 107,866.4 cu in; 466.95411 gal; 11.117955 Bbls (2)

CPL = 1.0001536

CPS = 1.0000523 Computer calculated volume is 11.11802 Bbls (3)

The main difference (1) to (3) is in rounding the volumes { Diff. (1) to (3) = 0.000076 Bbls

Valley Water Draw 4/19/88

$$CTS = 1 + (T - 60) \tau$$

$$\text{corr for 302SS} = CTS = \frac{1 + (T_m - 60) V_{32}}{1 + (T_p - 60) V_{ms}} \quad V_{32} = 2.65 \times 10^{-5} \quad V_{ms} = 1.86 \times 10^{-5}$$

RUA 5A

$$T_p = 57.5 \quad T_m = 57.7$$

$$CTS = \frac{1 + (57.7 - 60) 2.65 \times 10^{-5}}{1 + (57.5 - 60) 1.86 \times 10^{-5}} = \frac{.9999391}{.9999535} = 0.9999856$$

$$T_m = 57.5 \quad CTS = \frac{1 + (57.5 - 60) 2.65 \times 10^{-5}}{.9999535} = \frac{0.9999338}{.9999535} = 0.9999802$$

$$T_m = 57.6 \quad CTS = \frac{1 + (57.6 - 60) 2.65 \times 10^{-5}}{.9999535} = \frac{.9999364}{.9999535} = 9999829$$

RUA 5B

$$T_p = 57.8$$

$$T_m = 57.8$$

$$CTS = \frac{1 + (57.8 - 60) 2.65 \times 10^{-5}}{1 + (57.8 - 60) 1.86 \times 10^{-5}} = \frac{.9999417}{.9999591} = 9999875$$

$$T_m = 57.9 \quad CTS = \frac{1 + (57.9 - 60) 2.65 \times 10^{-5}}{1 + (57.8 - 60) 1.86 \times 10^{-5}} = \frac{.9999444}{.9999591} = 9999853$$

$$T_m = 57.8 \quad CTS = \frac{1 + (57.8 - 60) 2.65 \times 10^{-5}}{1 + (57.8 - 60) 1.86 \times 10^{-5}} = \frac{.9999417}{.9999591} = 9999826$$

$$CPL = \frac{1}{1 - (P - P_e)F}; \text{ for } P_e = 0 = \frac{1}{1 - (P \times F)} \approx 1 + PF. \quad F = 3.2 \times 10^{-6}$$

$$= 1 + [48.5 \times (3.2 \times 10^{-6})] = 1.0001552$$

$$CPS = 1 + \frac{P \times ID}{E \times t} = 1 + \frac{48.5 \times 12.25}{(30 \times 10^4) \times .375} = 1.00005281$$

$$1 + \frac{48.5 \times 12.00}{(30 \times 10^4) \times .375} = 1.0000520$$

Blair
4/21/88

CERTIFICATE NO. 12

DATE 6-7 19 88

THIS IS TO CERTIFY THAT THE PROVER DESCRIBED BELOW WAS CALIBRATED TO ESTABLISH A VOLUME FOR PROVING METERS.

PIPE PROVER

LOCATION: Pump Station No. 1 - 24"

DISTANCE BETWEEN DETECTOR SWITCHES: _____

BI-DIRECTIONAL: YES UNI-DIRECTIONAL: _____

STRAIGHT: _____ U-BEND: YES TYPE OF DISPLACER: Sphere

TYPE OF CALIBRATION: WATER DRAW _____ MASTER METER YES

CALIBRATING FLUID ANS Crude

AVERAGE VOLUME BETWEEN DETECTOR SWITCHES CORRECTED FOR TEMPERATURE AND PRESSURE IS 149.84005

BARRELS AT 60°F. AND ATMOSPHERIC PRESSURE. VOLUME SHOWN FOR BI-DIRECTIONAL PROVER IS FOR A ROUND TRIP.

OTHER INFORMATION:

Test #1 Volume 149.85938 BBL @ 803 BPH

Test #2 Volume 149.83904 BBL @ 589 BPH

Avg Volume 149.84921 BBL } OFFICIAL VOLUME

RECEIVED

JUL 22 1988

Checked 7/27/88 Blair

Alaska Oil & Gas Cons. Commission

THE VOLUMES SHOWN HAVE BEEN CORRECTED IN ACCORDANCE WITH PROVISIONS OUTLINED IN SECTION II OF API STANDARD 1101.

REMARKS: This volume is a volume decrease of -0.007%. Per

the Revised OM-41 Policy this will become the official volume

the Average Water Factor for each rate was used. All gauges

were Deadweight Tested and All Electronic Thermometers were

Certified using NBS Tracable Glass Thermometers with Stem Corrections

SIGNED BY: [Signature] APSC FOR: _____

SIGNED BY: Benton S. Gue ALL FOR: _____

SIGNED BY: _____ FOR: _____

LOCATION: PSD1-24° HIGH RATE

DATE: 06/07/88

API#60: 29.5

PROVER ID: 23.00

CALIBRATING FLUID: AHS CRUDE

WALL THICKNESS: 0.500 OFFICAL VOL: 149.95005

RUN NO.	1	2	3	4	5	AVERAGE
1. PULSES-OHE WAY	627892	627896	627849	627890	627876	
2. PULSES-RO TRIP	1255776	1255798	1255736	1255739	1255776	1255765
3. GROSS BARRELS	149.49714	149.49976	149.49238	149.49274	149.49714	149.49583
4. SECONDS	670.97	672.84	670.08	669.22	669.82	670.586
5. FLOW RATE	802	800	803	804	803	803
6. METER FACTOR	1.00390	1.00390	1.00390	1.00390	1.00390	1.00390
7. METER PRESSURE	58	58	58	58	58	58
8.						
9.						
10. CPL-METER	1.000342	1.000341	1.000342	1.000342	1.000342	1.000342
11. METER TEMP.	138.6	137.7	138.4	138.5	138.4	138.3
12. CTL-METER	0.96489	0.96531	0.96500	0.96495	0.96500	0.96502
13. CORR. METER REG	144.85034	144.92582	144.87232	144.86519	144.87693	144.87665
14. PU-TEMP. IN	138.8	137.8	138.6	138.7	138.6	138.5
15. PU-TEMP. OUT	137.8	137.5	137.7	137.7	137.9	137.7
16. PU-TEMP. AVG.	138.3	137.6	138.1	138.2	138.2	138.1
17. PU-PRESS. AVG	34	35	34	35	35	35
18. PU-CTS	1.001456	1.001443	1.001453	1.001455	1.001455	1.001453
19. PU-CPS	1.000052	1.000054	1.000052	1.000054	1.000054	1.000054
20. PU-CPL	1.000200	1.000206	1.000200	1.000206	1.000206	1.000206
21. PU-CTL	0.96502	0.96534	0.96511	0.96507	0.96507	0.96511
22. PU-COMB. FACT	0.966668	0.966984	0.966756	0.966726	0.966726	0.966764
23. BASE PU-VOL	149.85532	149.87406	149.85407	149.85134	149.86349	149.85938
X DIFF.	-0.0032X	0.0093X	-0.0040X	-0.0058X	0.0023X	-0.0004X
25. CPL-TAB#2 MTR	0.589	0.588	0.589	0.589	0.589	0.589
26. CPL-TAB#2 PU	0.589	0.588	0.589	0.589	0.589	0.589

1255765
149.49583

1.000342
T = 138.3
.96502
CCF_M = .96525

Prover
T = 138.1

1.001453
1.000052
1.000206
.96511
CCF_P = .96676

$SCF = 0.00009 * N * (T - A)$

27. GLASS CORR. MTR : 0.00
28. GLASS CORR. PU : 0.00
IMB. TEMP : 70
M-MTR : 0
M-PRU : 0

$IV = \frac{149.49583 * 1.00390 * .96525}{.96676} = 149.85948$

SIGNED BY: [Signature] APSC
WITNESS: [Signature] APL
REMARKS:
WITNESS:
WITNESS:
WITNESS:

Blair 7/12/88

Meter Factor
 1.00390 to 1.00347
 = 0.00043

LOCATION: PS01-24" LOW RATE

DATE: 06/07/88

API NO: 29.5

PROVER ID: 23.00

CALIBRATING FLUID: AHS CRUDE

WALL THICKNESS: 0.500 OFFICAL VOL: 149.86005

RUN NO.	1	2	3	4	5	AVERAGE
1. PULSES-ONE WAY	628193	628216	628216	628221	628202	
2. PULSES-20 TRIP	1256466	1256500	1256501	1256504	1256465	1256487.2
3. GROSS BARRELS	149.57929	149.58333	149.58345	149.58381	149.57917	149.58181
4. SECONDS	914.51	915.47	912.95	914.76	914.20	914.378
5. FLOW RATE	589	588	590	589	589	589
6. METER FACTOR	1.00347	1.00347	1.00347	1.00347	1.00347	1.00347
7. METER PRESSURE	47	47	47	47	47	47
8.						
9.						
10. CPL-METER	1.000276	1.000277	1.000276	1.000277	1.000277	1.000277
11. METER TEMP.	137.4	138.4	137.7	138.6	138.2	138.1
12. CTL-METER	0.96543	0.96498	0.96529	0.96489	0.96507	0.96511
13. CORR.METER REG	144.94936	144.88582	144.93230	144.87282	144.89540	144.90394
14. PU-TEMP. IN	137.3	138.3	137.1	138.5	138.1	137.9
15. PU-TEMP. OUT	136.3	137.2	136.6	137.1	137.4	136.9
16. PU-TEMP. AVG.	136.8	137.8	136.9	137.8	137.8	137.4
17. PU-PRESS. AVG	34	34	34	34	34	34
18. PU-CTS	1.001428	1.001447	1.001430	1.001447	1.001447	1.001440
19. PU-CPS	1.000052	1.000052	1.000052	1.000052	1.000052	1.000052
20. PU-CPL	1.000199	1.000200	1.000200	1.000200	1.000200	1.000200
21. PU-CTL	0.96570	0.96525	0.96565	0.96525	0.96525	0.96543
22. PU-COMB. FACT	0.967321	0.966890	0.967274	0.966890	0.966890	0.967064
23. BASE PU-VOL	149.84618	149.84726	149.83583	149.83381	149.85717	149.83904
X DIFF.	-0.5093X	-0.0085X	-0.0162X	-0.0175X	-0.0019X	-0.0140X
25. CPL-TAB#2 MTR	0.588	0.589	0.588	0.590	0.589	0.589
26. CPL-TAB#2 PU	0.586	0.588	0.587	0.588	0.588	0.588

1256487.2
 149.58181
 MMF = 1.00347
 47
 1.000277
 138.1
 .96511
 144.90392
 137.4
 34
 1.001440
 1.000052
 1.000200
 .96542
 CCF = 0.967054
 P

GCF = 0.00023 * H * (T-R)

27. GLASS CORR. MTR : 8.00
 28. GLASS CORR. PU : 0.00
 AMB. TEMP : 70
 M-MTR : 0
 M-PRU : 0

$$PV = \frac{149.58181 \times 1.00347 \times .965377}{.967054} = 149.84056$$

$$\frac{149.84056}{149.83904} = 1.000152$$

SIGNED BY: W. K. [Signature] APSC
 REMARKS:

WITNESS: Barton S. [Signature] ALL

WITNESS: _____

WITNESS: _____

WITNESS: _____

0.00152 = 0.000010
 149.840
 = 0.001 %
 My Avg = 149.8502
 0.0007 % (1.9%)

MEMORANDUM

To:	Subject:	
Mike E. Kopp	Measurement Dept. Wahl Digital Thermometer Certification and Probe Checks	
From:	Date:	File No.
Ferry A. Markley	5/21/88	

A calibration / certification was performed on 5/20/88 to the Measurement departments Wahl Platinum-RTD Heat-Prober Thermometers #5353 and #5354 also a check was performed on nine probes. This calibration and check was performed in preparation for the prover volume certifications to take place at NFMS and on the North Slope.

An OMEGA ice point cell SN#71001 was used for the 32 deg. ice point reference with a Imm Brooklyn F-M thermo company thermometer SN#79203, no certification was available at the testing site, SCADA AMF is to send a copy. A SYBRON TAYLOR certified total immersion glass thermometer #2541 was used for the range comparisons. An ice bath was made to check the above listed thermometer and several others used for counter checks.

The total immersion procedure was used with the glass thermometer, no glass correction factor was necessary.

During the accuracy check to the heat probes, probe #OM-4 went bad (see probe accuracy list). Degree of accuracy varied from probe to probe. Offsets should be applied to the particular probes.

Due to the frequent calibration drifts on the digital thermometer used PS-01, a check should be made anytime a temperature is questioned.

DIGITAL THERMOMETER CERTIFICATE

1. Digital Thermometer S/N 5353 Probe S/N om-3
2. NBS Glass Thermometer S/N 2541
3. Preliminary temperature checks:

Degrees F	32.0	105.0 ^{NA}	125.0 ^{130.0}	145.0
Digital Thermometer Reading	<u>32.0</u>			<u>144.5</u>
NBS Glass Thermometer Reading (totally submerged mercury column)	<u>32.0</u>			<u>145.0</u>

Or

NBS Glass Thermometer Reading (submerged to 75 degree mark on stem)	<u>NA</u>			<u>NA</u>
TC - Corrected Temperature	<u>NA</u>			<u>NA</u>
Ambient Temperature	<u>75.6</u>			

4. Temperature checks after calibration:

Digital Thermometer Reading	<u>32.1</u>	_____	<u>131.75</u>	<u>145.2</u>
NBS Glass Thermometer Reading (totally submerged mercury column)	<u>32.0</u>	_____	<u>131.7</u>	<u>145.2</u>

Or

NBS Glass Thermometer Reading (submerged to 75 degree mark on stem)	<u>NA</u>	_____	<u>NA</u>	<u>NA</u>
TC - Corrected Temperature	<u>NA</u>	_____	<u>NA</u>	<u>NA</u>
Ambient Temperature	<u>75.6</u>			

5. To calculate the temperature correction for the NBS glass thermometer, use the following formula:

Note: Use only if NBS glass thermometer was not fully submerged.

$$TC = T_b \pm SC \pm S_{lc}$$

Where: TC = Corrected NBS glass thermometer reading
 T_b = Temperature reading of NBS glass thermometer
 SC = Stem correction in degrees F for ambient temperature effects on NBS glass thermometer
 S_{lc} = Stem correction obtained from NBS glass thermometer laboratory test certificate

$$SC = 0.00009 \times (T_b - 75) \times (T_b - T_a)$$

Where: SC = Stem correction in degrees F for ambient temperature effects on NBS glass thermometer
 T_b - 75 = Number of thermometer scale degrees of mercury column not immersed in the liquid -75
 T_b = Temperature reading of NBS thermometer
 T_a = Average ambient temperature reading

6. Remarks: Adjustment to span was required then readjustment to zero.
7. Work performed by Perry Markley Date: 5/20/98
 Witnessed by _____

5/20/88

Platinum - RTD Heat Probe

Accuracy Checks

Reference Temperature 32.00 deg. F				Reference Temperature 131.80 deg. F			
Probe Numbers	Digital Thermometer #5353	Digital Thermometer #5354	AVG. Diff.	Probe Numbers	Digital Thermometer #5353	Digital Thermometer #5354	AVG.
OM-A	32.10	32.10	0.10	OM-A	131.95	131.95	0.15
OM-B	32.00	32.00	0.00	OM-B	131.80	131.75	-0.03
OM-1	32.10	32.00	0.05	OM-1	131.75	131.70	-0.08
OM-2	32.00	31.95	-0.03	OM-2	131.90	131.90	0.10
OM-3	32.10	32.10	0.10	OM-3	131.85	131.80	0.02
OM-4	NA	NA	NA	OM-4	NA	NA	NA
OM-5	31.90	31.90	-0.10	OM-5	131.80	131.80	0.00
OM-6	32.10	32.10	0.10	OM-6	132.00	132.05	0.22
PS-1 #9	31.80	31.80	-0.20	PS-1 #9	131.80	131.80	0.00

Reference Temperature 145.20 deg. F			
Probe Numbers	Digital Thermometer #5353	Digital Thermometer #5354	AVG. Diff.
OM-A	145.40	145.35	0.18
OM-B	145.05	145.15	-0.10
OM-1	145.05	145.05	-0.15
OM-2	145.30	145.30	0.10
OM-3	145.20	145.20	0.00
OM-4	NA	NA	NA
OM-5	145.10	145.20	-0.05
OM-6	145.45	145.40	0.23
PS-1 #9	145.15	145.20	-0.02

Probe #OM-4 went bad during its check, reading approximately 4 deg. F low at 145 deg F and 2 deg F low at 32 deg F. These checks were made after the Digital thermometers were calibrated and the errors should be applied during use with the particular probe.

REPORT OF CALIBRATION

CERTIFIED PRECISION QUALITY

Type of Instrument

Catalog No. 21013

Serial No. 65F 2541

Scale and Subdivision 122 to 176 F, 0.20 F

FEATURES: Total Immersion

Results of Tests

Reading of Thermometer	Temperature IPTS-68	Correction To Be Applied
32.000	32.000	0.
125.000	125.000	0.
145.000	145.000	0.
160.000	160.000	0.
174.980	175.000	+0.020

If the correction is + the true temperature is higher than the indicated temperature; if the correction is — the true temperature is lower than the indicated temperature.

The following paragraph applies to thermometers with an ice point. The tabulated corrections apply provided the ice-point reading, taken after exposure for not less than 3 days to a temperature of about 25° C. (77° F) is 32.000. If the ice-point reading is found to be higher (or lower) than stated, all other readings will be high (or lower) by the same amount. If the thermometer is used or tested at a given temperature shortly after being heated to a higher temperature, an error of (minus) —0.01° or less; for each 10° difference between the two temperatures, may be introduced.

We hereby certify that this thermometer is calibrated by comparison to "working standards" whose primary source of accuracy rests in platinum resistance thermometers calibrated by the National Bureau of Standards. Continuing accuracy is assured by periodically submitting our platinum resistance thermometers to the National Bureau of Standards. In addition, intermediate checks are made against a triple point of water cell, a freezing point of zinc cell, and a freezing point of tin cell.

Date 02/06/81 09:33:43
 Recertified 4/5/82 No change

Signed

Maurice Lytle

METER VOLUME CALCULATIONS

$$\text{Gross Std Volume} = \frac{\text{Meter Pulses}}{\text{"K" factor}} \times \text{CTL} \times \text{CPL} \times \text{MF}$$

$$\text{Meter Factor (MF)} = \frac{\text{Volume of Prover} \times \text{CPSP} \times \text{CTSP} \times \text{CPLP} \times \text{CTLP}}{\frac{\text{Meter Pulses}}{\text{"K" factor}} \times \text{CPLM} \times \text{CTLM}}$$

Gross Standard Volume -- the actual volume of fluid, at standard temperature and pressure, which passed through the meter. This value times the fractional percent of sediment and water provides Net Standard Volume.

Meter Pulses -- a series of electrical pulses, generated by the meter, whose number is proportional to the volume measured and whose frequency is proportional to the flow rate.

CPSP -- correction for the effects of pressure on the shell of the prover.

CTSP -- correction for the effects of temperature on the shell of the prover.

CPLP -- correction for the effects of pressure on the liquid in the prover.

CTLP -- correction for the effects of temperature on the liquid in the prover.

CPLM -- correction for the effects of pressure on the liquid in the meter.

CTLM -- correction for the effects of temperature on the liquid in the meter.

"K" factor -- a number which, for a particular meter, represents the uncorrected pulses per barrel.

TEMPERATURE & PRESSURE CORRECTION FACTORS FOR STEEL & CRUDE OIL

$$CPSP = 1 + \frac{P \times I.D.}{Wt \times (30 \times 10^6)}$$

Where:

P = pressure - psig

I.D. = internal diameter - in.

Wt = wall thickness - in.

(30×10^6) = ste modulus of elasticity

$$CTSP = 1 + (Tp - 60^\circ)(18.6 \times 10^{-6})$$

Tp = prover shell

temperature - °F

(18.6×10^{-6}) = steel expansion coefficient - per °F

$$CPL = 1 + PF$$

P = pressure - psig

$$F = C(A + BT + \frac{C}{\rho^2} + \frac{DT}{\rho^2})$$

A = constant - -1.99470

B = " - 0.00013427

C = " - 0.79392

D = " - 0.0023260

ρ = density - gm/cm³

$$\rho^2 = \frac{141.5 \times 0.999012}{131.5 \times \text{API @ } 60^\circ\text{F}}$$

$$CTL = e\{-\alpha_T \Delta t (1 - 0.8 \alpha_T)\}$$

ρ^2 = as above

$$\alpha = \frac{ko + k_1 T}{\rho^2 \times 10^6}$$

Ko = constant = 341.0957

K_1 = " = 0.0

APPENDIX IV A

ARCO's Prudhoe Oil Pool Meters at Pump Station #1

Total, corrected volume thru ARCO's meters on 6/30/90

07/01/90 00:03:52

METER SET - FE0520 LOG SUMMARY - ARCO

SET AVERAGE

API 6E/60 29.4 TEMP (DEGF) 119.5
 S.G. TEMP 119.0 PRES (PSIG) 67
 V.P. (PSIA) 10.2W WATER (%) 0.2

START TIME 06/30/90 00:00:00

STOP TIME 06/30/90 24:00:02

NET

	NON RST	FE-052A	FE-052C	FE-0520
START	3176680	3700672	25371756	23989965
STOP	3771275	3909161	25567951	24179885
TOTAL	594595	208489	196195	189920

CPLM = 1.00037
 CTLM = 0.97351
 CCF = 0.97387

FLOW WEIGHTED AVERAGE

METER ID	METER PULSES	CURRENT K-FACTR	CALC GROSS	INSTR GROSS	TEMP DEGF	PRESS PSIG	S.G. 60/60	S.G. TEMP
FE-052A	43767006	204.45 ✓	214078	214077	119.5	67	0.8796	119.0
FE-052C	41370220	205.28 ✓	201451	201455	119.5	67	0.8797	119.0
FE-0520	40474989	207.53 ✓	195013	195010	119.5	67	0.8796	119.0
GROSS TOTALS			610542	610542				
INSTR NET TOTAL			<u>594,679</u>	<u>594604</u>				

Handwritten annotations:
 214078
 201531
 195013
 610635
 594,679
 594604

Meter Proof Report

06/30/90 21:22:19

ARCO Meter 52A

6/30/90

METER PROOF-REPORT - ARCO
 METER ID - FE-052A
 PROOF TYPE AUTOMATIC

AVERAGE:		AVERAGE:		AVERAGE:	
METER PRESS (PSIG)	65	PROVER PRESS (PSIG)	59	S.G. CORRECTED	0.8801
METER TEMP (DEGF)	120.2	PROVER TEMP (DEGF)	120.3	S.G. RAW	0.8570
FLOW RATE (BPH)	8566			S.G. TEMP (DEGF)	119.8

RUN	L-R	R-L	TOTAL PULSES	TRIAL 1/K FACTOR	METER PSIG	METER TEMP	PROVER PSIG	PROVER TEMP	S.G. 60 CORR	FLOW RATE
1	15332	15331	30663	0.00489111	66	120.2	61	120.3	0.8797	8593
2	15332	15330	30662	0.00489153	66	120.3	61	120.3	0.8800	8589
3	15332	15330	30662	0.00489128	66	120.3	61	120.4	0.8800	8518
4	15330	15331	30661	0.00489133	61	120.1	55	120.2	0.8804	8514
5	15336	15330	30666	0.00489085	64	120.1	58	120.1	0.8803	8614
			30662.8		65	120.2	59	120.3	.88008	

ACTUAL DEVIATION WAS 0.014% OF 5 CONSECUTIVE RUNS OUT OF 5 TOTAL RUNS.
 ALLOWABLE DEVIATION 0.020%

29.28

PROVER BASE VOLUME IN BBL (SW 1-2) 149.80676
 PROVER VOL. CORR FOR TEMP AND PRESS 146.01506
 AVERAGE METER PULSES PER RUN 30662.8
 AVERAGE METER PULSES PER RUN (CORRECTED FOR PRESS & TEMP) 29852.7
 AVERAGE METER FACTOR (BBL PER PULSE) 0.0048912
 TRANSMITTED K FACTOR (PPB) 204.45
 FACTOR FROM PREVIOUS PROOF 204.44
 FACTOR FROM METER CURVE 204.53
 DIFFERENCE FROM METER CURVE 0.04%

PROVER:
 CTSP60 = 1.00112
 CPSPR = 1.00009
 CPLPR = 1.00033
 CTLP60 = 0.97319

METER:
 CPLM60 = 1.00036
 CTLM60 = 0.97323

MF - PSP = 204.
 = 204.450

Meter Proof Report

ARCO Meter 52C

#6/30/90 22:57:23

6/30/90

METER PROOF REPORT - ARCO
 METER ID - FE-052C
 PROOF TYPE AUTOMATIC

AVERAGE:		AVERAGE:		AVERAGE:	
METER PRESS (PSIG)	66	PROVER PRESS (PSIG)	64	S.G. CORRECTED	0.8790
METER TEMP (DEGF)	122.4	PROVER TEMP (DEGF)	122.1	S.G. RAW	0.8551
FLOW RATE (OPH)	7175			S.G. TEMP (DEGF)	121.6

RUN	L-R	R-L	TOTAL PULSES	TRIAL 1/K FACTOR	METER PSIG	METER TEMP	PROVER PSIG	PROVER TEMP	S.G. CORR	FLOW RATE
4	15398	15396	30794	0.00487117	65	120.5	62	120.3	0.8775	7176
5	15397	15399	30796	0.00487140	66	121.7	64	121.3	0.8784	7176
6	15398	15400	30798	0.00487092	65	122.6	62	122.3	0.8790	7166
7	15397	15394	30791	0.00487210	66	123.3	63	123.0	0.8793	7168
8	15399	15394	30793	0.00487140	68	123.7	66	123.6	0.8807	7187
			30794.4		66	122.4	63	122.1	0.87898	

ACTUAL DEVIATION WAS 0.024% OF 5 CONSECUTIVE RUNS OUT OF 8 TOTAL RUNS.
 ALLOWABLE DEVIATION 0.025%

29.48

PROVER BASE VOLUME IN BBL (SW 1-2) 149.80676
 PROVER VOL. CORR FOR TEMP AND PRESS 145.89474
 AVERAGE METER PULSES PER RUN 30794.4
 AVERAGE METER PULSES PER RUN (CORRECTED FOR PRESS & TEMP) 29949.1
 AVERAGE METER FACTOR (BBL PER PULSE) 0.0048714
 TRANSMITTED K FACTOR (PP8) 205.28
 FACTOR FROM PREVIOUS PROOF 205.36
 FACTOR FROM METER CURVE 205.54
 DIFFERENCE FROM METER CURVE 0.13%

PROVER:
 CTSP60 = 1.00116
 CPSPR = 1.00010
 CPLPR = 1.00036
 CTLP60 = 0.97232

METER:
 CPLM60 = 1.00037 ✓
 CTLM60 = 0.97219 ✓

MF-PSP = 205.278

06/30/90 22:24:30

Meter Proof Report

ARCO Meter 52D

METER PROOF REPORT - ARCO
METER ID - FE-0520
PROOF TYPE AUTOMATIC

6/30/90

AVERAGE:		AVERAGE:		AVERAGE:	
METER PRESS (PSIG)	66	PROVER PRESS (PSIG)	60	S.G. CORRECTED	0.8797
METER TEMP (DEGF)	119.5	PROVER TEMP (DEGF)	119.5	S.G. RAW	0.8568
FLOW RATE (OPH)	7852			S.G. TEMP (DEGF)	119.1

RUN	L-R	R-L	TOTAL PULSES	TRIAL 1/K FACTOR	METER PSIG	METER TEMP	PROVER PSIG	PROVER TEMP	S.G. CORR	FLOW RATE
3	15564	15565	31129	0.00481827	66	119.5	62	119.4	0.8777	7861
4	15564	15564	31128	0.00481830	66	119.7	61	119.7	0.8805	7850
5	15562	15560	31122	0.00481917	67	119.6	62	119.6	0.8807	7834
6	15567	15560	31127	0.00481830	64	119.4	58	119.4	0.8796	7829
7	15565	15560	31125	0.00481861	65	119.3	59	119.3	0.8801	7885

31126.2

66 119.5 60

119.5 .87972

29.35

ACTUAL DEVIATION WAS 0.019% OF 5 CONSECUTIVE RUNS OUT OF 7 TOTAL RUNS.
ALLOWABLE DEVIATION 0.020%

PROVER BASE VOLUME IN BULS (SW 1-2)	149.80676
PROVER VOL. CORR FOR TEMP AND PRESS	146.06415
AVERAGE METER PULSES PER RUN	31126.2
AVERAGE METER PULSES PER RUN (CORRECTED FOR PRESS & TEMP)	30312.9
AVERAGE METER FACTOR (BULS PER PULSE)	0.0048185
TRANSMITTED K FACTOR (PPH)	207.53
FACTOR FROM PREVIOUS PROOF	207.55
FACTOR FROM METER CURVE	207.47
DIFFERENCE FROM METER CURVE	0.03%

PROVER:
 CTSP60 = 1.00111
 CPSPR = 1.00009
 CPLPR = 1.00034
 CTLP60 = 0.97352

METER:
 CPLM60 = 1.00036 ✓
 CTLM60 = 0.97352 ✓

MF-PPSP = 207.533

APPENDIX IV B

BPX's Prudhoe Oil Pool Meters at Pump Station #1

Total corrected volume thru BPX
meters on 6/30/90

07/01/90 00:03:48

METER SET - FE0510 LOG SUMMARY - BPX

SET AVERAGE

API 60/60 29.3 TEMP (DEG) 125.8

S.G. TEMP 125.2 PRES (PSIG) 60

V.P. (PSIA) 11.4 WATER (%) 0.4

START TIME 06/30/90 00:00:00

STOP TIME 06/30/90 24:00:02

CPLM = 1.00034
CTLM = 0.97072
CCF = 0.97105

NET

	NON RST	FE-051A	FE-051B	FE-051C
START	44289880	20883230	20354082	1498152
STOP	45009022	21120554	20585965	1748093
TOTAL	719142	237324	231883	249941

FLOW WEIGHTED AVERAGE

METER ID	METER PULSES	CURRENT K-FACTR	CALC GROSS	INSTR GROSS	TEMP DEG	PRESS PSIG	S.G. 60/60	S.G. TEMP
FE-051A	49773149	203.54	244404	244408	125.8	60	0.8797	125.2
FE-051B	49009678	205.22	238799	238805	125.8	60	0.8797	125.2
FE-051C	53157186	206.50	257405	257403	125.8	60	0.8797	125.2
GROSS TOTALS			740608	740616				

INSTR NET TOTAL

203,67
244,291
238,805
257,403
740,616
719,175
719,148

Meter Proof Report

BPX Metal 51A

6/30/90

06/30/90 20:10:43

METER PROOF REPORT - BPX
 METER ID - FE-051A
 PROOF TYPE AUTOMATIC

AVERAGE:		AVERAGE:		AVERAGE:	
METER PRESS (PSIG)	60	PROVER PRESS (PSIG)	53	S.G. CORRECTED	0.8806
METER TEMP (DEGF)	129.9	PROVER TEMP (DEGF)	129.9	S.G. RAW	0.8538
FLOW RATE (BPH)	10335			S.G. TEMP (DEGF)	129.3

RUN	L-R	R-L	TOTAL PULSES	TRIAL 1/K FACTOR	METER PSIG	METER TEMP	PROVER PSIG	PROVER TEMP	S.G. 60 CORR	FLOW RATE
6	15268	15267	30535	0.00491261	61	130.1	54	130.1	0.8814	10349
7	15266	15265	30531	0.00491326	61	130.1	54	130.1	0.8807	10325
8	15268	15265	30533	0.00491296	60	129.9	53	129.9	0.8804	10343
9	15268	15265	30533	0.00491296	61	129.8	53	129.8	0.8803	10368
10	15268	15263	30531	0.00491320	60	129.6	52	129.6	0.8805	10290
			30532.6		61	129.9	53	129.9	0.88066	

ACTUAL DEVIATION WAS 0.013% OF 5 CONSECUTIVE RUNS OUT OF 10 TOTAL RUNS.
 ALLOWABLE DEVIATION 0.020%

29.17

PROVER BASE VOLUME IN BBLs (SW 1-2) 149.80676
 PROVER VOL. CORR FOR TEMP AND PRESS 145.39465
 AVERAGE METER PULSES PER RUN 30532.6
 AVERAGE METER PULSES PER RUN (CORRECTED FOR PRESS & TEMP) 29593.7
 AVERAGE METER FACTOR (BBLs PER PULSE) 0.0049130
 TRANSMITTED K FACTOR (PPB) 203.54
 FACTOR FROM PREVIOUS PROOF 203.67
 FACTOR FROM METER CURVE 203.74
 DIFFERENCE FROM METER CURVE 0.108

PROVER:
 CTSP60 = 1.00130
 CPSPR = 1.00008
 CPLPR = 1.00030
 CTLP60 = 0.96892

METER:
 CPLM60 = 1.00034
 CTLM60 = 0.96892

MF-PSP = 203.541

Meter Proof Report

BPX Meter 51B

06/30/90 20:35:40

6/30/90

METER PROOF REPORT - BPX
 METER ID - FE-0510
 PROOF TYPE AUTOMATIC

AVERAGE:		AVERAGE:		AVERAGE:	
METER PRESS (PSIG)	60	PROVER PRESS (PSIG)	51	S.G. CORRECTED	0.8804
METER TEMP (DEGF)	128.9	PROVER TEMP (DEGF)	128.9	S.G. RAW	0.8539
FLOW RATE (BPH)	10297			S.G. TEMP (DEGF)	128.4

RUN	L-R	R-L	TOTAL PULSES	TRIAL 1/K FACTOR	METER PSIG	METER TEMP	PROVER PSIG	PROVER TEMP	S.G. CORR	FLOW RATE
1	15394	15390	30784	0.00487276	60	129.0	51	129.0	0.8812	10305
2	15392	15388	30780	0.00487340	60	129.0	51	129.0	0.8807	10270
3	15391	15393	30784	0.00487275	60	128.9	52	128.9	0.8800	10265
4	15393	15391	30784	0.00487270	60	128.9	51	128.9	0.8802	10366
5	15392	15393	30785	0.00487254	61	128.8	51	128.8	0.8800	10280

30783.4

60 128.9 51 128.9 0.88022

ACTUAL DEVIATION WAS 0.018% OF 5 CONSECUTIVE RUNS OUT OF 5 TOTAL RUNS.
 ALLOWABLE DEVIATION 0.020%

29.26

PROVER WASE VOLUME IN BBLs (SW 1-2) 149.80676
 PROVER VOL. CORR FOR TEMP AND PRESS 145.45766
 AVERAGE METER PULSES PER RUN 30783.4 ✓
 AVERAGE METER PULSES PER RUN (CORRECTED FOR PRESS & TEMP) 29850.7
 AVERAGE METER FACTOR (BBLs PER PULSE) 0.0048728
 TRANSMITTED K FACTOR (PPB) 205.22
 FACTOR FROM PREVIOUS PROOF 285.24
 FACTOR FROM METER CURVE 205.26
 DIFFERENCE FROM METER CURVE 0.825

PROVER:
 CTSP60 = 1.00128
 CPSPR = 1.00608
 CPLPR = 1.00029
 CTLP60 = 0.96937

METER:
 CPLM60 = 1.00034 ✓
 CTLM60 = 0.96937 ✓

MF-PSPE 205.21

= 205.219

Meter Proof Report

BPX Meter 51D

6/30/90

06/30/90 21:01:09

METER PROOF REPORT - BPX
 METER ID - FE-0510
 PROOF TYPE AUTOMATIC

AVERAGE:		AVERAGE:		AVERAGE:	
METER PRESS (PSIG)	60	PROVER PRESS (PSIG)	54	S.G. CORRECTED	0.8802
METER TEMP (DEGF)	128.7	PROVER TEMP (DEGF)	128.7	S.G. RAW	0.8538
FLOW RATE (BPH)	10382			S.G. TEMP (DEGF)	128.1

RUN	L-R	R-L	TOTAL PULSES	TRIAL 1/K FACTOR	METER PSIG	METER TEMP	PROVER PSIG	PROVER TEMP	S.G. 60 CORR	FLOW RATE
3	15490	15489	30979	0.00484208	61	128.8	53	128.8	0.8799	10316
4	15486	15489	30975	0.00484269	61	128.6	53	128.6	0.8794	10402
5	15488	15487	30975	0.00484275	61	128.6	55	128.6	0.8806	10423
6	15491	15487	30978	0.00484228	60	128.7	53	128.7	0.8806	10347
7	15489	15485	30974	0.00484293	60	128.9	54	128.9	0.8807	10425
			30976.2		61	128.7	54	128.7	0.88024	

ACTUAL DEVIATION WAS 0.017% OF 5 CONSECUTIVE RUNS OUT OF 7 TOTAL RUNS.
 ALLOWABLE DEVIATION 0.020%

29.25

PROVER BASE VOLUME IN BBL (SW 1-2) 149.80676
 PROVER VOL. CORR FOR TEMP AND PRESS 145.46800
 AVERAGE METER PULSES PER RUN 30976.2 ✓
 AVERAGE METER PULSES PER RUN (CORRECTED FOR PRESS & TEMP) 30039.5
 AVERAGE METER FACTOR (BBL PER PULSE) 0.0048426
 TRANSMITTED K FACTOR (PPB) 206.50
 FACTOR FROM PREVIOUS PROOF 206.51
 FACTOR FROM METER CURVE 206.33
 DIFFERENCE FROM METER CURVE 0.08%

PROVER:
 CTSP60 = 1.00128
 CPSPR = 1.00008
 CPLPR = 1.00031
 CTLP60 = 0.96942

METER:
 CPLM60 = 1.00035
 CTLM60 = 0.96942

MF-PSP = 206.5
 = 206.501

Listing of Some of the Metering Problems Found by AOGCC Personnel

General Comments

At some of the Cook Inlet area LACT facilities, meter maintenance is lax at times. When contacted by AOGCC regarding metering, the operators are very responsive.

On the North Slope, the metering system originally installed at PS#1 pushed "state-of-the-art" to new limits. While the equipment was excellent, it was not being operated properly -- perhaps the maintenance was higher than envisioned. In early to mid-1981, Alyeska set up a separate measurement group. Since then we have had good cooperation from Alyeska, and major metering problems have been virtually non-existent.

ARCO has established a Kuparuk River Unit measurement group and a Prudhoe Bay measurement group. BPX has a measurement group for the Endicott Field.

We believe that the LACT facilities at the North Slope fields have excellent equipment, and are being used and maintained properly.

McArthur River Field

09/20/79 - found that data had been changed on the meter proving report form after it was signed by our inspector.

11/80 - insisted that Cook Inlet Pipeline Company use the API tables 5A and 6A for correction of gravity and temperature of the fluid, respectively.

07/07/90 - an incorrect pressure correction factor was used in the meter factor calculation. A corrected measurement ticket has been issued.

Middle Ground Shoal

01/22/79 - found error in calculation of one of Shell's LACT meters.

01/16/80 - letter to Shell regarding inadequate meters.

06/03/82 - an AOGCC inspector found the isolation block valve leaking which results in incorrect meter factors.

06/25/84 - letter to Shell insisting that they maintain their meters in good repair.

ARCO's Crude Oil Topping Plant - Prudhoe Bay Field

02/22/79 - contacted ARCO regarding erratic meter factors. ARCO was not concerned. As a result, we set an action limit of 0.0025 between successive meter factors. The temperature compensator was found to be worn.

03/31/81 - found that ARCO used the wrong master meter factor.

09/17/81 - our inspector noted that the ATG compensator was 0-150°F, the oil being metered was 160°F. They changed the temperature compensator.

04/14/82 - found that ARCO was not using a correction factor for the pressure of the liquid. They agreed, eventually, and started using it.

08/18/83 - found that the new master meter curves were invalid due to numerous errors. ARCO had the meters reproofed.

Endicott Oil Field

09/88 - we told BP that for the period February 17 through August 16, 1984, they had a problem with metering software. The correction involved an increase of 396 barrels.

Kuparuk River Field

08/04/83 - letter from ARCO this date stating they agreed with us that incorrect meter factors had been used at startup of the field. They adjusted Kuparuk production upward by 21,305 barrels.

03/13/85 - letter to ARCO pointing out that they had been using incorrect meter factors on February 27 due to negligence on ARCO's part. Our letter resulted in a meeting which brought about minor changes in metering procedure to improve reliability.

04/26/89 - letter to ARCO concerning use of incorrect average pressure and temperature correction factor for liquids for meter proof reports.

Milne Point Unit

During the engineering phase of this project, I was asked by Conoco to look at their proposed metering facilities. I requested some changes in the computer printout, and insisted they add equipment to preserve the meter pulses in the event of a power and/or computer failure.

On 11/07/85, for reasons unknown, the computer was "zero-ed" causing a loss of data. The on-skid gross (pulse) totalizer was used to arrive at the day's throughput. We were verbally thanked for requiring the "power-off" pulse totalizer.

Prudhoe Oil Pool

06/12/81 - called Alyeska's attention to a difference in value of the API gravity listed on the measurement ticket vs. the gravity used for meter factors. This was corrected.

07/07/81 - at our insistence, Alyeska decided to make the oil quality test prior to proving so the same API gravity valve would be used for meter factor calculations as would be reported on the run tickets.

09/26/83 - called Alyeska's attention to a discrepancy between the API gravity value used for metering vs. that used in the meter factor calculations. They found the API gravity analyzer needed repair.

Testimony concerning:

**QUANTITY AND QUALITY MEASUREMENTS
OF CRUDE OIL AND GAS IN THE STATE OF ALASKA**

Prepared for:

**Senate Resources Committee
and
Senate Special Committee on Oil and Gas**

**Hearing
September 20, 1990**

by

**Thomas R. Chapman
P.O. 80672
Fairbanks, Alaska 99708**

QUANTITY AND QUALITY MEASUREMENTS
OF CRUDE OIL AND GAS IN THE STATE OF ALASKA

I. QUESTIONS OF CONCERN

- * Do quantity and quality determinations of AMS crude oil produced and transported meet the accuracy requirements of all parties to custody transfer?
- * Do all parties to custody transfer have adequate assurance that standard methods are being employed and the results are valid?
- * Are measurements data being collected, processed, and reported in a form that can be substantiated and is appropriate for various revenue determinations?
- * Are improvements in measurement systems and data acquisition warranted and economically justifiable?

II. INTRODUCTION AND SCOPE

These are extremely sensitive questions given the competitive nature of the petroleum industry and the often adversarial relationship between the industry and the State of Alaska. There are no quick and easy answers, but there are ways to reduce the friction generated by these issues. With over four billion dollars in outstanding litigation between the petroleum industry and the State, there is obviously room for improvement.

Petroleum measurements is a complex subject, and one in which technology has advanced far beyond the comprehension of all except those dedicated to the subject. Technological advances in instrumentation, data acquisition, and computer sciences has greatly enhanced measurements capabilities. The benefits are great if appropriate applications of technology are correctly employed. If not, we are simply deluded by faith in a "black box" and have only gained the capability to make mistakes much faster.

All petroleum revenues, for both industry and State, are derived from quantity and quality measurements. Methods of value determination and financial accounting, though intimately related, are even more complex and sensitive subjects. The requirements of these subjects determine "what", "where", "when", and "how" volume measurements must be made. However, for the sake of simplicity, the scope of this testimony is limited strictly to quality and quantity measurements. A basic knowledge of how the value of crude oil, tariffs, royalties, quality bank payments, and taxes are determined is essential in analyzing and understanding volume measurements.

III. PERSPECTIVES

If these issues are to be resolved, it is imperative that the different perspectives be well defined and the mission of each interested party respected and understood.

III.1 The Industry's Perspective:

The purpose of the oil and gas industry is to discover, produce, transport, and refine these State resources to meet energy requirements in Alaska and the rest of the nation and world. Furthermore, to move crude and refined products to market in a cost effective manner that is safe for people and the environment. Whether this mission is being accomplished may be arguable from other perspectives, but at least it is well defined.

Industry professionals take great pride in the accuracy of meter systems and reported values. A substantial investment is put into these systems because they are the cash register of the business. Advanced technology is employed to produce the most accurate results possible, and every attempt is made to meet or exceed industry standards as set forth by API, ASTM, ISO and other international standards setting organizations.

Measurements within the Alaskan oil and gas network is a complex task. The product varies widely in quality and comes from a number of different fields and production companies, each with different accounting requirements. Each producer has the responsibility of measuring quality and quantity for custody transfer from the producing leases to the transporting carrier. This data and the wellhead price, by net-back accounting from the refinery gate price, determines ownership value and quality bank payments. Data is also reported to the State of Alaska for determination of royalty shares and tax liability. All production is then integrated in the TAPS system for transport to Valdez. The operators of the TAPS system have the responsibility to all producers, owners, and the State of Alaska to measure quality and quantity of the combined input and output for determination of transportation and operating costs, taxes, tariffs, and custody transfer from, and back to the separate owners.

III.2 The State's Perspective:

The State has a dual purpose, two hats to wear. In one hand is the policeman's hat. It is the State's responsibility to monitor and police the industry in the best interest of the Alaskan people and environment. In the other hand is the hard-hat of an oil producer. The State receives approximately 25% of the wellhead value of the oil in taxes and royalty payments both in-kind and in-value. It is also the State's responsibility to maximize the benefits of these revenues for the people and environment of Alaska. The priority of this paradoxical mission is not always well defined and varies with the political climate as determined at the polls.

The State of Alaska has interests and obligations similar to industry's, as a party to custody transfer, but with all eight individual producers and the carriers, not just one. The State has the added responsibility of accounting for quality and quantity measurements by the various requirements of several State agencies, DOR, DNR, DEC, and others. Royalty payments are made in-value (dollars) and in-kind (oil). Custody transfer of in-kind payments is made both within the State to local refiners and outside the State. Regulations and tariffs of intra-State oil is governed by the APUC, while inter-state regulations and tariffs are governed by FERC.

The added complexities of various tax legislation and regulation make it abundantly clear that the State has many diverse interests in being assured that the reported quality and quantity values of oil and gas are valid, as accurate as possible, and standardized. The State has tasked the Oil and Gas Conservation Commission with this responsibility, along with many other duties. Volume measurements is an intricate, specialized, and highly technical field. It is hard to imagine the Commission accomplishing this task, in conjunction with other duties, to the satisfaction of all parties involved without the resources, expertise, and technology of contemporary measurements professionals.

IV. SPECIFIC CONCERNS AND RECOMMENDATIONS

IV.1 Validity assurance of reported measurements data:

No matter how well the industry meters oil and gas, all parties to custody transfer, including the State of Alaska, have the right to maximize their assurance that reported quality and quantity data are valid. The Alaskan crude oil network contains two types of meter systems for the purpose of custody transfer:

- 1) LACT systems (Lease Automatic Custody Transfer) designed for the unattended transfer of liquid hydrocarbons from producing leases to the transporting carrier.
- 2) Pipeline systems designed for optimum measurement accuracy for custody transfer regardless of the volume handled.

The following is quoted from The Manual of Petroleum Measurement Standards, API Chapter 6, section 1, concerning these systems: "The system must provide a proper means for net volume determination, quality determination, and fail-safe and tamper proof operation while meeting requirements of accuracy and dependability as agreed to by such mutually concerned parties as the producer, the transporter, the royalty owner, and federal, state, and municipal regulatory bodies."

Assurance that meter systems achieve these criteria can only be attained from an independent third party monitor with documentable expertise, experience, and knowledge of the Alaskan petroleum industry. Employment of a third party monitor (metrologist) is common in the custody transfer of petroleum products. Measurements records, data, and computer software are considered proprietary and confidential. An independent third party monitor can attest to the accuracy of data within specified limits, can document deviations from these limits, and mitigate disputes and settlements that otherwise would proceed to costly litigation.

IV.2 Explicitly define measurements requirements of the State of Alaska and all parties to custody transfer:

Measurements data is used in a variety of revenue determinations, as well as for resource and environmental management. Each use of measurements data has its own peculiar requirements. What is appropriate for custody transfer from one company to another may be of little or no value in determining tax liabilities or meeting regulatory agency requirements. It is much more costly to dis-integrate a composite crude oil stream for individual value determination than to make the appropriate measurements prior to integration.

Each party, and within the State each department or agency, must specifically define the measurements it requires. This should include explicitly:

- 1) What parameters are to be measured.
- 2) Where (physical location) these parameters are measured.
- 3) When (time & frequency) of these measurements.
- 4) How, by what instruments or methods.
- 5) Format of raw, reduced, and reported data.
- 6) What is the degree of surety (quality assurance) of the data.

Cooperation within industry and with the State would be expected, as clear definitions of requirements are in the economic interest of all parties. The problem to resolve is not the relatively small value of quality and quantity measurements in question, but rather saving many of the costs of settlement and litigation incurred by not having the appropriate source data.

IV.3 Conduct an internal audit of State departments and agencies directly involved with petroleum measurements and revenue determinations:

An independent audit review would assist the explicit definition of requirements listed in IV.2 above, resulting in the ability to standardize data collection. It would also delineate the State's contradictory roles as policeman and producer.

In cases such as measurements, the State's obligations are quite similar to that of industry. Various State agencies are attempting to satisfy these obligations without the resources, experience, and expertise required and utilized by industry. An independent audit review of these functions may reveal which should be performed by the State and which should be contracted to specialist.

To be effective, audit teams would require a broad degree of freedom, authority, and expertise in specialized areas. They should be composed of volume measurements experts, royalty and tax accounting experts, legislators, and be coordinated by an ombudsman.

IV.4 There are areas in measurements where industry and the State could cooperate to the benefit of both.

One such area is research into the physical and chemical properties of Alaskan crude oil and gas. All will agree these resources are limited and their efficient and appropriate measurement, use, and conservation cannot be over estimated.

Crude oil is a composite of a wide spectrum of elemental hydrocarbon fractions. The physical properties of crude oil vary according to the chemical composition. The effects of temperature and pressure will differ from one crude oil to another. In order to facilitate petroleum measurements extensive testing has been done to determine a "global crude oil constant" which reflects the average physical properties of crude oil in general. This global constant is used in the API methods of computing volume correction factors.

A more appropriate constant for the composite of Alaskan crude oil would undoubtedly be different than the global constant, especially when the injection of LNG's is considered. This project was last completed jointly by API (The American Petroleum Institute) and NBS (The National Bureau of Standards) over five years (1974 to 1979) at a cost of \$500,000. Given the scientific and professional resources of industry and the State, research into this, and related subjects, could be rewarding to both parties.

V. CONCLUSION

Knowledge and expertise in quality and quantity determinations, and resultant revenue determinations, is costly and not openly shared. It is an area where a little knowledge can be dangerous and industry may understandably fear a deluge of questions, that appear as accusations, from semi-informed sources. It is the State's (or any party to custody transfer) right and obligation to question, verify, and obtain maximum quality assurance of reported measurements data. However, without knowing what questions to ask, the answers will be irrelevant and only serve to aggravate an already sensitive issue.

Validity assurance and standardization of measurements can best be obtained through employment of third party professionals. The State must explicitly define its requirements and determine what tasks can best be accomplished by governmental bodies and where the State's interest may best be served by utilizing the expertise of private consultants. The cost savings of such an investment probably are not in increased accuracy, but rather in reduced settlement and litigation costs by having assured, appropriate, and standardized source data.

Resolution of these issues should increase cooperation between the State and the petroleum industry, not add to the adversarial relationship. Where cooperation is not possible due to constraints of a proprietary or confidential nature, an independent third party should be employed as a monitor or mediator to provide all parties the necessary surety without risking security.

- Late Entry - September 13, 1990:

A CASE IN POINT: Recent Settlement of the "Amerada Hess" litigation.

The primary issue resolved was the price of crude oil at the refinery gate, of a producer/shipper selling crude to a subsidiary refinery. Once this price dispute was settled, it remained to recalculate the wellhead price, by net back accounting utilizing the 1985 TAPS settlement method (TSM) of computing tariffs.

As this increased the wellhead price per barrel, for the previous thirteen years, the State Departments of Revenue and Natural Resources must have had to apply this adjusted wellhead price(s) to reported quantities and qualities, over the same time period, to ascertain an adjusted value for settlement.

It would be enlightening to pose the initial questions in section I of this testimony to the accounting personnel involved, considering similar settlements may be made with other parties to the case. Furthermore, how much of the costs of this case could have been saved by having reliable, verifiable, and appropriate source measurements data?

A settlement is obviously a compromise to avoid further litigation. Is it the refinery gate price that is being compromised or is it total settlement value based on volumetric measurements that is being compromised?

Chapter 30. Alaska Native Claims State Settlement Act of 1968.

[Repealed, § 9 ch 70 SLA 1972.]

Chapter 35. Right-of-Way Leasing Act.

Section

- 10. Legislative declaration of policy
- 15. Powers of the commissioner
- 20. Grant of right-of-way lease
- 30. Abandonment, reduction or impairment of service of pipeline
- 40. Temporary or emergency service or temporary abandonment, reduction or impairment of service by lessee
- 50. Applications for right-of-way leases
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- 110. Term of lease
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Section

- 140. Payment of rental and costs
- 170. Forfeiture of lease
- 180. Suits to enjoin or recover damages for defaults
- 190. Application of the Administrative Procedure Act
- 200. Judicial review of decisions of commissioner on application
- 205. Lease savings clause
- 210. Delegation of commissioner's authority
- 220. Continued operation of certain carriers
- 225. Binding effect of covenants
- 230. Definitions
- 260. Short title

NOTES TO DECISIONS

Applied in *Arco Pipeline Co. v. 3.60 Acres, More or Less, 539 P.2d 64 (Alaska 1975).*

Sec. 38.35.010. Legislative declaration of policy. (a) The natural resources of this state in crude oil and natural gas and in its land for transportation of these resources and their products by pipeline toward markets both in and out of the state are capable of making a significant contribution to the general welfare of the people of this state. It is the policy of this state that the development, use, and control of a pipeline transportation system be directed to make the maximum contribution to the development of the human resources of this state, the increase in the standard of living for all of its residents, the advancement of existing and potential sectors of its economy, the strengthening of free competition in its private enterprise system, and the careful protection of its incomparable natural environment.

(b) The State of Alaska reserves unto itself all rights, powers, privileges and immunities not preempted by federal interstate commerce laws and regulations in the right-of-way leasing of any state land for

pipeline construction, transmission, or operation within its boundaries. (§ 1 ch 72 SLA 1972; am § 1 ch 3 FSSLA 1973)

Collateral references. — 63A Am. Jur. 2d, Public Lands, §§ 31 to 34, 113 to 121. 73A C.J.S., Public Lands, §§ 68 to 70.

Sec. 38.35.015. Powers of the commissioner. The commissioner has all powers necessary and proper to implement the policy, purposes, and provisions of this chapter, so as to subserve, as the exercise of reasoned discretion determines, the public interest, convenience and necessity, including but not limited to

- (1) granting leases of state land for pipeline right-of-way purposes;
- (2) leasing, purchasing, or otherwise acquiring (including condemning by declaration of taking), easements or other interests in land in this state for the purpose of utilizing or granting leases of the land, easements or interests for pipeline right-of-way purposes;
- (3) purchasing interests in pipelines in accordance with options included in right-of-way leases;
- (4) investigating any matters concerning any lessee with a view to assuring compliance by it with its right-of-way lease, this chapter, and any other applicable state or federal law;
- (5) developing from time to time and maintaining a comprehensive master plan for pipeline transportation development;
- (6) developing and promoting programs to foster efficient, economical, and safe pipeline transportation services in the state;
- (7) coordinating the activities of the commissioner under this chapter with the transportation and other relevant activities of other public agencies and authorities;
- (8) constructing, extending, enlarging, improving, repairing, acquiring, operating, or engaging in transportation, service, or sale by any pipeline or providing for these by contract, lease, or other arrangement on those terms that the commissioner may consider necessary, convenient or desirable with any agency, corporation, or person, including but not limited to any carrier or any state agency, when the commissioner determines that a lessee carrier is not willing to undertake and complete the action within a reasonable time, and to sell, lease, grant, and dispose of any property constructed or acquired in the exercise of this power. (§ 3 ch 72 SLA 1972; am §§ 25 — 27 ch 3 FSSLA 1973; am § 38 ch 127 SLA 1974)

Revisor's notes. — Formerly AS 38.05.020(c). Renumbered in 1984.

NOTES TO DECISIONS

Construction of state lease provision reserving right to grant right-of-way. — Provision in a lease issued by the State of Alaska, division of lands, expressly reserving the right to grant an easement or right-of-way across the leased property

was construed to include an interagency transfer of a right-of-way to the Department of Transportation and Public Facilities. *Wessells v. State, Dep't of Hwys.*, 562 P.2d 1042 (Alaska 1977).

Sec. 38.35.020. Grant of right-of-way lease. (a) Rights-of-way on state land including rights-of-way over, under, along, across, or upon the right-of-way of a public road or highway or the right-of-way of a railroad or other public utility, or across, upon, over, or under a river or other body of water or land belonging to or administered by the state may be granted by noncompetitive lease by the commissioner for pipeline purposes for the transportation of oil, products or natural gas under those conditions prescribed by law or by administrative regulation. Except to the extent authorized by an oil and gas lease or unit agreement approved by the state, no person may engage in any construction or operation of any part of an oil, products, or natural gas pipeline, which in whole or in part is or is proposed to be on state land unless that person has obtained from the commissioner a right-of-way lease of the land under this chapter.

(b) The commissioner may by regulation exempt the construction or operation of field gathering lines or any reasonable classification of them from the requirement of a right-of-way lease under this chapter.

(c) The commissioner may provide in a lease issued under this section that a lessee may, with the approval of the commissioner, use materials from state land when necessary to protect state land and resources from the dangers or hazards resulting from damage caused by a pipeline disaster or emergency. If the commissioner approves the use of state materials under this subsection, the materials remain the property of the state until the material is sold to the lessee in accordance with the provisions of the lease. However, the approval does not transfer responsibility for clean up of the materials to the state. (§ 1 ch 72 SLA 1972; am § 2 ch 3 FSSLA 1973; am § 2 ch 119 SLA 1986)

Effect of amendments. — The 1986 amendment added subsection (c).

Opinions of attorney general. — The lease conversion provisions enacted by 1977 legislation (§§ 12, 13, ch. 138, SLA 1977, as amended by § 21, ch. 182, SLA 1978) applied only to those leases entered into under the substantive statutory provisions which were amended by the 1977

legislation. Hence, substantive amendments to AS 38.05 could not be applied to a lease which was not authorized by the leasing provisions of AS 38.05, but rather by the leasing provisions of this chapter, and the state was not estopped from challenging the validity of the terms of a wrongfully converted lease. December 10, 1985, Op. Att'y Gen.

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(b) The State of Alaska reserves unto itself all rights, powers, privileges and immunities not preempted by federal interstate commerce laws and regulations in the right-of-way leasing of any state land for

pipeline construction, transmission, or operation within its boundaries. (§ 1 ch 72 SLA 1972; am § 1 ch 3 FSSLA 1973)

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- (2) leasing, purchasing, or otherwise acquiring (including condemning by declaration of taking), easements or other interests in land in this state for the purpose of utilizing or granting leases of the land, easements or interests for pipeline right-of-way purposes;
- (3) purchasing interests in pipelines in accordance with options included in right-of-way leases;
- (4) investigating any matters concerning any lessee with a view to assuring compliance by it with its right-of-way lease, this chapter, and any other applicable state or federal law;
- (5) developing from time to time and maintaining a comprehensive master plan for pipeline transportation development;
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(b) The commissioner may by regulation exempt the construction or operation of field gathering lines or any reasonable classification of them from the requirement of a right-of-way lease under this chapter.

(c) The commissioner may provide in a lease issued under this section that a lessee may, with the approval of the commissioner, use materials from state land when necessary to protect state land and resources from the dangers or hazards resulting from damage caused by a pipeline disaster or emergency. If the commissioner approves the use of state materials under this subsection, the materials remain the property of the state until the material is sold to the lessee in accordance with the provisions of the lease. However, the approval does not transfer responsibility for clean up of the materials to the state. (§ 1 ch 72 SLA 1972; am § 2 ch 3 FSSLA 1973; am § 2 ch 119 SLA 1986)

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legislation. Hence, substantive amendments to AS 38.05 could not be applied to a lease which was not authorized by the leasing provisions of AS 38.05, but rather by the leasing provisions of this chapter, and the state was not estopped from challenging the validity of the terms of a wrongfully converted lease. December 10, 1985, Op. Att'y Gen.

(h) The issuance of a conditional lease does not prevent the commissioner from issuing other conditional or unconditional leases for the same right-of-way. A conditional lease may be revoked at any time that the commissioner determines that the applicant or conditional lessee will not be fit, willing, and able to perform during the term of the lease or when another applicant or conditional lessee is determined to be fit, willing, and able to perform under an application or lease for all or part of the right-of-way. An applicant or conditional lessee accrues no rights, including preference or priority rights, to a particular right-of-way until the commissioner makes a determination that the applicant or conditional lessee is then fit, willing, and able to perform the transportation or other acts proposed under (a) of this section.

(i) The commissioner shall insert a provision implementing the requirements of (a)(5) of this section into each agreement entered into by the commissioner for the construction and operation of a pipeline within the state. (§ 1 ch 72 SLA 1972; am § 9 ch 3 FSSLA 1973; am §§ 1, 2 ch 51 SLA 1987)

Effect of amendments. — The 1987 amendment in subsection (a) inserted "in a written finding" in the first sentence, added paragraph (5), and made minor punctuation changes; in subsection (b) in the first sentence substituted "the" for

"these" preceding "determinations" and inserted "under (a) of this section" and added the second and third sentences; rewrote subsection (c); and added subsections (d) — (i).

Sec. 38.35.110. Term of lease. Each lease of state land for pipeline right-of-way purposes must contain a provision that the lease shall run for a specified term of not greater than 30 years, and shall be renewable for additional periods of up to 10 years each, so long as the lessee is in commercial operation and is in full compliance with all state law, including but not limited to state law pertaining to regulation and taxation of the pipeline facility, and is in compliance with all terms of the lease. In making this determination the commissioner shall take into consideration the cost of the proposed pipeline, its useful life, and the probable financing requirement for the proposed pipeline. (§ 1 ch 72 SLA 1972; am § 10 ch 3 FSSLA 1973)

Sec. 38.35.120. Covenants required to be included in lease.
 (a) A noncompetitive lease of state land for a right-of-way for an oil or natural gas pipeline valued at \$1,000,000 or more may be granted only upon the condition that the lessee expressly covenants in the lease, in consideration of the rights acquired by it under the lease, that

(1) it assumes the status of and will perform all of its functions undertaken under the lease as a common carrier and will accept, convey, and transport without discrimination crude oil or natural gas,

depending on the kind of pipeline involved, delivered to it for transportation from fields in the vicinity of the pipeline subject to the lease throughout its route both on state land obtained under the lease and on the other land; however, a lessee who owns or operates a natural gas pipeline subject to regulation either (A) under the Natural Gas Act (15 U.S.C. 717 et seq.) of the United States, or (B) by the state or political subdivisions with respect to rates and charges for the sale of natural gas, is, to the extent of that regulation, exempt from the common carrier requirement in this paragraph; it will accept, convey, and transport crude oil or natural gas without unjust or unreasonable discrimination in favor of one producer or person, including itself, as against another but will take the crude oil or natural gas, depending on the kind of pipeline involved, delivered or offered, without unreasonable discrimination, that the Alaska Public Utilities Commission shall, after a full hearing with due notice to the interested parties and a proper finding of facts, determine to be reasonable in the performance of its duties as a common carrier;

(2) it will interchange crude oil or natural gas, depending on the kind of pipeline involved, with each like common carrier and provide connections and facilities for the interchange of crude oil or natural gas at every locality reached by both pipelines when the necessity exists, subject to rates and regulations made by the appropriate state or federal regulatory agency;

(3) it will maintain and preserve books, accounts, and records and will make those reports that the state may prescribe by regulation or law as necessary and appropriate for purposes of administration of this chapter;

(4) it will accord at all reasonable times to the state and its authorized agents and auditors the right of access to its property and records, of inspection of its property, and of examination and copying of records;

(5) it will provide connections, as determined by the Alaska Public Utilities Commission under AS 42.06.340, to facilities on the pipeline subject to the lease, both on state land and other land in the state, for the purpose of delivering crude oil or natural gas, depending on the kind of pipeline involved, to persons (including the state and its political subdivisions) contracting for the purchase at wholesale of crude oil or natural gas transported by the pipeline when required by the public interest;

(6) it shall, notwithstanding any other provision, provide connections and interchange facilities at state expense at such places the state considers necessary if the state determines to take a portion of its royalty or taxes in oil or natural gas;

(7) it will construct and operate the pipeline in accordance with applicable state laws and lawful regulations and orders of the Alaska Public Utilities Commission;

(8) it will, at its own expense, during the term of the lease

- (A) maintain the leasehold and pipeline in good repair;
- (B) promptly repair or remedy any damage to the leasehold;
- (C) promptly compensate for any damage to or destruction of property for which the lessee is liable resulting from damage to or destruction of the leasehold or pipeline;

(9) it will not transfer, assign, or dispose of in any manner, directly or indirectly, or by transfer of control of the carrier corporation, its interest in a right-of-way lease, or any rights under the lease or any pipeline subject to the lease to any person other than another owner of the pipeline (including subsidiaries, parents and affiliates of the owners), except to the extent that the commissioner, after consideration of the protection of the public interest (including whether the proposed transferee is fit, willing and able to perform the transportation or other acts proposed in a manner that will reasonably protect the lives, property and general welfare of the people of Alaska), authorizes; the commissioner shall not unreasonably withhold consent to the transfer, assignment or disposal;

(10) it will file with the commissioner a written appointment of a named permanent resident of the state to be its registered agent in the state and to receive service of notices, regulations, decisions and orders of the commissioner; if it fails to appoint an agent for service, service may be made by posting a copy in the office of the commissioner and filing a copy of it in the office of the lieutenant governor and by mailing a copy to the lessee's last known address;

(11) the applicable law of this state will be used in resolving questions of interpretation of the lease;

(12) the granting of the right-of-way lease is subject to the express condition that the exercise of the rights and privileges granted under the lease will not unduly interfere with the management, administration, or disposal by the state of the land affected by the lease, and that the lessee agrees and consents to the occupancy and use by the state, its grantees, permittees, or other lessees of any part of the right-of-way not actually occupied or required by the pipeline for the full and safe utilization of the pipeline, for necessary operations incident to land management, administration, or disposal;

(13) it will be liable to the state for damages or injury incurred by the state caused by the construction, operation or maintenance of the pipeline and it will indemnify the state for the liabilities or damages;

(14) it will procure and furnish liability and property damage insurance from a company licensed to do business in the state or furnish other security or undertaking upon the terms and conditions the commissioner considers necessary if the commissioner finds that the net assets of the lessee are insufficient to protect the public from damage for which the lessee may be liable arising out of the construction or operation of the pipeline.

(b) For a right-of-way lease granted under this chapter for an oil or natural gas pipeline valued at \$1,000,000 or more to be valid and of legal effect, it must contain the terms required to be inserted under the provisions of AS 38.35.110 — 38.35.140. An oil or natural gas pipeline right-of-way lease granted under this chapter that does not contain the required terms is null and void and without legal effect and does not vest any interest in state land or any authority in the carrier granted the lease.

(c) The commissioner may insert in any right-of-way lease other reasonable provisions and conditions required by the public interest.

(d) The lease will also contain terms and conditions that are reasonably necessary to obligate the lessee, to the extent reasonably practicable, to

(1) prevent conflicts with other existing uses of the land involving a superior public interest;

(2) protect state and private property interests;

(3) prevent any significant adverse environmental impact, including but not limited to the erosion of the surface of the land, and damage to fish and wildlife and their habitat;

(4) restore and revegetate during the term and at termination of the lease; and

(5) protect the interests of individuals living in the general area of the right of way who rely on the fish, wildlife, and biotic resources of the area for subsistence purposes.

(e) In the event the commissioner proposes to offer a lease or leases to two or more lessees for the same pipeline, the commissioner may include terms in the lease or leases which establish the limit of the obligations and liabilities of each lessee arising under this chapter or under the lease or leases. (§ 1 ch 72 SLA 1972; am § 11 ch 3 FSSLA 1973; am §§ 2, 3 ch 110 SLA 1981; am § 69 ch 59 SLA 1982)

Revisor's notes. — Former (f) of this section was renumbered as AS 38.35.122 in 1984.

Sec. 38.35.122. Products pipeline leases. The commissioner has discretion to include any or all of the terms set out in AS 38.35.120 in leases of state land for products pipeline right-of-way purposes. (§ 11 ch 3 FSSLA 1973)

Revisor's notes. — Formerly AS 38.35.120(f). Renumbered in 1984.

Effect of amendments. — The 1986 amendment added the last two sentences in subsection (b).

Sec. 38.35.150. Additional provisions of lease. (Repealed, § 14 ch 3 FSSLA 1973.)

Sec. 38.35.160. Transfer of right-of-way lease, certificates, or pipeline. (Repealed, § 15 ch 3 FSSLA 1973.)

Sec. 38.35.170. Forfeiture of lease. Failure to begin construction of the pipeline facility within a reasonable time of the granting of a right-of-way lease under this chapter for reasons within the control of the lessee or failure of an owner of an interest in the granted right-of-way substantially to comply with the terms of the right-of-way shall be grounds for forfeiture of the right-of-way interest of the lessee or owner in an action brought by the commissioner in the superior court. Before the commencement of any action for forfeiture of an interest in a right-of-way under this section, the commissioner shall give the lessee or owner of the interest notice in writing of the alleged default and shall not commence the proceeding unless the lessee or owner of the interest has failed to initiate good faith efforts to cure the default within 60 days of the notice of the alleged default. (§ 1 ch 72 SLA 1972; am § 16 ch 3 FSSLA 1973)

Sec. 38.35.180. Suits to enjoin or recover damages for defaults. (a) When in the judgment of the commissioner a person has violated or is about to violate a provision of this chapter or an obligation, condition, or provision of a right-of-way lease, the attorney general, on advice of the commissioner, shall seek a prohibition or mandatory injunction from the superior court to remedy the violation.

(b) A penalty imposed by the provisions of a right-of-way lease issued under this chapter may be enforced in the superior court by proceedings in personam against the lessee carrier, or, in the case of a lien, by proceedings in rem against any of the lessee carrier's property.

(c) Neither this section nor the state's obtaining an injunction or recovering penalties extinguishes any civil cause of action arising out of a violation of this chapter or the provisions of a right-of-way lease. (§ 1 ch 72 SLA 1972; am § 17 ch 3 FSSLA 1973)

Sec. 38.35.190. Application of the Administrative Procedure Act. (a) AS 44.62.010 — 44.62.320, 44.62.640 and 44.62.650 apply to regulations adopted by the commissioner under the authority of this chapter.

(b) *(Repealed, § 18 ch 3 FSSLA 1973.)*

(c) *(Repealed, § 18 ch 3 FSSLA 1973.)*

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RIGHT-OF-WAY LEASE FOR THE
TRANS-ALASKA PIPELINE

Offered by the Commissioner of the Department of Natural Resources on behalf of the State of Alaska, having determined pursuant to AS 38.35.100 that a pipeline right-of-way lease may be offered to the applicants that applied on March 7, 1974, for a pipeline right-of-way lease across State lands under AS 38.35 for the Trans-Alaska Pipeline, namely:

Amerada Hess Corporation
ARCO Pipe Line Company
Exxon Pipeline Company
Mobil Alaska Pipeline Company
Phillips Petroleum Company
Sohio Pipe Line Company
Union Alaska Pipeline Company

Copy inserted
for reference
6/15/88

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RIGHT-OF-WAY LEASE FOR THE TRANS-ALASKA PIPELINE

This lease is entered into as of this 3rd day of May, 1974 (hereinafter referred to as the "Effective Date"), by the State of Alaska (hereinafter referred to as the "State"), acting through the Commissioner of Natural Resources (hereinafter referred to as the "Commissioner"), and by

Amerada Hess Corporation, a Delaware Corporation,
ARCO Pipe Line Company, a Delaware Corporation,
Exxon Pipeline Company, a Delaware Corporation,
Mobil Alaska Pipeline Company, a Delaware Corporation,
Phillips Petroleum Company, a Delaware Corporation,
Sohio Pipe Line Company, a Delaware Corporation,
Union Alaska Pipeline Company, a California
Corporation,

(hereinafter sometimes referred to as the "Original Lessees").

It is the intent of the parties that, in the performance of this Lease, the following principles shall apply:

- (1) In the construction (including, but not limited to, design), operation, maintenance (including but not limited to a continuing and reasonable program of preventative maintenance) and termination of the Pipeline, Lessees shall employ the best practicable technology available and use all practicable means and measures to preserve and protect the environment, as provided in this lease.
- (2) The parties shall protect environmental amenities and values within the practicable bounds of economic and technical feasibility and in accordance with applicable State policies. In so doing, the parties shall take into account, among other considerations, the following:
 - (a) The benefit or detriment to persons, property and the environment that may be anticipated to result from a proposed course of conduct.
 - (b) The particular environmental technical, and economic benefits or detriments reasonably expected to flow from a proposed course of conduct.

NOTE: Terms having special meaning are defined in the body of this Lease or in Exhibit "A" hereof. Such terms are capitalized herein.

(3) Lessees shall manage, supervise, and implement the construction, operation, maintenance and termination of the Pipeline in accordance with the best practicable engineering technology available, particularly with regard to permafrost and seismic areas, to the extent allowed by the state of the art and the development of technology. In the exercise of these functions, Lessees consent and shall submit to such review, inspection, and compliance procedures relating to construction, operation, maintenance, and termination of the Pipeline as are provided for in this Lease and other applicable authorizations.

1. Grant of Right-of-Way

a. Pursuant to the provisions of AS 38.35, the Alaska Right-of-Way Leasing Act, as amended, and for and in consideration of the annual rental fee prescribed in Section 3 hereof and the covenants herein contained to be kept and performed on the part of the Lessees and subject to the conditions and requirements herein contained, the State hereby grants to the Original Lessees, for the period of limited duration prescribed in Section 2 hereof and for the purpose prescribed in Subsection "c" of this section, a right-of-way (hereinafter referred to as the "Right-of-Way") for a pipeline with its Related Facilities (such pipeline and Related Facilities being hereinafter referred to as the "Pipeline"), the width and location thereof being subject to the provisions of Subsection "d" hereof, across, through and upon State land now owned or hereafter acquired (hereinafter sometimes referred to as "State Land"), along the General Route of the Pipeline shown in the application and accompanying alignment and Related Facility site location drawings referred to in Exhibit "B" hereof. The grant made hereby is of the following undivided interests in and to the Right-of-Way to the companies designated:

Amerada Hess Corporation, an undivided interest of 3.00% of the whole;

ARCO Pipe Line Company, an undivided interest of 28.08% of the whole;

Exxon Pipeline Company, an undivided interest of 25.52% of the whole;

Mobil Alaska Pipeline Company, an undivided interest of 8.68% of the whole;

Phillips Petroleum Company, an undivided interest of 3.32% of the whole;

Sohio Pipe Line Company, an undivided interest of 28.08% of the whole;

Union Alaska Pipeline Company, an undivided interest of 3.32% of the whole.

b. This grant is made subject to (i) all applicable laws and regulations of the State of Alaska, and (ii) any valid existing rights in the lands subject to the Right-of-Way.

c. The Right-of-Way is granted for the purpose of the construction, operation, maintenance and termination of one (1) Oil transportation pipeline, consisting of one (1) line of forty-eight (48)-inch-diameter pipe and its Related Facilities. Lessees shall not use the Right-of-Way or the land subject thereto for any other purpose and shall not locate or construct any other pipelines (including looping lines) or other improvements within the Right-of-Way without prior written approval of the Commissioner. The Pipeline shall be used for only the transportation of Oil, and it shall not be used for any other purpose without the prior written approval of the Commissioner. Each Lessee shall not allow or suffer any person or business entity, with the exception of the other Lessees under this Lease, to use the Right-of-Way for the purpose set forth in this section. Nothing in this subsection is intended to (i) excuse or preclude Lessees from complying with their obligations under Section 4 of this Lease, or (ii) preclude Lessees from employing agents or contractors to effect construction, operation, maintenance or termination of all or any part of the Pipeline.

d. (i) During construction of the Pipeline and prior to the execution of the release of interests in the Right-of-Way provided for in paragraph (ii) of this subsection, the width of the Right-of-Way shall be 400 feet, except (1) that in locations where the line of pipe is to enter or cross any river bed or flood plain, the width of the Right-of-Way shall be 600 feet within an area bounded by parallel lines on each side of and 1,000 feet from the centerline of the particular river, and (2) that the dimensions of the Right-of-Way for Related Facilities shall be those more particularly set forth in Exhibit "D" hereof.

(ii) After completion of construction of the Pipeline within a particular Mapping Segment, the land subject to the Right-of-Way shall be (1) 400 feet in width along the line of pipe across State Land, except that in locations where the line of pipe enters or crosses any river, river bed or flood plain, the width of the Right-of-Way shall be 600 feet in width within an area bounded by parallel lines on each side of and 1,000 feet from the centerline of the particular river, the centerline of the pipe being also the centerline of the 400 and 600 foot Rights-of-Way, and (2) the sites for Related

Facilities described in Exhibit "D." Within 360 days following the Commissioning of the Pipeline, Lessees shall execute and deliver to the State a release of all interest in such portions of the Right-of-Way as will result in Lessees retaining only (1) the Right-of-Way for Related Facilities described in Exhibit "D," and (2) the Right-of-Way not exceeding 100 feet in width along the line of pipe with the centerline of the line of pipe being the centerline of the Right-of-Way, except that at such locations where Lessees have requested authority from the Commissioner to retain a wider Right-of-Way and the Commissioner has found and recorded the reasons for his finding that in his judgment a wider Right-of-Way is necessary for the operation and maintenance of the Pipeline after construction, or that a wider Right-of-Way is necessary to protect the environment or public safety, the width of the Right-of-Way which Lessees retain may exceed 100 feet in width in accordance with the Commissioner's finding.

e. Upon the release required by Subsection "d" of this section, Lessees shall survey and provide adequate monumentation as the Commissioner may require to locate and describe the Right-of-Way and the Lessees shall file: (i) Proof of construction of the Pipeline in accordance with the provisions of this Lease and the applicable regulations of the Department of Natural Resources; and (ii) a map, or maps or survey, approved by the Commissioner, showing the final "as built" location of the completed Pipeline, including the final locations of all buried and above-ground improvements, the centerline of the Right-of-Way, as definitely located, and, referenced to the centerline, the boundaries of the Right-of-Way, as definitely located.

f. All construction activities within the Right-of-Way shall be limited to a construction zone approved by the Pipeline Coordinator in the applicable Notice to Proceed.

2. Duration of Right-of-Way Grant

a. The grant hereby made of the Right-of-Way shall come to an end and expire on the 2nd day of May, 2004, at 12 noon, (Alaska Standard Time) unless prior thereto it is released, abandoned, or otherwise terminated pursuant to the provisions of this Lease or of any applicable law or regulation.

b. Upon the expiration of the initial or any subsequent grant of the Right-of-Way, or its earlier relinquishment, abandonment, or other termination, the provisions of this Lease, to the extent applicable, shall continue in effect and shall be binding on the parties hereto, their successors or assigns, until they have fully performed their respective obligations and liabilities accruing before or on account of the expiration, or the prior termination, of the grant.

c. The Commissioner shall renew the Lease for additional periods up to ten (10) years each, so long as the Pipeline is in commercial operation and the Lessees are in full compliance with State law, including but not limited to State law pertaining to regulation and taxation of the Pipeline.

d. Any subsequent conveyance, transfer or other disposition of any right, title, or interest in the State Land or any part thereof, burdened by and subservient to this Lease, shall, to the extent allowed by law, be subject to the Right-of-Way and the provisions of this Lease, including Lessees' right to renew the Lease under Subsection "c" of this section.

3. Rental

a. Lessees shall pay to the State, annually and in advance, the fair market rental value of the Right-of-Way based on the appraised fair market value of the land.

b. The initial charge for the first year's rental shall be One Hundred Forty-One Thousand Two Hundred Twenty-Five Dollars (\$141,225.00); however, this amount shall be adjusted based on a formal appraisal conducted before January 1, 1975.

c. The annual rental payment is subject to adjustment at five-year intervals and charges or adjustments shall be the reappraised fair market rental value of the land.

d. Rental shall not be charged for any land acquired under AS 38.35.130 and conveyed without cost to the State.

e. For the year in which portions of the Right-of-Way are released to the State pursuant to Section 1, Subsection "d", paragraph (ii) hereof, the State shall credit Lessees against the payment of future rental for a portion of the rental paid to the State for that year, the amount of the credit to be the portion of rental paid for that year attributable to the lands so reconveyed to the State reduced pro rata by the portion of the lease year which had elapsed prior to the reconveyance.

4. Common Carrier

Each Lessee shall assume the status and perform all of its functions undertaken under the Lease as a common carrier and accept, convey and transport without discrimination, crude oil delivered to it for transportation from fields in the vicinity of the Pipeline subject to the Lease throughout its route, both on State Land obtained under the Lease and on other land; Lessee shall accept, convey and transport crude oil without unjust or unreasonable discrimination in favor of one producer or person, including itself, as against another,