NATIONAL PETROLEUM RESERVE IN ALASKA

HISTORY OF DRILLING OPERATIONS

U. S. NAVY

SOUTH BARROW WELL NO. 13

HUSKY OIL NPR OPERATIONS, INC.
Prepared by: Drilling Department
Edited by: S. L. Hewitt and Gordon W. Legg

For the

U. S. GEOLOGICAL SURVEY
Office of the National Petroleum Reserve in Alaska
Department of the Interior
JANUARY 1983

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SOUTH BARROW WELL NO. 13

INTRODUCTION

The U. S. Navy South Barrow Well No. 13 is located in the South Barrow Gas Field, southeast of Barrow, Alaska, on the National Petroleum Reserve in Alaska which, at the time of drilling, was designated the Naval Petroleum Reserve No. 4 (Figure 1). The well is located 807' from the west line and 552' from the south line of protracted Section 14, Township 22 North, Range 18 West, Umiat Meridian (Latitude: 71°15'13.84" North; Longitude: 156°37'40.41" West). The Alaska State Plane Coordinates are: X = 661,513 and Y = 6,310,250, Zone 6. Elevations are 22' ground level, 26' pad and 40' Kelly bushing. Operations started November 16, 1976, with movement of camp units to the location. Rigging-up started on December 6, 1976. Operations at South Barrow No. 13 ended on January 22, 1977, with final movement of rig components to the South Barrow No. 14 location.

The well was drilled to a total depth of 2534' (measured depth). The hole deviated from the vertical and the true vertical depth at total depth was 2491'. At a measured depth of 2475' (last calculated point), the true vertical depth was 2433' and the bottom hole location had migrated 366.65' in a south 86°, 16 minute west direction from the surface location. The azimuth was 266.27°. Although the perforated intervals correlate with log depths (measured depths) and, thus, with the proper sand intervals, they are approximately 40' low to their actual structural position based on true vertical depth.

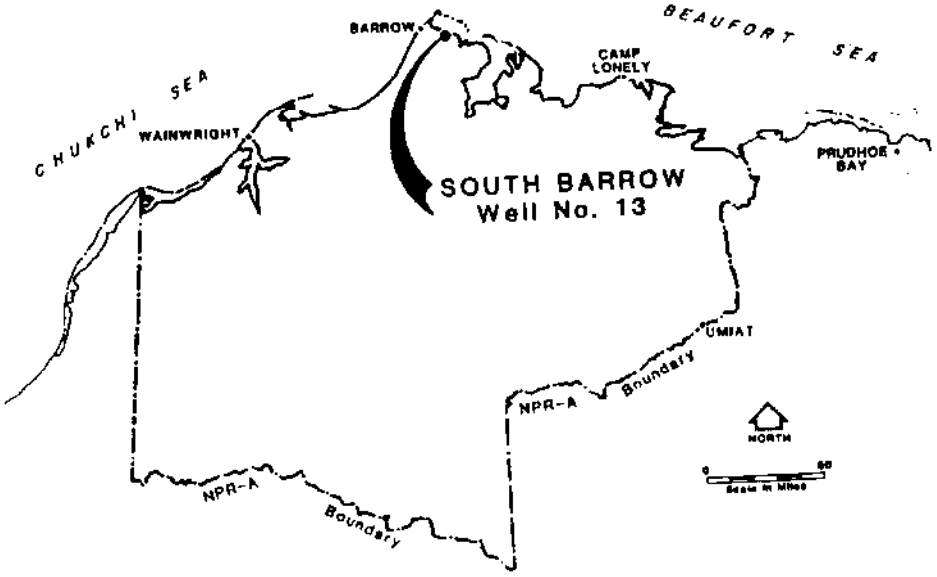


FIGURE 1 - WELL LOCATION MAP - SOUTH BARROW WELL NO. 13

The primary objective of the well was the Lower Barrow sand. The sand zone was assumed to have suffered damage from drilling with fresh water mud which is known to cause permeability restriction from swelling clays. A calcium-chloride system was used in later wells to minimize damage (see discussion in report on South Barrow Well No. 16). The sand was also found to have somewhat poorer than normal porosities and permeabilities.

At the conclusion of the drilling and evaluation operations, tubing was run and the well was completed as a marginally productive natural gas well.

Husky Oil NPR Operations, Inc. supervised and directed the drilling and completion operations as prime contractor for the Navy. Parco, Inc. was the labor contractor. A Cardwell Model H, owned by the U. S. Navy, was used to drill the well.

DRILLING SUMMARY

The drilling pad at South Barrow Well No. 13 had been previously constructed and components of the drilling rig had been stored at that location. Field operations started on November 16, 1976, with the movement of camp units from the NARL facility to the well location. Considerable time was spent in overhauling and repairing rig components, water and mud lines, and in repairing and replacing the electrical system. Actual rig-up operations began on December 6, 1976. Rig-up was completed in 17 days and the well was spudded at 10:00 p.m., December 17, 1976.

Rig-up operations were delayed by the necessity to repair much of the rig and its auxiliary components. These included the boiler; hot air heater; mud pumps; mud system; steam, water and mud lines; and the electrical system. Also, the camp generators broke down, requiring the use of the rig generators to power the camp while temporary repairs could be made. The pre-set conductor had to be thawed and pulled, since it had not been cemented and would not support the necessary blowout-preventer equipment. The conductor hole was deepened and 60' of 20" conductor was set and cemented with Permafrost cement at 74', which was 60' below ground level. A 20" head was then welded onto the casing.

A 16" annular blowout preventer and diverter lines were installed on the 20" conductor. A 14-3/4" hole was drilled from 74' to 1148'. The hole was logged from 1148' to the bottom of the 20" conductor with a Dual Induction Laterolog and the Bore Hole Compensated-Sonic/Gamma Ray log. After logging, the hole was deepened to 1166' to accommodate the casing to be used.

Ten and three-quarters inch surface casing was run to 1157' and cemented to the surface with 760 sacks of Permafrost cement. A 10" 3,000 psi blowout-preventer stack, choke manifold, and kill line were installed on the 10-3/4" casing. The 10-3/4" casing was tested to 1,500 psi and drilled out with an 8-1/2" bit.

An 8-1/2" hole was drilled from 1166' to 2159'. Core No. 1 was cut from 2159' to 2189' and 30 feet of core was recovered. Core No. 2 was cut from 2189' to 2219' recovering 27 feet. Drilling was resumed to 2288' and Core No. 3 was cut from 2288' to 2318' recovering 30 feet. Core No. 4 was cut from 2318' to 2348' recovering 30 feet. Drilling was resumed from 2348' to 2410'. Core No. 5 was cut from 2410' to 2425' recovering 15 feet. The 8-1/2" hole was logged from 2425' to 1157' with a Dual Induction Laterolog and Compensated Formation Density/Compensated Neutron/Gamma Ray log.

After evaluation of the logs, the hole was deepened to 2522'. Core No. 6 was cut from 2522' to 2534' when the core barrel jammed, recovering 3 feet. The 8-1/2" hole was logged from 2534' to 1157' with a Dual Induction Laterolog, Compensated Formation Density/Compensated Neutron/Gamma Ray log, Bore Hole Compensated-Sonic/Gamma Ray log and High Resolution Dipmeter. Twenty-four sidewall cores were attempted and 17 recovered.

To complete the well, a 7" production casing string was run to 2514'. It was cemented to the surface with 805 sacks of Permafrost cement, tailed in with 80 sacks of Class "G" cement containing 2% Calcium-Chloride as an accelerator.

The tubing head and blowout preventer stack were nippled up and tested. The 7" casing was cleaned out and tested to 1,200 psi. The Cement Bond/Variable Density/Gamma Ray/Casing Collar Locator log was run, and the 7" casing was perforated at four shots per foot using Schlumberger's 4" Hyperjet II casing gun across the intervals 2358-2368', 2315-2330', 2330-2345', 2224-2234'. The tree was nippled up and tested to 3,000 psi.

In an attempt to bring the well in, it was reverse circulated to water and swabbing operations started. Considerable difficulty was encountered while attempting to swab the well due to swabbing equipment failure, which resulted in the swab tools becoming stuck in the tubing. Several attempts were made, but the tools could not be pulled free. Blowout-preventer equipment was nippled up and the tubing pulled to recover the swab tools which were frozen in the tubing. An alcohol-water mixture was circulated into the well to prevent freezing and the tree nippled up.

A temporary gas line was laid from Well No. 10 to Well No. 13, and gas from No. 10 was used to rock the fluid from the No. 13 well. The well responded very poorly. Further attempts to get the well to flow were not successful and the well was circulated and killed with calcium-chloride water.

All data from the well was reviewed in an attempt to determine why the perforated intervals would not produce. The High Resolution Dipmeter log indicated hole deviation. A Sperry-Sun Gyroscopic Multishot Directional Survey was run on 100' stations (Appendix No. 1). The survey results indicated that the well had kicked off. The lowest survey point in the well was at 2475' measured depth, corresponding to a 2433' true vertical depth. The horizontal displacement was calculated to be 366.65' at South 86°16' West of true North at 2475' measured depth. The maximum inclination of 14°29' was surveyed at 1100' measured depth.

Because of the deviated hole, the 7" casing was reperforated with four Hyperjet shots per foot over the intervals 2224.5-2234.5', 2383-2387', 2356.5-2376.5', 2315.5-2345.5'. Tubing was rerun and landed at 2394'. The tree was installed and tested. The well was rocked in with gas from Well No. 10. The well flowed very slightly. Five barrels of alcohol were pumped into the well for hydrate prevention, and the back-pressure valve was set. The rig was released to South Barrow No. 14 at 10:30 a.m., January 16, 1977.

Detailed drilling information, in the form of bit records, mud summary, time analysis, and casing and cementing reports, is included in this report.

South Barrow Well No. 13 was re-entered on July 20, 1978, and draw-down and back-pressure testing carried out. The well produced gas with a calculated Absolute Open Flow of 360 MCF/D. Appendix No. 2 of this report contains the detailed analysis of the reservoir by Stephen K. Lewis, Reservoir Engineer, Husky ONPRA.

Form 9-331 C
(May 1963)

AMENDED

SUBMIT IN TRIPLICATE*
(Other instructions on reverse side)

Form approved.
Budget Bureau No. 42-R1425.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

APPLICATION FOR PERMIT TO DRILL, DEEPEN, OR PLUG BACK

5. LEASE DESIGNATION AND SERIAL NO.: None

6. IF INDIAN, ALLOTTEE OR TRIBE NAME: None

1a. TYPE OF WORK: DRILL [X] DEEPEN [ ] PLUG BACK [ ]

7. UNIT AGREEMENT NAME:

b. TYPE OF WELL: OIL WELL [ ] GAS WELL [X] OTHER — SINGLE ZONE [ ] MULTIPLE ZONE [ ]

8. FARM OR LEASE NAME: Naval Petroleum Reserve #4

2. NAME OF OPERATOR: Husky Oil NPR Operations, Inc.

9. WELL NO.: So. Barrow No. 13

3. ADDRESS OF OPERATOR: 3201 C Street, Suite 600, Anchorage, AK 99503

10. FIELD AND POOL, OR WILDCAT: So. Barrow Gas Field

4. LOCATION OF WELL (Report location clearly and in accordance with any State requirements.*)
At surface: 807' FWL & 552' FSL, Sec 14, T22N, R18W
At proposed prod. zone: Same as above

11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA: Sec 14, T22N, R18W

14. DISTANCE IN MILES AND DIRECTION FROM NEAREST TOWN OR POST OFFICE*: Approximately four miles south of Barrow

12. COUNTY OR PARISH: No. Slope Borough | 13. STATE: Alaska

15. DISTANCE FROM PROPOSED* LOCATION TO NEAREST PROPERTY OR LEASE LINE, FT. (Also to nearest drlg. unit line, if any)	16. NO. OF ACRES IN LEASE	17. NO. OF ACRES ASSIGNED TO THIS WELL
Approximately 739,200'	23,680,000	160
18. DISTANCE FROM PROPOSED LOCATION* TO NEAREST WELL, DRILLING, COMPLETING, OR APPLIED FOR, ON THIS LEASE, FT.	**19. PROPOSED DEPTH**	**20. ROTARY OR CABLE TOOLS**
2009'	2500'	Rotary

21. ELEVATIONS (Show whether DF, RT, GR, etc.): Ground = 22'; Pad = 26'; KB = 40'

22. APPROX. DATE WORK WILL START*: December 1, 1976

23. PROPOSED CASING AND CEMENTING PROGRAM

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	SETTING DEPTH	QUANTITY OF CEMENT
26"	20"	133#	40'	100 sx as required to surface
14 3/4"	10 3/4"	51#	1200'	2500 sx as required to surface
8 1/2"	7"	23#	2500'	560 sx as required to surface

This form is filed for information only. Please refer to letter from the Director, Naval Petroleum and Oil Shale Reserves, Serial #394, August 27, 1968.

RECEIVED
DEPUTY MINERALS MANAGER
ONSHORE FIELD OPERATIONS

JAN 18 1983

MINERALS MANAGEMENT SERVICE
411 W. 4TH AVE., SUITE 2A
ANCHORAGE, ALASKA 99501

IN ABOVE SPACE DESCRIBE PROPOSED PROGRAM: If proposal is to deepen or plug back, give data on present productive zone and proposed new productive zone. If proposal is to drill or deepen directionally, give pertinent data on subsurface locations and measured and true vertical depths. Give blowout preventer program, if any.

24.

SIGNED /s/ J. M. McCarthy TITLE Drilling Engineer DATE 11-1-76

(This space for Federal or State office use)

PERMIT NO. _____ APPROVAL DATE _____

APPROVED William D. Hansen TITLE Acting Oil and Gas Supervisor DATE 1/18/83

CONDITIONS OF APPROVAL, IF ANY:

This amends original signed 11/1/76 Amended 1/14/83

*See Instructions On Reverse Side

Form 10-401
REV. 1-1-71

SUBMIT IN TRIPLICATE
(Other instructions on reverse side)

AMENDED

STATE OF ALASKA

OIL AND GAS CONSERVATION COMMITTEE

PERMIT TO DRILL OR DEEPEN

1a. TYPE OF WORK: DRILL [X] DEEPEN [ ]

b. TYPE OF WELL: OIL WELL [ ] GAS WELL [X] OTHER SINGLE ZONE [X] MULTIPLE ZONE [ ]

2. NAME OF OPERATOR: Husky Oil NPR Operations, Inc.

3. ADDRESS OF OPERATOR: 3201 C Street, Suite 600, Anchorage, AK 99503

4. LOCATION OF WELL: At surface: 807' FWL & 552' FSL, Sec 14, T22N, R18W
At proposed prod. zone: Same as above

13. DISTANCE IN MILES AND DIRECTION FROM NEAREST TOWN OR POST OFFICE*: Approximately 4 miles south of Barrow

14. BOND INFORMATION: TYPE: Surety and/or No. None

6. LEASE DESIGNATION AND SERIAL NO.: None

7. IF INDIAN, ALLOTTEE OR TRIBE NAME: None

8. UNIT FARM OR LEASE NAME: Naval Petroleum Reserve No.

9. WELL NO.: South Barrow Well No. 13

10. FIELD AND POOL, OR WILDCAT: South Barrow Gas Field

11. SEC., T., R., M., (BOTTOM HOLE OBJECTIVE): Sec 14, T22N, R18W

12. North Slope Borough

15. DISTANCE FROM PROPOSED* LOCATION TO NEAREST PROPERTY OR LEASE LINE, FT. (Also to nearest drlg. unit, if any): Approximately 739,200'

16. NO. OF ACRES IN LEASE: 23,680,000

17. NO. ACRES ASSIGNED TO THIS WELL: 160

18. DISTANCE FROM PROPOSED LOCATION* TO NEAREST WELL DRILLING, COMPLETED, OR APPLIED FOR, FT.: 2009'

19. PROPOSED DEPTH: 2500'

20. ROTARY OR CABLE TOOLS: Rotary

21. ELEVATIONS (Show whether DF, RT, GR, etc.): Ground = 22'; Pad = 26'; KB = 40'

22. APPROX. DATE WORK WILL START*: December 1, 1976

23. PROPOSED CASING AND CEMENTING PROGRAM

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	GRADE	SETTING DEPTH	QUANTITY OF CEMENT
26"	20"	133#	K-55	40'	100 sx as required to surface.
14 3/4"	10 3/4"	51#	N-80	1200'	2500 sx as required to surface.
8½"	7"	23#	N-80	2500'	560 sx as required to surface.

This form is filed for information only. Please refer to letter from the Director, Naval Petroleum and Oil Shale Reserves, Serial # 394, August 27, 1968.

RECEIVED
DEPUTY MINERALS MANAGER
ONSHORE FIELD OPERATIONS

JAN 18 1983

MINERALS MANAGEMENT SERVICE
411 W. 4TH AVE., SUITE 2A
ANCHORAGE, ALASKA 99501

IN ABOVE SPACE DESCRIBE PROPOSED PROGRAM: If proposal is to deepen, give data on present productive zone and proposed new productive zone. If proposal is to drill or deepen directionally, give pertinent data on subsurface locations and measured and true vertical depths. Give blowout preventer program.

24. I hereby certify that the Foregoing is True and Correct

SIGNED: (s/) M. McCarthy DATE: 11-1-76 TITLE: Drilling Engineer

(This space for State office use)

CONDITIONS OF APPROVAL, IF ANY:

SAMPLES AND CORE CHIPS REQUIRED	MUD LOG	OTHER REQUIREMENTS:
[ ] YES [ ] NO	[ ] YES [ ] NO	
DIRECTIONAL SURVEY REQUIRED	A.P.I. NUMERICAL CODE	
[ ] YES [ ] NO	50-023-20008	

PERMIT NO. _____ APPROVAL DATE _____

APPROVED BY _____ TITLE _____ DATE _____

*See Instructions On Reverse Side

This amends original signed 11/1/76. Amended 1/14/83

Form 9-331
Dec. 1973

Form Approved.
Budget Bureau No. 42-R1424

UNITED STATES AMENDED
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SUNDRY NOTICES AND REPORTS ON WELLS

(Do not use this form for proposals to drill or to deepen or plug back to a different reservoir. Use Form 9-331-C for such proposals.)

1. oil well ☐ gas well ☒ other

2. NAME OF OPERATOR
Husky Oil NPR Operations, Inc.

3. ADDRESS OF OPERATOR
3201 C Street, Suite 600, Anchorage, AK 99503

4. LOCATION OF WELL (REPORT LOCATION CLEARLY. See space 17 below.)
AT SURFACE: 807' FWL & 552' FSL
AT TOP PROD. INTERVAL:
AT TOTAL DEPTH:

5. LEASE
Naval Petroleum Reserve #4

6. IF INDIAN, ALLOTTEE OR TRIBE NAME
N/A

7. UNIT AGREEMENT NAME
N/A

8. FARM OR LEASE NAME
So. Barrow Gas Field

9. WELL NO.
So. Barrow No. 13

10. FIELD OR WILDCAT NAME
South Barrow Gas Field

11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA
Sec. 14, T22N, R18W

12. COUNTY OR PARISH 13. STATE
No. Slope Borough, Alaska

14. API NO.
50-023020008

15. ELEVATIONS (SHOW DF, KDB, AND WD)
Ground = 22'; Pad = 26'; KB = 40'

16. CHECK APPROPRIATE BOX TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

REQUEST FOR APPROVAL TO:		SUBSEQUENT REPORT OF:	
TEST WATER SHUT-OFF	☐		☐
FRACTURE TREAT	☐		☐
SHOOT OR ACIDIZE	☐		☐
REPAIR WELL	☐		☐
PULL OR ALTER CASING	☐		☐
MULTIPLE COMPLETE	☐		☐
CHANGE ZONES	☐		☐
ABANDON*	☐		☐
(other) Progress report.			

(NOTE: Report results of multiple completion or zone change on Form 9-330.)

17. DESCRIBE PROPOSED OR COMPLETED OPERATIONS (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work. If well is directionally drilled, give subsurface locations and measured and true vertical depths for all markers and zones pertinent to this work.)*

12/17/76: Spudded well at 10:00 p.m.
12/23/76: Drilled 14 3/4" hole to 1166. Ran DIL, BHC/Sonic/GR/CAL. Ran 10 3/4" 60.70# P-110 casing to 1157. Cemented to surface w/760 sx Permafrost II. Full cement returns to surface
12/25/76: Nipple up stack. Tested casing and stack to 1500#.
12/26/76: Drilled 8 1/2" hole.
12/27/76: Core #1, 2159-2189, 100% recovery.
12/29/76: Core #2, 2189-2219, 97% recovery.
12/30/76: Core #3, 2288-2318, 100% recovery.
12/31/76: Core #4, 2318-2348, 100% recovery.
1/1/77: Core #5, 2410-2425, 100% recovery.
1/1/77: Drilled 8½" hole to 2438'. Ran DIL, BHC/Sonic/GR/CAL and FDC/CNL/CAL. (See continuation attached)

RECEIVED
DEPUTY MINERALS MANAGER
ONSHORE FIELD OPERATIONS
JAN 18 1983
MINERALS MANAGEMENT SERVICE
411 W. 4TH AVE., SUITE 2A
ANCHORAGE, ALASKA 99501

Subsurface Safety Valve: Manu. and Type _____ Set @ _____ Ft.

18. I hereby certify that the foregoing is true and correct

SIGNED (SI) J. M. McCarthy TITLE Drilling Mgr DATE 1-6-76

(This space for Federal or State office use)

APPROVED BY William J. Hause TITLE Acting District Supervisor DATE 1/18/83
CONDITIONS OF APPROVAL, IF ANY:

This amends original signed 1/6/76. Amended 1/14/83

*See Instructions on Reverse Side

Item 17 continued:

1/2/77: Drilled 8¼" hole to 2522'. Core #6, 2522-2534', 25% recovery.
1/3/77: Ran DIL, BHC/Sonic, FDC/CNL, Dipmeter from TD to 2534. Took 24 sidewall cores, recovered 17.
1/4/77: Ran 7" casing N-80 32# R-3, C-1, 8RD to 2514. Cemented w/805 sx Permafrost II, tailed in w/80 sx Class G 2% $CaCl_2$ Full cement returns to surface.

This report is CONFIDENTIAL and is filed for information purposes only.

Form 10-403
REV. 1-10-73

Submit "Intentions" in Triplicate
& "Subsequent Reports" in Duplicate

AMENDED

STATE OF ALASKA
OIL AND GAS CONSERVATION COMMITTEE

SUNDRY NOTICES AND REPORTS ON WELLS
(Do not use this form for proposals to drill or to deepen
Use "APPLICATION FOR PERMIT—" for such proposals.)

5. API NUMERICAL CODE: 50-023-20008

6. LEASE DESIGNATION AND SERIAL NO.: N/A

1. OIL WELL ☐ GAS WELL ☒ OTHER

7. IF INDIAN, ALLOTTEE OR TRIBE NAME: N/A

2. NAME OF OPERATOR: Husky Oil NPR Operations, Inc.

8. UNIT, FARM OR LEASE NAME: So. Barrow Gas Field

3. ADDRESS OF OPERATOR: 3201 C Street, Suite 600, Anchorage, AK 99503

9. WELL NO.: So. Barrow No. 13

4. LOCATION OF WELL
At surface
807' FWL & 552' FSL

10. FIELD AND POOL, OR WILDCAT: So. Barrow Gas Field

11. SEC., T., R., M., (BOTTOM HOLE OBJECTIVE): Sec. 14, T22N, R18W

13. ELEVATIONS (Show whether DF, RT, GR, etc.): Ground = 22; Pad = 26; KB = 40'

12. PERMIT NO.: N/A

14. Check Appropriate Box To Indicate Nature of Notice, Report, or Other Data

NOTICE OF INTENTION TO:				SUBSEQUENT REPORT OF:			
TEST WATER SHUT-OFF	☐	PULL OR ALTER CASING	☐	WATER SHUT-OFF	☐	REPAIRING WELL	☐
FRACTURE TREAT	☐	MULTIPLE COMPLETE	☐	FRACTURE TREATMENT	☐	ALTERING CASING	☐
SHOOT OR ACIDIZE	☐	ABANDON*	☐	SHOOTING OR ACIDIZING	☐	ABANDONMENT*	☐
REPAIR WELL	☐	CHANGE PLANS	☐	(Other) Progress report.			☐
(Other)	☐			(NOTE: Report results of multiple completion on Well Completion or Recompletion Report and Log form.)			

15. DESCRIBE PROPOSED OR COMPLETED OPERATIONS (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work.

12/17/76: Spudded well @ 10:00 p.m.
12/23/76: Drilled 14 3/4" hole to 1166', ran DIL, BHC/Sonic/GR, Cal. Ran 10 3/4" 60.70# P-110 casing to 1157. Cemented to surface w/760 sx Permafrost II. Full cement returns to surface.
12/25/76: Nipple up stack. Test casing and stack to 1500#.
12/26/76: Drilled 8½" hole.
12/27/76: Core #1, 2159-2189, 100% recovery.
12/29/76: Core #2, 2189-2219, 97% recovery.
12/30/76: Core #3, 2288-2318, 100% recovery.
12/31/76: Core #4, 2318-2348, 100% recovery.
1/1/77: Core #5, 2410-2425, 100% recovery.
1/1/77: Drill 8½" hole to 2438'. Run DIL, BHC/Sonic/GRA/CA/ and FDC/CNL/CAL.
1/2/77: Drilled 8½" hole to 2522'. Core #6, 2522 to 2534', 25% recovery.
1/3/77: Ran DIL, BHC/Sonic, FDC/CNL, Dipometer from TD of 2534. Took 24 sidewall cores; recovered 17.
1/4/77: Ran 7" casing N-80 32# R-3, C-1, 8RD to 2514. Cement w/805 sx Permafrost II, tail in w/80 sx Class G 2% $CaCl_2$. Full cement returns to surface.

RECEIVED
DEPUTY MINERALS MANAGER
OFFSHORE FIELD OPERATIONS
JAN 18 1983
MINERALS MANAGEMENT SERVICE
411 W. 4TH AVE., SUITE 2A
ANCHORAGE, ALASKA 99501

This report is CONFIDENTIAL and is being filed for information purposes only.

16. I hereby certify that the foregoing is true and correct

SIGNED (s/) J. M. McCarthy TITLE Drilling Manager DATE 1-6-76

(This space for State office use)

APPROVED BY William S. Hawkins TITLE Acting District Supervisor DATE 1/18/83
CONDITIONS OF APPROVAL, IF ANY:

This amends original signed 1/6/76 Amended 1/14/83

See Instructions On Reverse Side

Form 9-331
Dec. 1973

Form Approved.
Budget Bureau No. 42-R1424

AMENDED

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SUNDRY NOTICES AND REPORTS ON WELLS

(Do not use this form for proposals to drill or to deepen or plug back to a different reservoir. Use Form 9-331-C for such proposals.)

1. oil well ☐ gas well ☒ other

2. NAME OF OPERATOR
Husky Oil NPR Operations, Inc.

3. ADDRESS OF OPERATOR
3201 C Street, Suite 600, Anchorage, AK

4. LOCATION OF WELL (REPORT LOCATION CLEARLY. See space 17 below.)
AT SURFACE: 807' FWL & 552' FSL
AT TOP PROD. INTERVAL:
AT TOTAL DEPTH:

5. LEASE
None

6. IF INDIAN, ALLOTTEE OR TRIBE NAME
N/A

7. UNIT AGREEMENT NAME
N/A

8. FARM OR LEASE NAME
Naval Petroleum Reserve No. 4

9. WELL NO.
South Barrow Well No. 13

10. FIELD OR WILDCAT NAME
South Barrow Gas Field

11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA
Sec. 14, T22N, R18W

12. COUNTY OR PARISH 13. STATE
No. Slope Borough Alaska

14. API NO.
None

15. ELEVATIONS (SHOW DF, KDB, AND WD)
Grd = 22; Pad = 26; KB = ?

16. CHECK APPROPRIATE BOX TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

REQUEST FOR APPROVAL TO:		SUBSEQUENT REPORT OF:
TEST WATER SHUT-OFF	☐	☐
FRACTURE TREAT	☐	☐
SHOOT OR ACIDIZE	☐	☐
REPAIR WELL	☐	☐
PULL OR ALTER CASING	☐	☐
MULTIPLE COMPLETE	☐	☐
CHANGE ZONES	☐	☐
ABANDON*	☐	☐
(other) Progress report		

(NOTE: Report results of multiple completion or zone change on Form 9-330.)

17. DESCRIBE PROPOSED OR COMPLETED OPERATIONS (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work. If well is directionally drilled, give subsurface locations and measured and true vertical depths for all markers and zones pertinent to this work.)*

1/6/77 Nipple up stack. Test casing & BOP to 1500 psi. PBD 2474'.
1/7/77 Ran CBL/VDL/GR/CCL Log.
Perforate selected intervals with 4SPF, Hyperjet II.
Ran 2 7/8", 6.5#, N-80, EUE tubing. Land at 2384'.
1/8/77 Nipple up tree. Test same to 3000 psi.
1/9/77 Swab well. Stuck wireline tools in tubing.
1/10/77 Nipple up BOP. Test to 1500 psi.
1/11/77 Pull tubing, recover wireline tools. Land tubing @ 2384'
1/12/77 Nipple up tree, test to 3000 psi.
Rock well w/gas from Well No. 10.
1/13/77 Test well.
1/14/77 Circulate $CaCl_2$ water killing well.
1/15/77 Nipple up BOP. Test to 1500 psi. Pull tubing.
(Continuation attached)

RECEIVED
DEPUTY MINERALS MANAGER
ONSHORE FIELD OPERATIONS
JAN 19 1983
MINERALS MANAGEMENT SERVICE
[illegible] AVE., SUITE 2A
ANCHORAGE, ALASKA 99501

Subsurface Safety Valve: Manu. and Type _____ Set @ _____ Ft.

18. I hereby certify that the foregoing is true and correct

SIGNED (S/ J. M. McCarthy TITLE Drilling Engineer DATE 1-28-77

(This space for Federal or State office use)

William F. Hauser TITLE OIL AND GAS SUPERVISOR DATE 1/16/83

This amends original signed 1/28/77. Amended 1/14/83.

*See Instructions on Reverse Side

ITEM 17 Continued:

1/15/77 (Continued) Ran gyro survey. Perforate selected intervals with 4SPF, Hyperjet II.

1/16/77 Ran tubing. Land @ 2394'. Nipple up tree and test to 3000 psi. Rock well w/gas from Well No. 10. Test well.

1/17/77 Suspend well

This report is CONFIDENTIAL and is filed for information only.

Form 10-403
REV. 1-10-73

Submit "Intentions" in Triplicate
& "Subsequent Reports" in Duplicate

AMENDED

STATE OF ALASKA
OIL AND GAS CONSERVATION COMMITTEE

5. API NUMERICAL CODE
50-023-20008

SUNDRY NOTICES AND REPORTS ON WELLS

(Do not use this form for proposals to drill or to deepen
Use "APPLICATION FOR PERMIT—" for such proposals.)

6. LEASE DESIGNATION AND SERIAL NO.
None

1. OIL WELL ☐ GAS WELL ☒ OTHER

7. IF INDIAN, ALLOTTEE OR TRIBE NAME
N/A

2. NAME OF OPERATOR
Husky Oil NPR Operations, Inc.

8. UNIT, FARM OR LEASE NAME
Naval Petroleum Reserve No. 4

3. ADDRESS OF OPERATOR
3201 C Street, Suite 600, Anchorage, AK

9. WELL NO.
So. Barrow No. 13

4. LOCATION OF WELL
At surface 807' FWL & 552' FSL

10. FIELD AND POOL, OR WILDCAT
South Barrow Gas Field

11. SEC., T., R., M., (BOTTOM HOLE OBJECTIVE)
Sec 14, T22N, R18W

13. ELEVATIONS (Show whether DF, RT, GR, etc.)
Grd = 22; Pad = 26; KB = 40

12. PERMIT NO.
N/A

14. Check Appropriate Box To Indicate Nature of Notice, Report, or Other Data

NOTICE OF INTENTION TO:				SUBSEQUENT REPORT OF:			
TEST WATER SHUT-OFF	☐	PULL OR ALTER CASING	☐	WATER SHUT-OFF	☐	REPAIRING WELL	☐
FRACTURE TREAT	☐	MULTIPLE COMPLETE	☐	FRACTURE TREATMENT	☐	ALTERING CASING	☐
SHOOT OR ACIDIZE	☐	ABANDON*	☐	SHOOTING OR ACIDIZING	☐	ABANDONMENT*	☐
REPAIR WELL	☐	CHANGE PLANS	☐	(Other) Progress Report			☐
(Other)			☐	(NOTE: Report results of multiple completion on Well Completion or Recompletion Report and Log form.)			

15. DESCRIBE PROPOSED OR COMPLETED OPERATIONS (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work.

1/6/77 Nipple up stack. Test casing & BOP to 1500 psi. PBD 2474'.
1/7/77 Ran CBL/VDL/GR/CCL Log.
Perforate selected intervals with 4SPF, Hyperjet II.
Ran 2 7/8", 6.5#, N-80, EUE tubing. Land at 2384'.
1/8/77 Nipple up tree . Test same to 3000 psi.
1/9/77 Swab well. Stuck wireline tools in tubing.
1/10/77 Nipple up BOP. Test to 1500 psi.
1/11/77 Pull tubing, recover wireline tools. Land tubing @ 2384'.
1/12/77 Nipple up tree, test to 3000 psi.
Rock well w/gas from Well No. 10.
1/13/77 Test well.
1/14/77 Circulate $CaCl_2$ water killing well.
1/15/77 Nipple up BOP. Test to 1500 psi. Pull tubing.
Ran gyro survey. Perforate selected intervals with 4SPF, Hyperjet II.
1/16/77 Ran tubing. Land @ 2394'. Nipple up tree and test to 3000 psi. Rock well w/gas from Well No. 10. Test well.
1/17/77 Suspend well.

RECEIVED
DEPUTY MINERALS MANAGER
ONSHORE FIELD OPERATIONS
JAN 18 1983
MINERALS MANAGEMENT SERVICE
411 C. 4TH AVE., SUITE 2A
ANCHORAGE, ALASKA 99501

This report is CONFIDENTIAL and is filed for information only.

16. I hereby certify that the foregoing is true and correct

SIGNED (S/) J. M. McCarthy TITLE Drilling Engineer DATE 1-28-77

(This space for State office use)

APPROVED BY _____ TITLE _____ DATE _____
CONDITIONS OF APPROVAL, IF ANY:

This amends original signed 1/28/77 Amended 1/14/83

See Instructions On Reverse Side

Form 9-330
(Rev. 5-63)

AMENDED

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SUBMIT IN DUPLICATE* (See other instructions on reverse side)

Form approved.
Budget Bureau No. 42-R355.5.

WELL COMPLETION OR RECOMPLETION REPORT AND LOG*

1a. TYPE OF WELL: OIL WELL ☐ GAS WELL ☒ DRY ☐ Other

b. TYPE OF COMPLETION: NEW WELL ☒ WORK OVER ☐ DEEP-EN ☐ PLUG BACK ☐ DIFF. RESVR. ☐ Other

2. NAME OF OPERATOR: Husky Oil NPR Operations, Inc.

3. ADDRESS OF OPERATOR: 3201 C Street, Suite 600, Anchorage, AK 99503

4. LOCATION OF WELL (Report location clearly and in accordance with any State requirements)*
At surface: 807' FWL & 552' FSL, Sec 14, T22N, R18W
At top prod. interval reported below
At total depth

5. LEASE DESIGNATION AND SERIAL NO.: None

6. IF INDIAN, ALLOTTEE OR TRIBE NAME: N/A

7. UNIT AGREEMENT NAME: N/A

8. FARM OR LEASE NAME: NavalPetroleumReserveNo.4

9. WELL NO.: So. Barrow Well No. 13

10. FIELD AND POOL, OR WILDCAT: South Barrow Gas Field

11. SEC., T., R., M., OR BLOCK AND SURVEY OR AREA: Sec 14, T22N, R18W

14. PERMIT NO.: N/A — DATE ISSUED:

12. COUNTY OR PARISH: North Slope — 13. STATE: Alaska

15. DATE SPUDDED	16. DATE T.D. REACHED	17. DATE COMPL. (Ready to prod.)	18. ELEVATIONS (DF, RKB, RT, GR, ETC.)*	19. ELEV. CASINGHEAD
12/17/76	1/2/77	Suspended 1/17/77	Grd: 22; Pad: 26; KB: 40	26'

20. TOTAL DEPTH, MD & TVD	21. PLUG, BACK T.D., MD & TVD	22. IF MULTIPLE COMPL., HOW MANY*	23. INTERVALS DRILLED BY	ROTARY TOOLS	CABLE TOOLS
2534' MD	2474' MD		→	All	

24. PRODUCING INTERVAL(S), OF THIS COMPLETION—TOP, BOTTOM, NAME (MD AND TVD)*

25. WAS DIRECTIONAL SURVEY MADE: Yes

26. TYPE ELECTRIC AND OTHER LOGS RUN: DIL/BHC Sonic/FDC-CNL-GR/HRD

27. WAS WELL CORED

28. CASING RECORD (Report all strings set in well)

CASING SIZE	WEIGHT, LB./FT.	DEPTH SET (MD)	HOLE SIZE	CEMENTING RECORD	AMOUNT PULLED
10 3/4"	51	1157'	14 3/4"	Cmt to Surf w/760 sx PFII	
7"	32	2514'	8 1/2"	Cmt to Surf w/805 sx PFII; tail in w/80 sx Class "G" w/2% CaCl2	

29. LINER RECORD

SIZE	TOP (MD)	BOTTOM (MD)	SACKS CEMENT*	SCREEN (MD)

30. TUBING RECORD

SIZE	DEPTH SET (MD)	PACKER SET (MD)

31. PERFORATION RECORD (Interval, size and number)

Selected intervals have been perforated with 4SPF, Hyperjet II.

32. ACID, SHOT, FRACTURE, CEMENT SQUEEZE, ETC.

DEPTH INTERVAL (MD)	AMOUNT AND KIND OF MATERIAL USED

RECEIVED
DISTRICT MINERALS MANAGER
JAN 18 1983
MINERALS MANAGEMENT SERVICE
411 W. 4TH AVE., SUITE 2A
ANCHORAGE, ALASKA 99501

33.* PRODUCTION

DATE FIRST PRODUCTION	PRODUCTION METHOD (Flowing, gas lift, pumping—size and type of pump)	WELL STATUS (Producing or shut-in)

DATE OF TEST	HOURS TESTED	CHOKE SIZE	PROD'N. FOR TEST PERIOD →	OIL—BBL.	GAS—MCF.	WATER—BBL.	GAS-OIL RATIO

FLOW. TUBING PRESS.	CASING PRESSURE	CALCULATED 24-HOUR RATE →	OIL—BBL.	GAS—MCF.	WATER—BBL.	OIL GRAVITY-API (CORR.)

34. DISPOSITION OF GAS (Sold, used for fuel, vented, etc.)

TEST WITNESSED BY

35. LIST OF ATTACHMENTS

None.

36. I hereby certify that the foregoing and attached information is complete and correct as determined from all available records

SIGNED s/ J. M. McCarthy TITLE Drilling Engineer DATE 1-28-77

*(See Instructions and Spaces for Additional Data on Reverse Side)

This amends original signed 1/28/77 Amended 1/14/83

Form P-7

AMENDED

SUBMIT IN DUPLICATE*

STATE OF ALASKA

OIL AND GAS CONSERVATION COMMITTEE

WELL COMPLETION OR RECOMPLETION REPORT AND LOG*

5. API NUMERICAL CODE: 50-023-20008

6. LEASE DESIGNATION AND SERIAL NO.: None

1a. TYPE OF WELL: OIL WELL ☐ GAS WELL ☒ DRY ☐ Other

7. IF INDIAN, ALLOTTEE OR TRIBE NAME: N/A

b. TYPE OF COMPLETION: NEW WELL ☒ WORK OVER ☐ DEEP-EN ☐ PLUG BACK ☐ DIFF. RESVR. ☐ Other

8. UNIT, FARM OR LEASE NAME: Naval Petroleum Reserve

2. NAME OF OPERATOR: Husky Oil NPR Operations, Inc.

9. WELL NO.: So. Barrow No. 13

3. ADDRESS OF OPERATOR: 3201 C Street, Suite 600, Anchorage, Alaska

10. FIELD AND POOL, OR WILDCAT: South Barrow Gas Field

4. LOCATION OF WELL (Report location clearly and in accordance with any State requirements)*

At surface: 807'FWL & 552' FSL, Sec 14, T22N, R18W

At top prod. interval reported below

At total depth

11. SEC., T., R., M., (BOTTOM HOLE OBJECTIVE): Sec 14, T22N, R18W

12. PERMIT NO.: N/A

13. DATE SPUDDED	14. DATE T.D. REACHED	15. DATE COMP. SUSP. OR ABAND.	16. ELEVATIONS (DF, RKB, RT, GR, ETC.)*	17. ELEV. CASINGHEAD
12/17/76	1/2/77	Susp. 1/17/77	Grd = 22; Pad = 26; KB = 40.	26'

18. TOTAL DEPTH, MD & TVD	19. PLUG, BACK MD & TVD	20. IF MULTIPLE COMPL., HOW MANY*	21. ROTARY TOOLS	INTERVALS DRILLED BY	CABLE TOOLS
2534' MD	2474' MD		All		

22. PRODUCING INTERVAL(S), OF THIS COMPLETION—TOP, BOTTOM, NAME (MD AND TVD)*

23. WAS DIRECTIONAL SURVEY MADE: Yes

24. TYPE ELECTRIC AND OTHER LOGS RUN: DIL/BHC Sonic/FDC-CNL-GR/HRD

25. CASING RECORD (Report all strings set in well)

CASING SIZE	WEIGHT, LB./FT.	GRADE	DEPTH SET (MD)	HOLE SIZE	CEMENTING RECORD	AMOUNT PULLED
10 3/4"	51	J-55	1157	14 3/4	Cmt to Surf 760 sx PFII	
7"	32	N-80	2514	8 1/2	Cmt to Surf w/805 sx	
					PF II. Tail in w/80 sx	
					Class "G" w/ 2% CaCl2	

26. LINER RECORD

SIZE	TOP (MD)	BOTTOM (MD)	SACKS CEMENT*	SCREEN (MD)

27. TUBING RECORD

SIZE	DEPTH SET (MD)	PACKER SET (MD)

28. PERFORATIONS OPEN TO PRODUCTION (Interval, size and number)

Selected Intervals have been Perforated with 4 SPF, Hyperjet II.

29. ACID, SHOT, FRACTURE, CEMENT SQUEEZE, ETC.

DEPTH INTERVAL (MD)	

RECEIVED
JAN 1 3 1983
MINERALS MANAGEMENT SERVICE
411 W. 4TH AVE., SUITE 2-1

30. PRODUCTION

DATE FIRST PRODUCTION	PRODUCTION METHOD (Flowing, gas lift, pumping—size and type of pump)						
DATE OF TEST,	HOURS TESTED	CHOKE SIZE	PROD'N FOR TEST PERIOD →	OIL—BBL.	GAS—MCF.	WATER—BBL.	GAS-OIL RATIO
FLOW. TUBING PRESS.	CASING PRESSURE	CALCULATED 24-HOUR RATE →	OIL—BBL.	GAS—MCF.	WATER—BBL.	OIL GRAVITY-API (CORR.)	

31. DISPOSITION OF GAS (Sold, used for fuel, vented, etc.)

TEST WITNESSED BY

32. LIST OF ATTACHMENTS

None. This report is CONFIDENTIAL and is filed for information only.

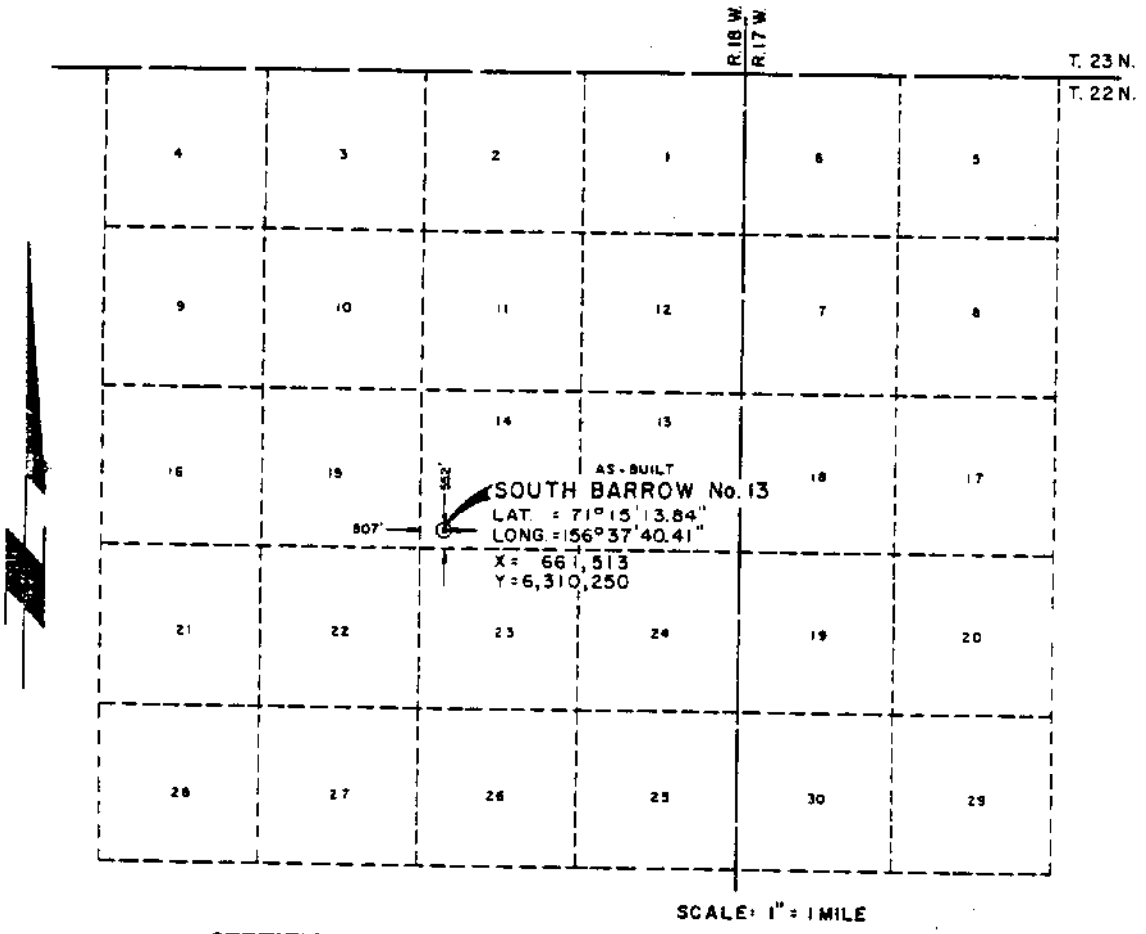
33. I hereby certify that the foregoing and attached information is complete and correct as determined from all available records.

SIGNED (for) J. M. McCarthy TITLE Drilling Engineer DATE 1-28-77

*(See Instructions and Spaces for Additional Data on Reverse Side)

This amends original signed 1/28/77

Amended 1/14/83



CERTIFICATE OF SURVEYOR

I hereby certify that I am properly registered and licensed to practice land surveying in the State of Alaska and that this plat represents a location survey made by me or under my supervision, and that all dimensions and other details are correct.

1-3-77
Date

SURVEYOR

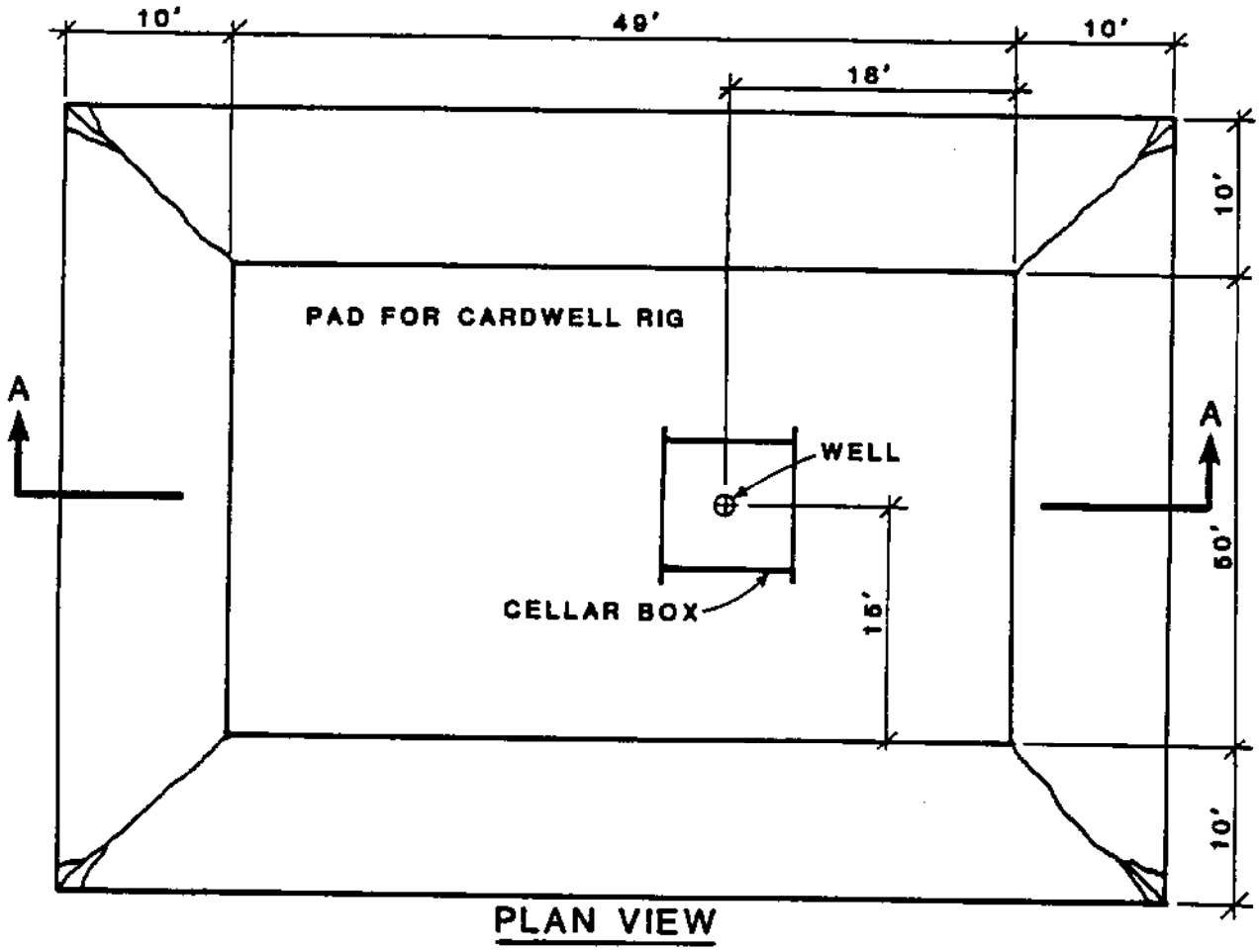
AS-BUILT

SOUTH BARROW No. 13

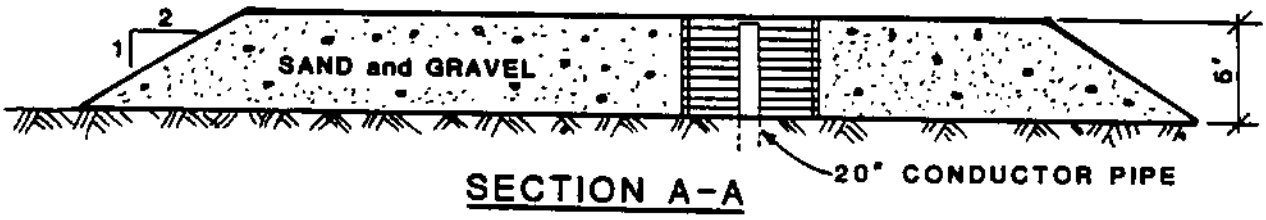
Located in
SW 1/4 PROTRACTED SEC. 14, T.22 N., R.18W., U.M., ALASKA

Surveyed for
HUSKY OIL
N.P.R. OPERATIONS

Surveyed by
F.M. LINDSEY & ASSOC.
LAND & HYDROGRAPHIC SURVEYORS
2502 West Northern Lights Boulevard Box 4-081
Anchorage Alaska



PLAN VIEW



SECTION A-A

SOUTH BARROW NO. 13 DRILL PAD

OPERATIONS HISTORY

DATE AND FOOTAGE DRILLED AS OF 6:00 A.M.	ACTIVITY
12/2/76	Rigging up camp and rig. Rigged up miscellaneous mud, fuel, water and electrical lines.
12/3/76	Rigged up mud, water, and fuel lines. Continued rigging up electrical to buildings. Worked on catwalk and ramp.
12/4/76	Rigging up camp, started generators, set waterhouse, hauled water to camp. One hundred percent of rig at location. Preparing to haul casing, drill pipe, and drill collar.
12/5/76	Kitchen and wash house in service. Received water house and Schlumberger equipment.
12/6/76	Rigging up. Hauled casing and drill pipe.
12/7/76	Continued rigging up. Fired Tioga heater. Moved into rig camp.
12/8/76	Rigging up. Tioga heater down; fuel pump out. Camp generators went down. 175-KW V8-71 water seal out; 100-KW 671 diodes burnt. Cut loose rig generators and skidded to camp. Tied in; started OK. Made temporary repairs on 175-KW V8-71. Started OK.
12/9/76	Continued rigging up. Changed out boiler feed pump. Fired boiler, checked steam lines for plugs and repaired leaks. Received Tioga parts. Worked on Tioga. Started work to repair 100-KW generator. Sixty percent rigged up.
12/10/76	Continued rigging up. Repaired steam lines. Steamed and thawed around conductor. Tioga heater down. Changed out 4-1/2" pipe rams. Installed 3-1/2" rams. Released 4-1/2" rams. Hauled in 100-KW generator.
12/11/76	Thawed out and pulled 20" conductor pipe. Twenty-inch pipe had been packed in with cement, gravel, sand and moss. Insulated mud, water and steam lines. Fixed pump. Picked up Kelly and thawed rat hole. Rigged up flowline. Seventy-five percent rigged up.

12/12/76 Continued rigging up. Started pump motors. Repaired shale shakers and screens and repaired mud gate. Installed 600-amp breaker. Installed 100-KW generator. Started Tioga heater. Continued general repairs. Eighty percent rigged up.

12/13/76 Continued rigging up. Tied in 100-KW camp generator. Modified wanigan to install accumulator and choke manifold. Eighty-five percent rigged up.

12/14/76 Continued rigging up. Rigged up choke manifold. Built hallways between buildings. Rigged up cellar jet line. Performed general repairs. Ninety percent rigged up.

12/15/76 Continued rigging up. Drilled 26" dry conductor hole to 63' KB.

12/16/76 Drilled 26" dry hole to 74'. Pulled out of hole. Laid down two joints drill pipe and 26" dry-hole auger. Ran 60' of 20" casing to 74' (Kelly bushing), 60' below ground level. Welded on 20" head. Mixed and pumped 120 sacks Permafrost cement. Waited on cement four hours and nippled up.

12/17/76 Waited on cement. Nippled up on 20" casing with 16" blowout preventer. Rigged up TOTCO. Rigged up Petro-tec. Mixed mud. Worked on mud pump. Rigged up accumulator. Picked up drilling assembly. Prepared to spud.

12/18/76 Nippled up 4" flare line in spool. Rigged up TOTCO, mixed mud. Spudded well 12/17/76 at 10:00 p.m. Drilled to 256'; unplugged flowline. Repaired jet. Drilling at 340'.

12/19/76 Drilling and cleaning flowline.

12/20/76 Drilling. Unplugged flowline.

12/21/76 Drilled to 1148'. Circulated to log. Dropped survey. Tripped out and steel-line measured. Logging. Ran DIL and BHC-Sonic. Tripped in. Unplugged bit. Drilled rat hole 1148' to 1166'. Circulated. Tripped out to run 10-3/4" casing.

12/22/76 Tripped out. Changed stand-pipe valve. Rigged up and ran 38 joints 10-3/4" casing. Broke circulation with 18 joints in and again on bottom. Landed casing at 1157'. Cut off landing joint. Picked up Baker stab-in tool and 21 joints 3-1/2" drill pipe. Tripped

in with 16 stands 3-1/2" drill pipe and stab in to duplex collar at 1123'. Circulated and prepared to cement.

12/23/76 Rigged up to cement. Cemented with 10 barrels water spacer and 760 sacks Permafrost II (average weight 13.7 ppg). Displaced with 9-1/2 barrels water. Cemented to surface with full returns. Cement in place at 9:15 a.m. Washed out stack. Tripped out and laid down 21 joints 3-1/2" drill pipe and Baker stinger. Waited on cement. Cleaned cellar and mud tanks; drained pumps and changed liners. Slipped and cut drilling line. Removed spider and nippled down.

12/24/76 Nippled down blowout preventer. Nippled up blowout-preventer stack. Mixing mud.

12/25/76 Nippled up blowout preventer. Pressure tested blowout-preventer stack and choke manifold to 1,500 psi. OK. Tripped in to 1123'. Drilled float collar, 15' cement and shoe.

12/26/76 Drilling. Circulated samples at 1946'. Drilling.

12/27/76 Drilled to 2159'. Circulated. Dropped survey. Pulled out of hole. Steel-line measured. Picked up core barrel (6-7/8 x 4-1/4). Ran in hole. Circulated. Cored to 2185'. Coring Core No. 1.

12/28/76 Cut Core No. 1 to 2189'. Pulled out of hole. Laid down Core No. 1, recovered 30'. Ran in hole. Repaired rig (sheared bolts on drum sprocket). Ran in hole. Washed 8' to bottom. Cored to 2207'. Coring Core No. 2.

12/29/76 Cored to 2219'. Pulled out of hole. Recovered 27' core. Stand back core barrel. Cut drilling line and adjusted brakes. Ran in hole with Bit No. 3. Reamed 60' core hole. Drilled to 2223' and circulated samples. Drilled to 2228' and circulated sample. Drilled to 2266' and circulated samples. Drilled to 2288' and circulated samples. Pulled out of hole to core.

12/30/76 Pulled out of hole with Bit No. 3. Picked up core barrel. Ran in hole, circulated. Cut Core No. 3 from 2288' to 2318'. Pulled out of hole. Recovered 30' of core. Checked core barrel. Ran in hole with core barrel. Circulated. Cut Core No. 4 from 2318' to 2325'. Coring.

12/31/76 Cut Core No. 4 to 2348'. Pulled out of hole. Recovered 30' of core. Stand back core barrel. Ran in hole with bit. Laid down three 6-1/4" drill collars. Reamed 30' core hole. Drilled 2348' to 2410'. Pulled out of hole. Picked up core barrel. Ran in hole for Core No. 5.

1/1/77 Washed to bottom with core barrel. Cut Core No. 5 from 2410' to 2425'. One hundred percent recovered. Logged with DIL, BHC/GR/CAL, CNL/FDC/GR/CAL. Rigged down Schlumberger. Went in hole with Bit No. 4. Drilling ahead.

1/2/77 Drilled to 2522'. Surveyed. Pulled out of hole. Washed and reamed 60'. Cored 2522' to 2534' (Core No. 6). Barrel jammed. Recovered 3'. Laid down core barrel. Rigged up to log.

1/3/77 Logged with Schlumberger DIL, FDC/CNL/GR, BHC. Dipmeter, shot 24 sidewall cores, recovered 17. Rigged down Schlumberger. Ran in hole with bit. Reamed 15'. Circulated. Pulled out of hole. Laid down drill collars.

1/4/77 Finished laying down drill collars. Rigged up to run casing. Ran 62 joints 7", 32#, N-80, 8RD, R-3, C-1 casing. Set at 2514'; float at 2474'. Circulated. Rigged down casing tools. Ran in hole with stab-in tool. Cemented with 10 barrels water, 805 sacks Permafrost II (14.4 ppg), 80 sacks Class "G" (15.6 ppg) with 2% $CaCl_2$. Displaced with 19 barrels water. Full returns at 14.4 ppg. Cement in place at 5:15 a.m. Float OK.

1/5/77 Pulled out of hole. Nippled down. Set slips with 65,000 pounds. Cut 7", installed tubing spool, tested packoff; 2,500 pounds upper seals OK. Lowered slips to 1,200 pounds. Nippled up blowout preventers.

1/6/77 Nippled up. Picked up kelly, drill collars, bit. Ran in hole. Circulated out cement in drill pipe. Circulated and cleaned out to 2474'. Tested casing and blowout preventer to 1,200 pounds. OK. Rigging up to log.

1/7/77 Ran CBL/VDL/GR. Rigged up and perforated with four shots per foot: 2358-2368', 2315-2330', 2330-2345', 2224-2234'. Pulled out of hole. Ran 77 joints 2-7/8" tubing, 6.50#, N-80, R-2. Circulated tubing. Prepared to land.

1/8/77 Circulated tubing and landed same at 2384'. Nippled down blowout preventer and nippled up Christmas tree. Tested same to 3,000 pounds. Cleaned mud tanks and filled with water. Reversed out mud to water. No flow. Rigged up Otis. Prepared to start swabbing unit.

1/9/77 Rigged up Otis. Swabbed well down to ±500'. Hydraulic line on unit broke. Repaired same. Ran swab to 250'. Stuck. Attempting to pull loose. Sent up second Otis unit.

1/10/77 Rigged up second Otis unit. Attempted to pull swab. Pulled line in two. Nippled down lubricator. Pulled on swab line with blocks. Pulled out of rope socket with 3,000 pounds. Installed back-pressure valve. Nippled down tree. Nippled up blowout preventer.

1/11/77 Tested blowout preventer to 1,100 pounds. Unseated tubing hanger. Pulled five joints tubing. Solid ice in joints 5-10. Circulated tubing. Mixed alcohol. Ran in hole with tubing. Installed back-pressure valve. Nippled down blowout preventer.

1/12/77 Nippled down blowout preventer. Nippled up Christmas tree. Circulated and mixed alcohol. Laid gas line to No. 13 annulus. Recovered 50 barrels water and alcohol through tubing. Shut in. Rocked well back. No response. Bled annulus to 0. Pressured annulus with gas from Well No. 10 at 750 pounds.

1/13/77 Pressured annulus with gas from Well No. 10. Well would not flow through tubing. Bled off annulus. Tied in No. 10 line to tubing. Unloaded 15 barrels fluid from annulus. Went to mist. Shut well in. Put No. 10 gas back on annulus. Recovered two barrels fluid through tubing. Shut in with 200# on tubing. No build up. Flowed well; slowly died. Pressured up tubing with No. 10 gas. TU P-450, AP-750. Bled off through prover. Well dead. Injected gas down annulus through tubing. Blew mist. Bled off. Tubing and annulus open. Very slight flow.

1/14/77 Flowed gas well. Very slight blow. Would not register on a 1" pitot tube. Dumped alcohol/water mix from mud pits. Filled pits with water. Mixed $CaCl_2$ water to 9.2 ppg. Shut in well. Rigged up to kill well. Circulated $CaCl_2$ water, killing well. Installed back-pressure valve.

1/15/77 Set back-pressure valve. Nippled down tree; nippled up blowout preventer. Tested to 1,200 pounds. OK. Pulled back-pressure valve. Ran in hole with tubing. Ran gyro at 100' stations. Rigged up Schlumberger. Perforated with four shots per foot: 2224.5-2234.5'; 2315.5-2345.5'; 2356.5-2376.5'; 2383-2387'. Rigged down Schlumberger.

1/16/77 Ran tubing. Landed at 2394'. Installed back-pressure valve. Nippled down blowout preventer; nippled up tree and tested to 3,000 pounds. OK. Pulled back-pressure valve. Tied Well No. 10 into 13. Rocked 13 in. Blew well clean. Flowed well; very slight flow.

1/17/77 Flowed well with very slight flow. Pumped five barrels alcohol into tubing. Set back-pressure valve. Released rig January 16, 1977, at 10:30 a.m. Rigging down.

1/18/77 Results of Sperry-Sun Gyro Survey indicate bottom-hole location 60.48' south and 364.46' west of the surface location.

DRILLING TIME ANALYSIS

SOUTH BARROW WELL NO. 13

PARCO, INC., Cardwell Rig

Spud 12/17/76; Rig released 1/16/77

Total Depth: 2,534 Feet

True Vertical Depth: 2,491 Feet

DRILLING TIME ANALYSIS (HOURS) - HUSKY NPR OPERATIONS, INC. SOUTH BARROW WELL NO. 13 Page 1 of 5

DATE	RIG UP/RIG DOWN	DRILLING	REAMING	TRIP	DEV. SURVEY	RIG MAINT.	RIG REPAIR	CIRC. & COND. MUD	LOGGING	CASING & CEMENT	W O C	NIPPLE UP/DOWN BOP	TEST BOP	CHANGE BHA	LOST CIRC.	FISHING	CORING	DST	PLUG BACK	SQUEEZE CEMENT	DIR. WORK	W O MAT./EQUIP.	OTHER	Operations at 6:00 a.m.	Comments
11-15																							12		Clean Up Camp
11-16																							12		Clean Up Camp
11-17																							12		Install Generator
11-18																							12		Rig Up Generator House
11-19																							12		Move Camp to Location
11-20																							12		Move Camp to Location
11-21																							12		Rig Mud Pump
11-22																							12		Rig Up Camp
11-23																							12		Rig Up Camp
11-24																							24		Rig Up Camp
11-25																							24		Rig Up Camp
11-26																							24		Rig Up Camp
11-27																							24		Rig Up Generator
11-28																							24		Rig Up Generator
11-29																							24		Set Mud Pits

DRILLING TIME ANALYSIS (HOURS) - HUSKY NPR OPERATIONS, INC. SOUTH BARROW WELL NO. 13 Page 2 of 5

DATE	RIG UP/RIG DOWN	DRILLING	REAMING	TRIP	DEV. SURVEY	RIG MAINT.	RIG REPAIR	CIRC. & COND. MUD	LOGGING	CASING & CEMENT	W O C	NIPPLE UP/DOWN BOP	TEST BOP	CHANGE BHA	LOST CIRC.	FISHING	CORING	DST	PLUG BACK	SQUEEZE CEMENT	DIR. WORK	W O MAT./EQUIP.	OTHER	Operations at 6:00 a.m.	Comments
11-30																							24		Set Equipment Building
12-1																							24		Set Equipment Building
12-2																							24		Rig Up Equipment Building
12-3																							24		Rig Up Heaters
12-4																							24		Repair Plumbing
12-5																							24		Rig Up Fuel Tanks
12-6	24																							Rigging Up	
12-7	24																							Rigging Up	
12-8	24																							Rigging Up	
12-9	24																							Rigging Up	
12-10	24																							Rigging Up	
12-11	24																							Rigging Up	
12-12	24																							Rigging Up	
12-13	24																							Rigging Up	
12-14	24																							Rigging Up	

DRILLING TIME ANALYSIS (HOURS) - HUSKY NPR OPERATIONS, INC. SOUTH BARROW WELL NO. 13 Page 3 of 5

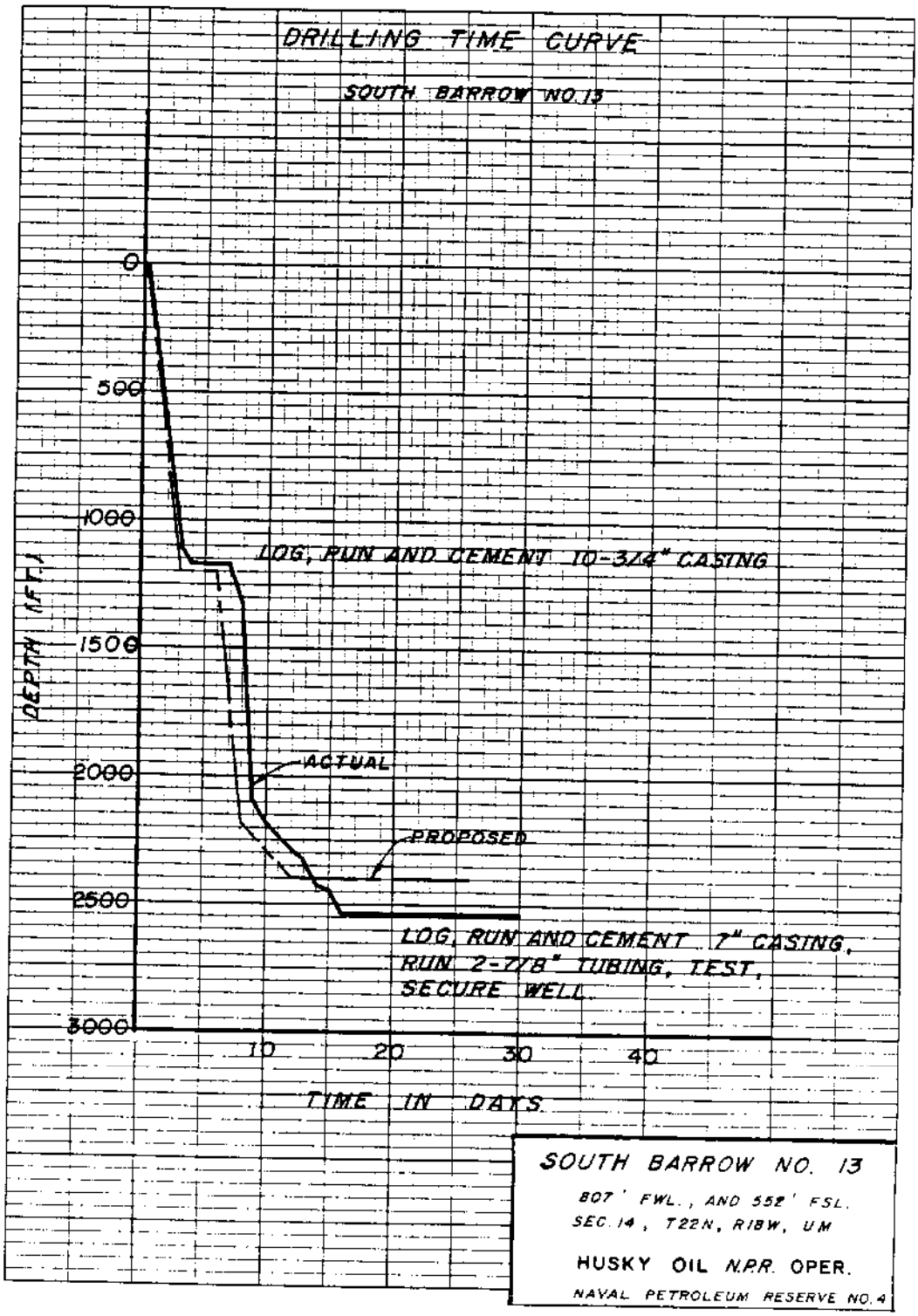
DATE	RIG UP/RIG DOWN	DRILLING	REAMING	TRIP	DEV. SURVEY	RIG MAINT.	RIG REPAIR	CIRC. & COND. MUD	LOGGING	CASING & CEMENT	W O C	NIPPLE UP/DOWN BOP	TEST BOP	CHANGE BHA	LOST CIRC.	FISHING	CORING	DST	PLUG BACK	SQUEEZE CEMENT	DIR. WORK	W O MAT./EQUIP.	OTHER	Operations at 6:00 a.m.	Comments
12-15	24																							Rigging Up	
12-16	24																							Rigging Up	
12-17		2						16				6												Fill Mud Pits W/Water	Spudded at 10:00 p.m.
12-18		12																					12	Drilling	Clean Out Flow Line
12-19		14¾																					9¼	Drilling	
12-20		11¼		4				1½	6														1	Drilling	Running Schlumberger Wireline Logs
12-21		1½		9				2½		8½													3	P.O.H.	Rig Up to Run 10¾" Casing
12-22				4½				4½		9													6	Prep to cement casing	Ran 10-3/4" casing to 1157'
12-23												24												Clean Out Cellar	
12-24				2								20¼	1¾											Nipple Down	
12-25		22½		¼																			1¼	Drilling	
12-26		8¾		6½	¼			3									4						1½	Drilling	
12-27		4¼		2½			3										12						2¼	Coring	Cutting Core No. 1
12-28		½	1½	9¾			½	1¼									10						1	Coring	Cutting Core No. 2
12-29		2½		8¾				3¾									8						1	P.O.H.	

DRILLING TIME ANALYSIS (HOURS) - HUSKY NPR OPERATIONS, INC. SOUTH BARROW WELL NO. 13 Page 4 of 5

DATE	RIG UP/RIG DOWN	DRILLING	REAMING	TRIP	DEV. SURVEY	RIG MAINT.	RIG REPAIR	CIRC. & COND. MUD	LOGGING	CASING & CEMENT	W O C	NIPPLE UP/DOWN BOP	TEST BOP	CHANGE BHA	LOST CIRC.	FISHING	CORING	DST	PLUG BACK	SQUEEZE CEMENT	DIR. WORK	W O MAT./EQUIP.	OTHER	Operations at 6:00 a.m.	Comments
12-30		5	½	8½				¼									8¼						1½	Coring	Cutting Cores No. 3 and No. 4
12-31		¾	1½	8¼				1½	7								4						1	R.I.H.; Reaming	
1977 1-1		6½	3	5¾	¼				2½								4½						1½	Drilling	Cut Core No. 5, Ran Schlumberger logs
1-2				5¾				1½	14½								¾						1½	Rig Up Schlumberger	Cut Core No. 6
1-3			½	9¾				2¾		8													3	Lay Down Drill Collar	Ran final logs; shot sidewall core
1-4				5						5		6											8	Cementing	Ran 7" casing to 2514'
1-5				5½								16											2½	Nipple Up BOP	
1-6				9¼				4¾	8½														1½	Rig Up Schlumberger	
1-7								1½				18											4½	Prep to run tubing	Perforated 2224-2234'; 2315-2330'; 2330-2345'; 2358-2368'
1-8								3															21	Waiting on Otis to Swab	Swabbing
1-9												8											16	Swab Stuck in Hole	
1-10				4½				5½				11½	2½											Nipple Up BOP	
1-11								14½				8											1½	Nipple Up BOP	Rig Up For Gas Injection
1-12								1															23	Injecting Gas From Well 10 into Well 13	Injecting Gas
1-13																							24	Flowing	

DRILLING TIME ANALYSIS (HOURS) - HUSKY NPR OPERATIONS, INC. SOUTH BARROW WELL NO. 13 Page 5 of 5

DATE	RIG UP/RIG DOWN	DRILLING	REAMING	TRIP	DEV. SURVEY	RIG MAINT.	RIG REPAIR	CIRC. & COND. MUD	LOGGING	CASING & CEMENT	W O C	NIPPLE UP/DOWN BOP	TEST BOP	CHANGE BHA	LOST CIRC.	FISHING	CORING	DST	PLUG BACK	SQUEEZE CEMENT	DIR. WORK	W O MAT./EQUIP.	OTHER	Operations at 6:00 a.m.	Comments
1-14				2½					4½			8½	1										7½	Flowing	
1-15				3				½	6½			5											9	Rigging Down Schlumberger	Perforated 2224.5-2234.5'; 2315.5-2345.5',2356.5-2376.5' 2383-2387'
1-16	13																						11	Flowing	Rig Released at 10:30 a. m.
1-17	24																							Rigging Down	
1-18																							24	Rigging Down	Waiting on ITT Dozers
1-19																							24	Moving Rig to No. 14	
	301	6¼		½		3½		49½		-0-		5¼		-0-		5½		-0-		-0-			620¼		
TOTAL HOURS		92		115		-0-		69		30½		131¼		-0-		-0-		-0-		-0-		-0-			


DRILLING TIME CURVE
SOUTH BARROW NO. 13
0
500
1000
1500
2000
2500
3000
DEPTH (FT.)
LOG, RUN AND CEMENT 10-3/4" CASING
ACTUAL
PROPOSED
LOG, RUN AND CEMENT 7" CASING, RUN 2-7/8" TUBING, TEST, SECURE WELL.
10
20
30
40
TIME IN DAYS.
SOUTH BARROW NO. 13
807' FWL., AND 552' FSL.
SEC. 14, T22N, R18W, UM
HUSKY OIL N.P.R. OPER.
NAVAL PETROLEUM RESERVE NO. 4

DRILLING MUD RECORD

BAROID DIVISION

N L Industries, Inc.

DRILLING MUD RECORD

COMPANY Husky Oil Company STATE Alaska CASING PROGRAM: 20 inch at 74 ft.

WELL South Barrow #13 COUNTY Barrow 10 3/4 inch at 1157 ft.

CONTRACTOR Parco Drilling Company LOCATION North Slope SEC 14 TWP 22N RNG 18W 7 inch at 2514 ft.

STOCKPOINT Fairbanks, Alaska DATE 1-17-77 BAROID ENGINEER Boswell, Forman, Aimes TOTAL DEPTH 2534 ft.

DATE	DEPTH	WEIGHT	VISCOSITY		Yp	GELS	pH	FILTRATION			FILTRATE ANALYSIS				SAND	RETORT			CEC	REMARKS AND TREATMENT
1976	feet	lb/gal	Sec API @ °F	PV @ °F		10 sec / 10 min	Strip ☒ Meter ○	ml API	HTHP @ °F	Cake 32nds	PF	MF	Cl ppm	Ca ppm	%	Solids %	Oil %	Water %	Mud, me/ml	
12-18	100	9.3	34	5	6	2/5	9.0	23.6		2	.3		2475							
12-19	611	10.0	42	13	9	2/20	8.5	10.6		2	.1		1815	60	1/2	12		88		Pit Check.
12-20	1001	10.3	34	8	5	2/5	8.5	10.2		2	.1		1320	TR	1/2	14		86		Gumbo clay. Plugging flow line.
12-21	1166	10.4	38	12	6	2/7	8.5	10.2		2	.1		1320	TR	1/2	14		86		Log. Run casing.
12-24	1130	9.0	38	12	8	2/7	9.0	10.2		2	1.0		1320	TR	TR	8		92		Nipple up.
12-25	1283	9.3	38	10	8	2/7	9.5	9.8		2	.8		900	TR	1/4	9		91		Drilling.O.K.
12-26	2053	10.6	42	15	9	2/7	9.0	9.2		2	.2		850	TR	1/4	15		85		Drilling. O.K.
12-27	2181	10.6	47	21	19	3/9	9.0	4.2		2	.3		825	TR	1/4	15		85		Coring from 2,159'-2,181'.
12-28	2206	10.6	43	16	13	2/5	9.0	4.2		2	.3		825	TR	1/4	15		85		Run in hole core bbl #2.
12-30	2319	10.7	45	20	10	3/7	9.0	4.0		2	.3		800	00	1/4	16		84		Coring.
12-31	2404	10.8	46	24	8	3/7	9.0	3.8		1	.3		750	40	3/4	16		84		Drill to argillitePOH to pick up
12-31	2425	10.9	46	23	10	3/7	9.0	3.8		1	.3		600	40	1/4	17		83		core bbl. POH at 2425' to log.
1-1-77	2500	10.7	45	23	8	2/3	9.0	3.4		1	.2		500	40	1/2	16		84		
1-2	2534	10.8	44	21	6	2/3	9.0	2.4		1	.2		450	40	1/2	17		83		POH w/core barrel.
1-3	2534	10.7	47	22	9	2/3	9.0	3.6		1	.2		450	40	1/2	16		84		
1-4	2534	10.8	41	21	6	1/2	9.0	3.4		1	.2		450	40	1/2	15		85		
1-5	2534	10.8	41	19	5	1/2	9.0	4.6		1	.2		450	40	1/4	15		85		
1-6	2534	10.6	51	34	12	3/5	9.0	4.0		1	.2		450	40	3/4	15		85		Circ. & cond. mud to perf.casing.
1-7	2534	10.6	52	40	8	2/3	9.0	2.8		1	.2		450	40	3/4	15		85		Completing.
1-8	2534	10.6	52	40	8	2/3	9.0	2.8		1	.2		450	40	3/4	15		85		Completing.
1-9	2534	10.6	52	40	8	2/3	9.0	2.8		1	.2		450	40	3/4	15		85		Completing.
1-10	2534	10.6	52	40	8	2/3	9.0	2.8		1	.2		450	40	3/4	15		85		Completing.
1-11	2534	10.6	52	40	8	2/3	9.0	2.8		1	.2		450	40	3/4	15		85		Completing.
1-12	2534	10.6	52	40	8	2/3	9.0	2.8		1	.2		450	40	3/4	15		85		Completing.
1-13	2534	10.6	52	40	8	2/3	9.0	2.8		1	.2		450	40	3/4	15		85		Completing.
1-14	2534	10.6	52	40	8	2/3	9.0	2.8		1	.2		450	40	3/4	15		85		Completing.
1-15	2534	10.6	52	40	8	2/3	9.0	2.8		1	.2		450	40	3/4	15		85		Completing.
1-16	2534	10.6	52	40	8	2/3	9.0	2.8		1	.2		450	40	3/4	15		85		Completing.

DRILLING MUD RECORD

BAROID DIVISION

N L Industries, Inc.

COMPANY Husky Oil Company — STATE Alaska

WELL South Barrow #13 — COUNTY Barrow

CONTRACTOR Parco Drilling Company — LOCATION North Slope — SEC 14 TWP 22N RNG 18W

STOCKPOINT Fairbanks, Alaska — DATE 1-17-77 — BAROID ENGINEER Boswell, Forman, Aimes

CASING PROGRAM: 20 inch at 74 ft. / 10 3/4 inch at 1157 ft. / 7 inch at 2514 ft.

TOTAL DEPTH 2534 ft.

DATE	DEPTH feet	WEIGHT lb/gal	VISCOSITY Sec API @ °F	VISCOSITY PV @ °F	Yp	GELS 10 sec / 10 min	pH Strip ☐ Meter ☐	FILTRATION ml API	FILTRATION HTHP @ °F	FILTRATION Cake 32nds	FILTRATE ANALYSIS Pm	FILTRATE ANALYSIS Pf/Mf	FILTRATE ANALYSIS Cl ppm	FILTRATE ANALYSIS Ca ppm	SAND %	RETORT Solids %	RETORT Oil %	RETORT Water %	CEC Mud, me/ml	REMARKS AND TREATMENT

MATERIAL	AMOUNT	COST $	MATERIAL	AMOUNT	COST $	MATERIAL	AMOUNT	COST $
AQUAGEL, (M)	126	1,437.66	CAUSTIC SODA	8	190.88	Spersene	42	890.82
BAROID, (MAR.)	207	2,007.90	CELLEX (H.V.)	8	933.68			
BEN-EX	26	308.36	Q-BROXIN	4	97.20	TOTAL MATERIALS		6,135.12
BICARB of SODA	3	77.40	SAPP	3	191.22	Technical Service		
						32 days @ $265.00		8,480.00
								14,615.12
						Drayage		
						Sales Tax		
							TOTAL COST	

BAROID DIVISION

NL INDUSTRIES

MUD MATERIALS
Used (Total)

DRILLING MUD RECORD

FM-1901-5A

PRINTED IN U.S.A.

BIT RECORD

U.S. NAVY/HUSKY OIL
SOUTH BARROW WELL NO. 13
Sec. 14, Twp 22N, R18W

BIT NO.	BIT SIZE	BIT MFGR.	BIT TYPE	SER. NO. OF BIT	JET SIZE 1	2	3	DEPTH OUT	FTGE.	HRS. RUN	ACC. HRS.	FT. PER. HR.	WEIGHT 1000 LBS	ROTARY R.P.M.	VERT DEV.	PUMP PRESS.	PUMPS LINER	SPM.	MUD WT.	VIS	DULL CODE T	B	G
1	14 3/4	HTC	OSC3A	FN413	0	0	0	1139	1069	37	37	28.9	20	150		800	7	50		34	4	1	I
RR 1	14 3/4	HTC	OSC3A	FN413	0	0	0	1166	27	1¼	38¼	21.6	20	150		800	7	50		34	5	2	I
2	8½	HTC	OSC3A	ND510	13	13	13	2164	998	31¼	69½	31.9	25	120		1000	6¼	40	10.7	40	7	8	I
CB 1	8 15/32	ACC	DIA	10713	N/A	N/A	N/A	2189	25	11½	81	2.2	10/20	80		950	6¼	42	10.6	38			
CB 1	8 15/32	ACC	DIA	10713	N/A	N/A	N/A	2219	30	14	95	2.1	10/20	80		950	6¼	42	10.7	40			
3	8½	HTC	OSC3A	RT792	13	13	13	2288	69	2 3/4	97 3/4	25.1	25	50		1000	6¼	40	10.7	39	1	1	I
CB 1	8 15/32	ACC	DIA	10713	N/A	N/A	N/A	2318	30	8	105 3/4	3.8	10/15	50		1000	6¼	40	10.7	40			
CB 1	8 15/32	ACC	DIA	10713	N/A	N/A	N/A	2348	30	7¼	113	4.1	10/15	50		1000	6¼	40	10.7	45			
RR 3	8½	HTC	OSC3A	RT792	14	14	14	2410	62	2 3/4	115 3/4	22.6	20/30	55		1000	6¼	40	10.7	45	4	5	I
CB 1	8 15/32	ACC	DIA	10713	N/A	N/A	N/A	2425	15	4	119 3/4	3.8	10/15	50		1000	6¼	40	10.7	40			
4	8½	HTC	OSC3A	X2177	15	15	15	2522	97	6½	126¼	14.9	20/25	80		1000	6¼	37	10.7	40			
CB 1	8 15/32	ACC	DIA	10713	N/A	N/A	N/A	2534	12	4	129¼	3.0	15/20	80		1000	6¼	37	10.7	40			

CASING

Programmed casing for South Barrow Well No. 13 was 20" conductor at ±40', 10-3/4" at 1200', 7" at 2500', and 2-7/8" production tubing if required. Casing actually run was 20" conductor set at 74', 10-3/4" at 1157', and 7" at 2514'. The 2-7/8" production tubing was run to 2394' and hung in the 7" casing when the well was completed.

PAGE 1 OF 1

CASING TALLY

DATE: January 4, 1977

FIELD So. Barrow Gas Field LEASE & WELL NO. So. Barrow No. 13 TALLY FOR 10 3/4" CASING

JOINT NO.	FIRST MEASUREMENT FEET	FIRST MEASUREMENT .00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT .00'S	WT GR.
1	29	80			
2	33	00			
3	32	10			
4	30	64			
5	31	19			
6	31	60			
7	31	90			
8	31	02			
9	30	55			
0	33	40			
TOTAL A	315	20			

JOINT NO.	FIRST MEASUREMENT FEET	FIRST MEASUREMENT .00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT .00'S	WT GR.
1	32	30			
2	31	95			
3	29	94			
4	28	99			
5	28	38			
6	32	36			
7	32	22			
8	15	00	Landing Joint		
9					
0					
TOTAL D	231	14			

1	32	00			
2	31	68			
3	29	87			
4	26	38			
5	32	55			
6	31	69			
7	31	68			
8	32	00			
9	27	68			
0	32	09			
TOTAL B	307	62			

1					
2					
3					
4					
5					
6					
7					
8					
9					
0					
TOTAL E					

1	32	39			
2	32	07			
3	28	54			
4	31	88			
5	30	00			
6	26	54			
7	31	60			
8	25	81			
9	30	55			
0	30	43			
TOTAL C	299	81			

TOTAL A	315	20		
TOTAL B	307	62		
TOTAL C	299	81		
TOTAL D	231	14		
TOTAL E				
TOTAL PAGE	1153	77		

CASING OR LINER CEMENT JOB

Lease So. Barrow Gas Field Well So. Barrow No. 13 Date December 23, 1976

Size Casing 10 3/4" Setting Depth 1157.40 Top (liner hanger) _____

Hole Size 14 3/4" " Mud Gradient .54 psi/ft (10.4 ppg) Viscosity 38

Casing Equipment

Baker (1157') shoe, Baker Duplex (1123') float located 34 feet

above shoe, _____ (DV, FO) collars located at _____ feet

and _____ feet.

Five Baker centralizers located middle of shoe joint,

#3 and #5 collars, #34 and #36 collars.

_____ scratchers located _____

Liner hanger and pack off (describe) _____

Miscellaneous (baskets, etc.) _____

Cement (around shoe)

	No. Sacks	Brand	Type	Additives	Slurry Weight	Slurry Volume
(1)	760	Halliburton	Pmfst.	None	13.7	714 ft^3
(2)						

Cement through (DV, FO) Collar at _____ feet

	No. Sacks	Brand	Type	Additives	Slurry Weight	Slurry Volume
(3)						
(4)						

PAGE 1 OF 2

CASING TALLY

DATE: January 4, 1977

FIELD So.Barrow Gas Field LEASE & WELL NO. So. Barrow No. 13 TALLY FOR 7 " CASING

JOINT NO.	FIRST MEASUREMENT FEET	FIRST MEASUREMENT .00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT .00'S	WT GR.
1	34	10			
2	41	52			
3	42	38			
4	40	70			
5	42	28			
6	39	98			
7	38	74			
8	40	98			
9	39	03			
0	40	75			
TOTAL A	400	46			

JOINT NO.	FIRST MEASUREMENT FEET	FIRST MEASUREMENT .00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT 00'S	WT GR.
1	40	18			
2	40	32			
3	41	80			
4	38	64			
5	39	80			
6	40	88			
7	41	54			
8	39	55			
9	41	41			
0	40	56			
TOTAL D	404	68			

1	41	00			
2	38	28			
3	40	22			
4	42	38			
5	39	00			
6	41	40			
7	36	75			
8	42	22			
9	38	75			
0	42	08			
TOTAL B	402	08			

1	40	10			
2	42	03			
3	40	19			
4	40	65			
5	41	55			
6	41	16			
7	39	12			
8	39	38			
9	42	10			
0	41	48			
TOTAL E	404	76			

1	40	15			
2	41	52			
3	39	50			
4	41	69			
5	41	58			
6	42	55			
7	36	58			
8	39	75			
9	40	48			
0	42	10			
TOTAL C	405	90			

TOTAL A	400	46		
TOTAL B	402	08		
TOTAL C	405	90		
TOTAL D	404	68		
TOTAL E	407	76		
TOTAL PAGE	2020	88		

PAGE 2 OF 2

CASING TALLY

DATE: January 4, 1977

FIELD So.Barrow Gas Field LEASE & WELL NO. So. Barrow Well No. 13 TALLY FOR 7 " CASING

JOINT NO.	FIRST MEASUREMENT FEET	.00'S	CHECK MEASUREMENT FEET	.00'S	WT GR.
1	38	80			
2	40	18			
3	41	73			
4	38	40			
5	41	31			
6	41	85			
7	39	32			
8	40	98			
9	41	56			
0	41	85			
TOTAL A	405	98			

JOINT NO.	FIRST MEASUREMENT FEET	.00'S	CHECK MEASUREMENT FEET	.00'S	WT GR.
1					
2					
3					
4					
5					
6					
7					
8					
9					
0					
TOTAL D					

1	42	45			
2	42	65			
3					
4					
5					
6					
7					
8					
9					
0					
TOTAL B	85	10			

1					
2					
3					
4					
5					
6					
7					
8					
9					
0					
TOTAL E					

1	1	53	Shoe	
2	1	44	Crossover	
3	1	50	Crossover	
4	1	77	Float Collar	
5	2	11	Crossover	
6	(6	00)	Cut Off	
7				
8				
9				
0				
TOTAL C	2	35		

TOTAL A	405	98		
TOTAL B	85	10		
TOTAL C	2	35		
TOTAL D	2020	88		
TOTAL E				
TOTAL PAGE	2514	31		

CASING OR LINER CEMENT JOB

Lease So. Barrow Gas Field Well So. Barrow No. 13 Date January 5, 1977

Size Casing 7" Setting Depth 2514' Top (liner hanger) _____

Hole Size 8¼" " Mud Gradient .56 psi/ft (10.7 ppg) Viscosity 47

Casing Equipment

Baker shoe, Baker Duplex float located 40 feet

above shoe, _____ (DV, FO) collars located at _____ feet

and _____ feet.

Twelve centralizers located 15' above shoe, joints #2, 4, 6, 8, 10, 12, 14, 16, 18, 60, 61.

_____ scratchers located _____

Liner hanger and pack off (describe) _____

Miscellaneous (baskets, etc.) _____

Cement (around shoe)

	No Sacks	Brand	Type	Additives	Slurry Weight	Slurry Volume
(1)	805	Howco	Pmfst.	None	14.4	765 ft^3
(2)	80	Portland	"G"	2% $CaCl_2$	15.6	92 ft^3

Cement through (DV, FO) Collar at _____ feet

	No Sacks	Brand	Type	Additives	Slurry Weight	Slurry Volume
(3)						
(4)						

PAGE 1 OF 2

TUBING TALLY

DATE: January 7, 1977

FIELD So. Barrow Gas Field LEASE & WELL NO. So. Barrow Well No. 13 TALLY FOR 2 7/8 " TUBING

JOINT NO	FIRST MEASUREMENT FEET	FIRST MEASUREMENT 00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT 00'S	WT GR
Cut Off	10	00			
"XN" 2		71			
Collar 3		44			
Gray 4	1	10			
5					
6					
7					
8					
9					
0					
TOTAL A	12	25			

JOINT NO	FIRST MEASUREMENT FEET	FIRST MEASUREMENT 00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT 00'S	WT GR
1	31	50			
2	31	51			
3	31	50			
4	31	52			
5	31	50			
6	31	60			
7	31	20			
8	30	70			
9	31	70			
0	31	40			
TOTAL D	314	13			

1	31	20			
2	31	70			
3	31	30			
4	31	50			
5	30	00			
6	30	40			
7	31	80			
8	31	00			
9	30	00			
0	31	71			
TOTAL B	310	60			

1	31	30			
2	31	30			
3	30	60			
4	31	60			
5	31	50			
6	30	70			
7	31	50			
8	31	60			
9	31	61			
0	31	50			
TOTAL E	314	21			

1	31	71			
2	31	40			
3	31	70			
4	31	71			
5	31	66			
6	30	88			
7	31	10			
8	31	50			
9	30	90			
0	29	70			
TOTAL C	312	18			

TOTAL A	12	25
TOTAL B	310	60
TOTAL C	312	18
TOTAL D	314	13
TOTAL E	314	21
TOTAL PAGE	1263	37

PAGE 2 OF 2 TUBING TALLY DATE: January 7, 1977

FIELD So. Barrow Gas Field LEASE & WELL NO. So. Barrow Well No. 13 TALLY FOR 2 7/8 " TUBING

JOINT NO	FIRST MEASUREMENT FEET	FIRST MEASUREMENT 00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT 00'S	WT GR
1	30	90			
2	30	20			
3	30	79			
4	31	28			
5	31	30			
6	30	50			
7	30	80			
8	31	80			
9	30	10			
0	30	00			
TOTAL A	307	67			

JOINT NO	FIRST MEASUREMENT FEET	FIRST MEASUREMENT 00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT 00'S	WT GR
1	31	72			
2	30	09			
3	31	00			
4	31	70			
5	31	19			
6	31	63			
Landing Joint	13	00			
8					
9					
0					
TOTAL D	187	46			

1	30	10			
2	31	60			
3	31	59			
4	30	90			
5	31	50			
6	31	40			
7	31	50			
8	31	50			
9	29	70			
0	30	70			
TOTAL B	310				

1					
2					
3					
4					
5					
6					
7					
8					
9					
0					
TOTAL E					

1	31	50			
2	31	30			
3	31	29			
4	31	70			
5	31	71			
6	29	90			
7	31	40			
8	31	30			
9	31	60			
0	31	29			
TOTAL C	312	99			

TOTAL A	307	67			
TOTAL B	310	49			
TOTAL C	312	99			
TOTAL D	187	46			
TOTAL E					
TOTAL PAGE	1118	61			

PAGE 1 OF 2

TUBING TALLY

DATE: January 16, 1977

FIELD So. Barrow Gas Field LEASE & WELL NO. So. Barrow Well No. 13 TALLY FOR 2 7/8 " TUBING

JOINT NO	FIRST MEASUREMENT FEET	FIRST MEASUREMENT 00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT 00'S	WT GR.
Collar 1		44			
"XN" 2		71			
Collar 3		44			
4					
Gray 5	1	10			
6					
7					
8					
9					
0					
TOTAL A	1	59			

JOINT NO	FIRST MEASUREMENT FEET	FIRST MEASUREMENT 00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT 00'S	WT GR.
1	31	50			
2	31	51			
3	31	50			
4	31	52			
5	31	50			
6	31	60			
7	31	20			
8	30	70			
9	31	70			
0	31	40			
TOTAL D	314	13			

3	31	20			
4	31	70			
3	31	30			
4	31	50			
5	30	00			
6	30	40			
7	31	80			
8	31	00			
9	30	00			
0	31	70			
TOTAL B	310	60			

1	31	30			
2	31	30			
3	30	60			
4	31	60			
5	31	50			
6	31	70			
7	31	50			
8	31	60			
9	31	61			
0	31	50			
TOTAL E	314	21			

1	31	71			
2	31	40			
3	31	70			
4	31	71			
5	31	66			
6	30	80			
7	31	10			
8	31	50			
9	30	90			
0	29	70			
TOTAL C	312	18			

TOTAL A	1	59
TOTAL B	310	60
TOTAL C	312	18
TOTAL D	314	13
TOTAL E	314	21
TOTAL PAGE	1252	71

PAGE 2 OF 2

TUBING TALLY

DATE: January 16, 1977

FIELD So. Barrow Gas Field LEASE & WELL NO. So. Barrow Well No. 13 TALLY FOR 2 7/8 " TUBING

JOINT NO.	FIRST MEASUREMENT FEET	FIRST MEASUREMENT 00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT 00'S	WT GR.
1	30	90			
2	30	20			
3	30	79			
4	31	28			
5	31	30			
6	30	50			
7	30	80			
8	31	80			
9	30	10			
0	30	00			
TOTAL A	307	67	1560	38	

JOINT NO.	FIRST MEASUREMENT FEET	FIRST MEASUREMENT .00'S	CHECK MEASUREMENT FEET	CHECK MEASUREMENT .00'S	WT GR
1	31	72	2215	58	
2	30	09	2245	67	
3	31	00	2276	67	
4	31	70	2308	37	
5	31	19	2339	76	
6	31	63	2371	19	
7	13	00	Landing	Joint	
8					
9					
0					
TOTAL D	200	33	2384	19	

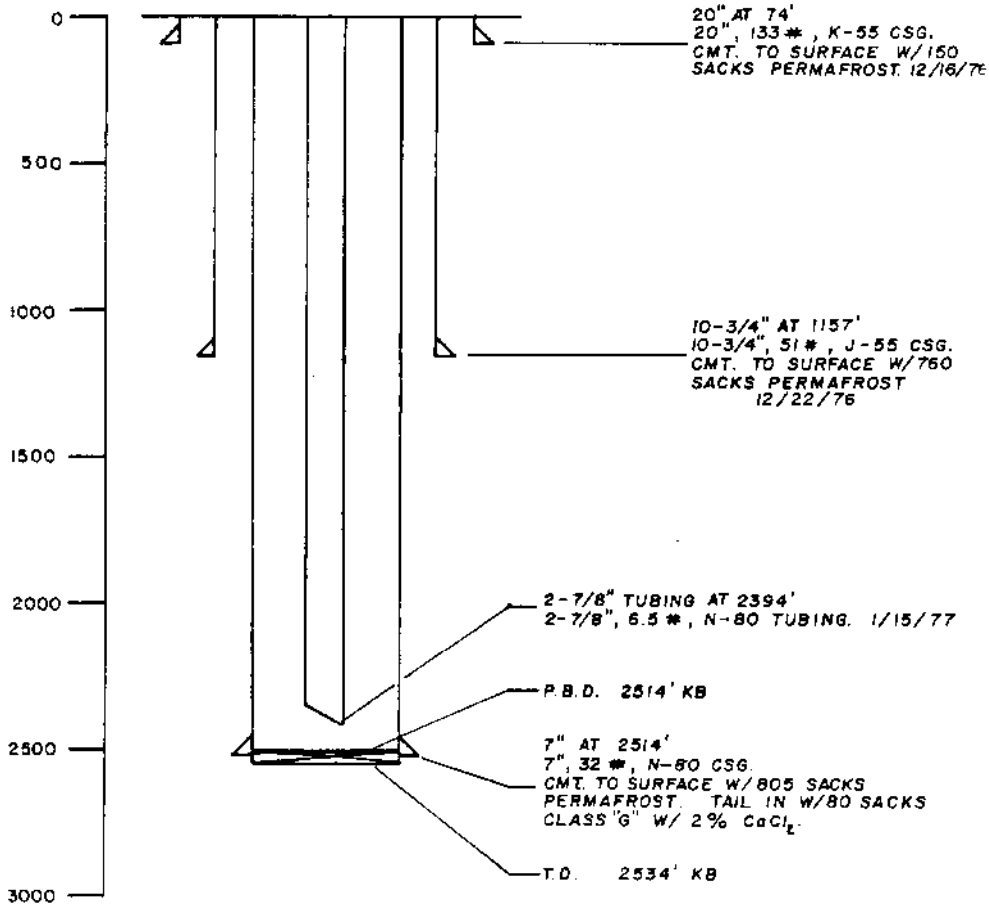
1	30	10			
2	31	60			
3	31	59			
4	30	90			
5	31	50			
6	31	40			
7	31	50			
8	31	50			
9	29	70			
0	30	70			
TOTAL B	310	49	1870	87	

1					
2					
3					
4					
5					
6					
7					
8					
9					
0					
TOTAL E					

1	31	50			
2	31	30			
3	31	29			
4	31	70			
5	31	71			
6	29	90			
7	31	40			
8	31	30			
9	31	60			
0	31	29			
TOTAL C	312	99	2183	86	

TOTAL A	307	67
TOTAL B	310	49
TOTAL C	312	99
TOTAL D	200	33
TOTAL E		
TOTAL PAGE	2384	19

WELLBORE SCHEMATIC



PERFORATIONS	1/6/77
INTERVAL	*SPF*
2224 – 34	4
2315 – 30	4
2330 – 45	4
2358 – 68	4
REPERFORATIONS	1/14/77
2224.5 – 34.5	4
2315.5 – 45.5	4
2356.5 – 76.5	4
2383 – 87	4

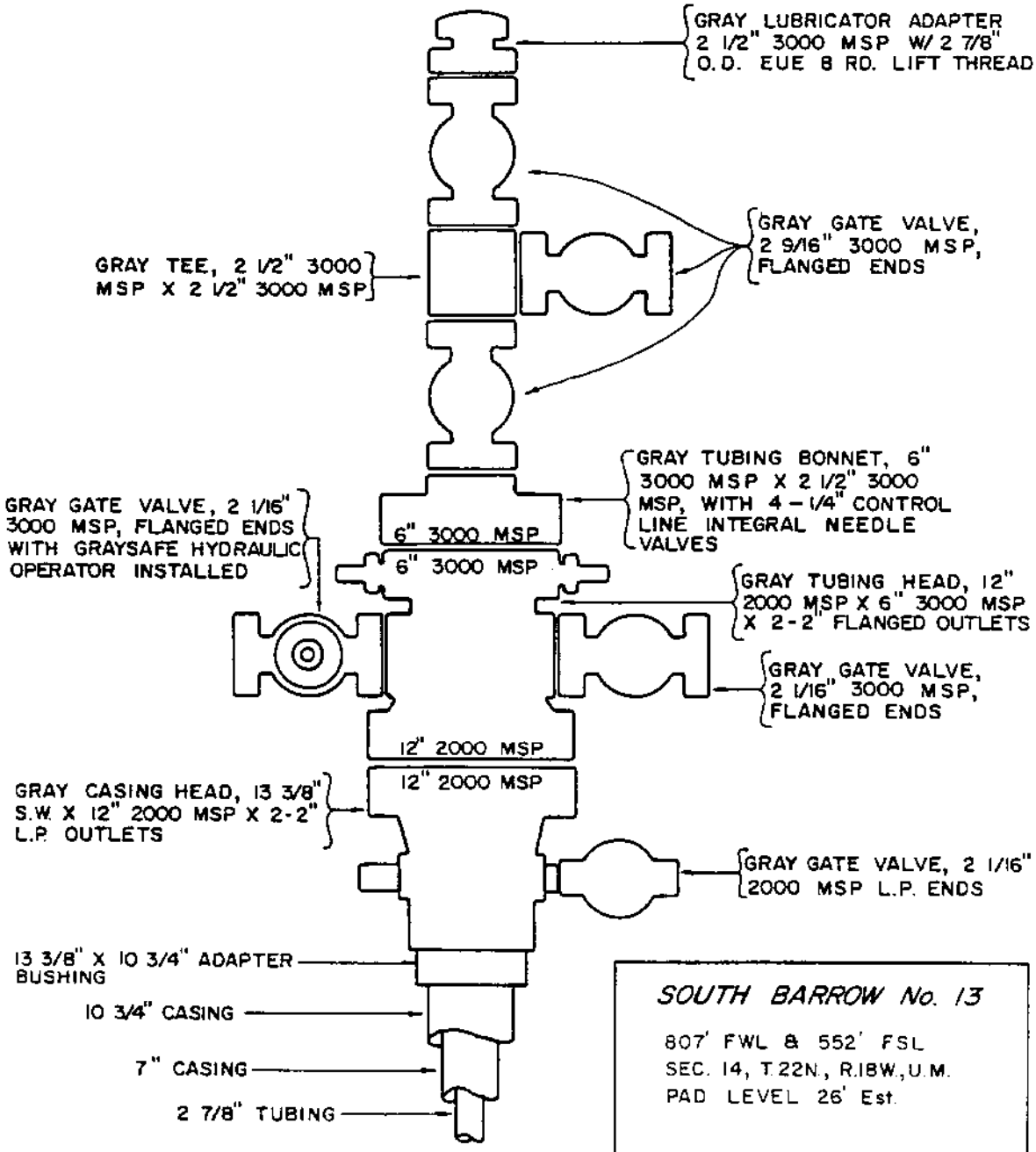
SOUTH BARROW NO. 13

807' FWL AND 552' FSL
SECTION 14, T22N, R18W, UM.
PAD LEVEL 26' EST
KB 40' EST.

HUSKY OIL *N.P.R.* OPERATIONS
NAVAL PETROLEUM RESERVE NO. 4

WELLHEAD DRAWING

SOUTH BARROW No. 13



SOUTH BARROW No. 13

807' FWL & 552' FSL
SEC. 14, T.22N., R.18W., U.M.
PAD LEVEL 26' Est.

SOUTH BARROW GAS FIELD
HUSKY OIL N.P.R. Operations Inc.

SPERRY-SUN

DIRECTIONAL SURVEY REPORT

FOR

HUSKY OIL NPR-4 OPERATIONS

TYPE OF SURVEY: Gyroscopic Multishot

SURVEY DEPTH: FROM Surface FT. TO 2475 FT.

LEASE: South Barrow WELL NO. 13

FIELD: South Barrow Gas Field

COUNTY/PARISH North Slope Borough STATE Alaska

DATE OF SURVEY January 14, 1977 JOB NO. 503-16114

OFFICE: Anchorage, Alaska 274-6656

SP-135C

SPERRY-SUN WELL SURVEYING COMPANY
ANCHORAGE, ALASKA

HUSKY OIL NPR-4 OPERATIONS
SOUTH BARROW 13
SOUTH BARROW GAS FIELD
ALASKA

COMPUTATION DATE
JANUARY 17 1977

DATE OF SURVEY JANUARY 14 1977
SURWEL GYROSCOPIC MULTISHOT SURVEY
JOB NUMBER SU3-16144
KELLY BUSHING ELEV. = 40.00 FT.

MEASURED DEPTH	TRUE VERTICAL DEPTH	SUB-SEA VERTICAL DEPTH	COURSE INCLINATION DEG	COURSE INCLINATION MIN	COURSE DIRECTION DEGREES	DOG-LEG SEVERITY DEG/100	TOTAL RECTANGULAR COORDINATES NORTH/SOUTH	TOTAL RECTANGULAR COORDINATES EAST/WEST	VERTICAL SECTION
0	.00	-40.00	0	0	S 0. 0 E	.00	.00	.00	.00
100	100.00	60.00	0	29	S 55. 8 E	.48	.24 S	.35 E	-.33
200	199.99	159.99	0	35	S 40. 5 E	.17	.87 S	1.02 E	-.96
300	299.98	259.98	1	20	S 4.96 E	.92	2.42 S	1.45 E	-1.29
400	399.94	359.94	1	40	S 0.37 W	.36	5.03 S	1.54 E	-1.21
500	499.89	459.89	2	3	S 8.66 W	.47	8.26 S	1.26 E	-.72
600	599.81	559.81	2	29	S 25.37 W	.79	11.98 S	.06 E	.72
700	699.65	659.65	3	54	S 45.11 W	1.77	16.34 S	3.28 W	4.33
800	799.28	759.28	5	45	S 52.25 W	1.94	21.81 S	9.65 W	11.04
900	898.53	858.53	8	15	S 64.64 W	2.91	27.95 S	20.09 W	21.86
1000	997.03	957.03	11	34	S 72.32 W	3.56	34.07 S	36.13 W	38.27
1100	1094.45	1054.45	14	29	S 77.81 W	3.17	39.75 S	57.91 W	60.37
1200	1191.31	1151.31	14	20	S 79.67 W	.49	44.61 S	82.31 W	85.03
1300	1288.21	1248.21	14	15	S 80.57 W	.24	48.85 S	106.63 W	109.58
1400	1385.19	1345.19	14	0	S 81.49 W	.34	52.66 S	130.74 W	133.88
1500	1482.26	1442.26	13	49	S 83.75 W	.57	55.75 S	154.57 W	157.86
1600	1579.48	1539.48	13	15	S 87.21 W	.99	57.61 S	177.89 W	181.25
1700	1676.92	1636.92	12	44	S 89.50 W	.73	58.26 S	200.35 W	203.71
1800	1774.46	1734.46	12	44	N 85.89 W	1.02	57.57 S	222.36 W	225.63
1900	1871.91	1831.91	13	10	N 82.26 W	.92	55.24 S	244.64 W	247.71
2000	1969.25	1929.25	13	20	N 78.62 W	.85	51.43 S	267.23 W	270.01
2100	2066.61	2026.61	13	5	N 75.67 W	.72	46.36 S	289.50 W	291.90
2200	2164.04	2124.04	12	55	N 74. 8 W	.39	40.49 S	311.22 W	313.19
2300	2261.62	2221.62	12	20	N 71.76 W	.77	34.08 S	332.11 W	333.62
2400	2359.47	2319.47	11	29	N 73.78 W	.95	27.96 S	351.81 W	352.88
2475	2433.02	2393.02	11	5	N 73.20 W	.55	23.79 S	365.88 W	366.65

HORIZONTAL DISPLACEMENT = 366.65 FEET AT SOUTH, 86 DEG. 16 MIN. WEST AT MD = 2475

THE CALCULATION PROCEDURES ARE BASED ON THE USE OF THREE DIMENSIONAL RADIUS OF CURVATURE METHOD.

HUSKY OIL NPR-4 OPERATIONS
SOUTH BARROW 13
SOUTH BARROW GAS FIELD
ALASKA

COMPUTATION DATE
JANUARY 17 1977

DATE OF SURVEY JANUARY 14 1977
SURWEL GYROSCOPIC MULTISHOT SURVEY
JOB NUMBER SU3-16144
KELLY BUSHING ELEV. = 40.00 FT.

ALASKA

KELLY BUSHING ELEV. = 40.00 FT.

INTERPOLATED VALUES FOR EVEN 1000 FEET OF MEASURED DEPTH

MEASURED DEPTH	TRUE VERTICAL DEPTH	SUB-SEA VERTICAL DEPTH	TOTAL RECTANGULAR COORDINATES NORTH/SOUTH	EAST/WEST	MD-TVD DIFFERENCE	VERTICAL CORRECTION
0	.00	-40.00	.00	.00	.00	
1000	997.03	957.03	34.07 S	36.13 W	2.97	2.97
2000	1969.25	1929.25	51.43 S	267.23 W	30.75	27.78
2475	2433.02	2393.02	23.79 S	365.88 W	41.98	11.23

THE CALCULATION PROCEDURES ARE BASED ON THE USE OF THREE DIMENSIONAL RADIUS OF CURVATURE METHOD.

HUSKY OIL NPR-4 OPERATIONS
SOUTH BARROW 13
SOUTH BARROW GAS FIELD
ALASKA

COMPUTATION DATE
JANUARY 17 1977

DATE OF SURVEY JANUARY 14 1977
SURWEL GYROSCOPIC MULTISHOT SURVEY
JOB NUMBER SU3-16144
KELLY BUSHING ELEV. = 40.00 FT.

INTERPOLATED VALUES FOR EVEN 100 FEET OF SUB-SEA DEPTH

MEASURED DEPTH	TRUE VERTICAL DEPTH	SUB-SEA VERTICAL DEPTH	TOTAL RECTANGULAR COORDINATES NORTH/SOUTH	EAST/WEST	MD-TVD DIFFERENCE	VERTICAL CORRECTION
0	.00	-40.00	.00	.00	.00	
40	40.00	.00	.00	.00	.00	.00
140	140.00	100.00	.43 S	.62 E	.00	.00
240	240.00	200.00	1.18 S	1.28 E	.01	.01
340	340.00	300.00	3.35 S	1.53 E	.03	.02
440	440.00	400.00	6.20 S	1.53 E	.07	.04
540	540.00	500.00	9.68 S	1.04 E	.14	.06
640	640.00	600.00	13.56 S	.69 W	.23	.09
740	740.00	700.00	18.28 S	5.23 W	.45	.22
840	840.00	800.00	24.32 S	13.32 W	.96	.52
941	940.00	900.00	30.52 S	26.09 W	1.98	1.02
1043	1040.00	1000.00	36.67 S	45.07 W	3.97	1.99
1147	1140.00	1100.00	42.21 S	69.41 W	7.04	3.08
1250	1240.00	1200.00	46.82 S	94.55 W	10.26	3.22
1353	1340.00	1300.00	50.97 S	119.58 W	13.42	3.17
1456	1440.00	1400.00	54.60 S	144.23 W	16.48	3.06
1559	1540.00	1500.00	57.15 S	168.60 W	19.44	2.96
1662	1640.00	1600.00	58.19 S	192.01 W	22.15	2.71
1764	1740.00	1700.00	58.12 S	214.60 W	24.67	2.52

HUSKY OIL NPR-4 OPERATIONS
SOUTH BARROW 13
SOUTH BARROW GAS FIELD
ALASKA

COMPUTATION DATE
JANUARY 17 1977

DATE OF SURVEY JANUARY 14 1977
SURWEL GYROSCOPIC MULTISHOT SURVEY
JOB NUMBER SU3-16144
KELLY BUSHING ELEV. = 40.00 FT.

INTERPOLATED VALUES FOR EVEN 100 FEET OF SUB-SEA DEPTH

MEASURED DEPTH	TRUE VERTICAL DEPTH	SUB-SEA VERTICAL DEPTH	TOTAL RECTANGULAR COORDINATES NORTH/SOUTH	EAST/WEST	MD-TVD DIFFERENCE	VERTICAL CORRECTION
1867	1840.00	1800.00	56.25 S	237.24 W	27.22	2.55
1969	1940.00	1900.00	52.80 S	260.44 W	29.94	2.71
2072	2040.00	2000.00	47.89 S	283.51 W	32.68	2.75
2175	2140.00	2100.00	42.00 S	305.91 W	35.33	2.65
2277	2240.00	2200.00	35.56 S	327.62 W	37.86	2.53
2380	2340.00	2300.00	29.06 S	348.01 W	40.13	2.27
2475	2433.02	2393.02	23.79 S	365.88 W	41.98	1.85

THE CALCULATION PROCEDURES USE A LINEAR INTERPOLATION BETWEEN THE NEAREST 20 FOOT MD (FROM RADIUS OF CURVATURE) POINTS

HUSKY OIL NPR-A OPERATIONS
SOUTH BARROW 13
SOUTH BARROW GAS FIELD
ALASKA

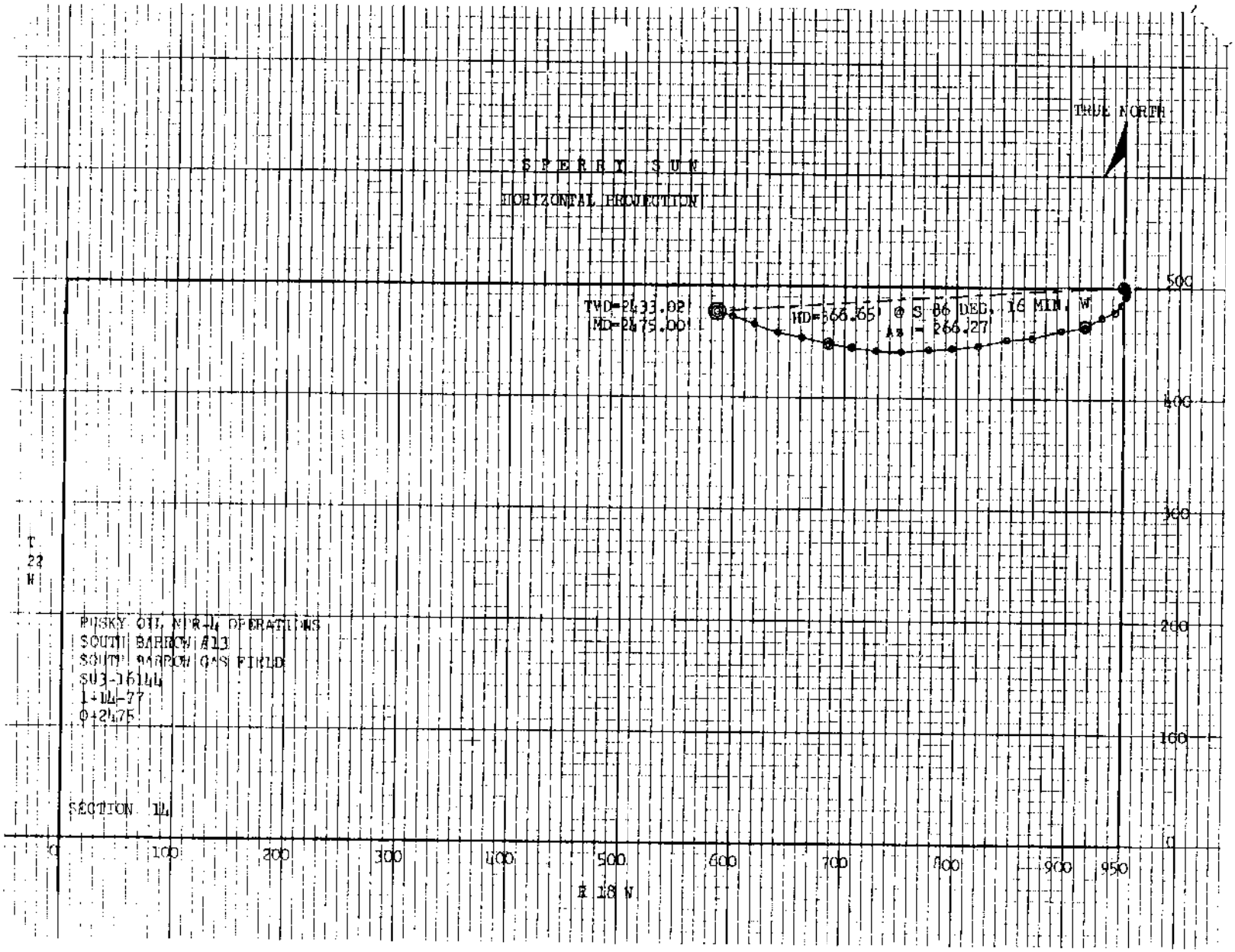
COMPUTATION DATE
JANUARY 17 1977

DATE OF SURVEY JANUARY 14 1977
SURVEY GYROSCOPIC MULTISHOT SURVEY
JOB NUMBER SU3-16144
KELLY BUSHING ELEV. = 40.00 FT.

INTERPOLATED VALUES FOR SPECIAL SURVEY POINTS

MEASURED DEPTH	TRUE VERTICAL DEPTH	SUB-SEA VERTICAL DEPTH	TOTAL RECTANGULAR COORDINATES NORTH/SOUTH	EAST/WEST	MARKER
2143	2108.49	2068.49	43.95 S	298.93 W	K-8
2224	2187.44	2147.44	39.02 S	316.38 W	TOP UNCONFORMITY SD.
2236	2199.13	2159.13	38.28 S	318.95 W	JURASSIC UNCONFORMITY
2260	2222.55	2182.55	36.75 S	323.99 W	J-2
2289	2250.88	2210.88	34.82 S	329.88 W	J-3
2315	2276.28	2236.28	33.08 S	335.15 W	UPPER BARROW SAND
2357	2317.33	2277.33	30.35 S	343.59 W	LOWER BARROW SAND
2475	2433.02	2393.02	23.79 S	365.88 W	ARGILLITE

At the total depth of 2534' (measured depth), the true vertical depth is 2491'. The bottom hole location at the last calculated point of 2433' (TVD) has migrated 366.65' at S86^{0}, 16' W; the azimuth equals 266.27^{0}.


S P E R R Y S U N
HORIZONTAL PROJECTION
TRUE NORTH
TVD=2433.02
MD=2475.00
HD=566.65 @ S 86 DEG. 16 MIN. W
Az = 266.27
500
400
300
200
100
0
T
22
N
PUSKY OIL NORTH OPERATIONS
SOUTH BARROW #13
SOUTH BARROW GAS FIELD
SW3-16W4
1+W4-77
0+2475
SECTION 14
0
100
200
300
400
500
600
700
800
900
950
E 18 W

September 12, 1978

Engineering Memo: Reservoir Exploitation Optimization
South Barrow Gas Field

A review of the production history, standard operational procedure, and recent testing program in the South Barrow Gas Field indicates that there are many unanswered questions with respect to both reservoir mechanics and flow dynamics which are of basic impact on production optimization.

Of immediate concern is the increasing water production being experienced in the Field. Evidence of this is the increasing frequency and duration of the blowdown periods necessary to unload accumulated fluids from the wellbores. Wells 9 and 11 have shown an increase in water production since their recent flow tests. This may be attributable to bottom water coning or altered relative permeability to water and may be either temporary or permanent. Well No. 5 must be blown down twice daily to maintain production. The most probable source of the water is the lower zones of the reservoir. This is substantiated by the fact that Well No. 5 is the deepest well currently producing, by the free water produced from Well No. 9 which is the second deepest well, and by the fact that bottom water is most common in reservoirs of this type. However, the possibility of water production from higher zones has not been ruled out. The use of open hole completions complicates the solution of the source of water influx.

A second question is the extent and horizontal and vertical continuity of the inter-well pressure communication. The existence of some degree of drainage has long been evidenced by the relatively uniform decline in wellhead pressures and the depressed initial shut-in pressures of the new completions. The interference evidenced by the testing of Well No. 9 is, however, unexpectedly high. The question remains as to which zones are in communication, to what extent, and whether vertical or horizontal communication is most important.

The performance of Well No. 13 is the strongest indication to date that the formation is to some extent "self-healing." This is probably due to the dehydration of interstitial shales by methane. The improved performance of Well No. 11, with respect to its initial production test, also supports the "self-healing" thesis. The amount of formation improvement attributable to clay dehydration and the amount attributable to the removal of drilling fluid filtrate, drill solids, and formation fines is unknown.

Although many questions remain unanswered, there are several steps, both short and long term, which need to be considered in order to optimize reservoir exploitation.

The location and deliverability of all water producing zones should be determined. Commercially available production logging techniques can be utilized toward this end. The amount of water being produced and the amount of reserves lost through blowdowns should be quantified in order to evaluate water lift mechanisms which are less wasteful of reservoir energy than open venting.

The degree and directional dependence of pressure communication should be investigated through the use of properly designed interference testing. This data is of importance in assessing short-term production philosophy and in developing the optimum production pattern as the reservoir nears depletion.

The advisability of deepening and recompleting selected wells is questionable on several points. The sole benefit of such work would be a potential increase in short-term deliverability. The degree of communication between wells and the open hole completion technique effectively negate any increase in ultimate recoverable reserves due to deepening. The potential risks are the influx of bottom water, increased water production due to increased flow rates, formation damage and increased relative permeability to water due to filtrate loss during deepening, and the loss of productivity from offset wells already producing from the deeper zones should these zones prove to be ones of high pressure communication.

The potential deliverability of Well No. 13 is still in question. Two courses of action are possible in response to this problem. The well could be temporarily connected to the gathering system and allowed to produce in an attempt to allow continued clean up and "self-healing." Alternatively, the well could be acid treated in order to reduce formation damage.

In the past there has been no attempt to optimize the utilization of reservoir energy or obtain maximum ultimate recovery from the South Barrow Field. Given that the Field is currently unable to meet peak demand, it is apparent that a program of production optimization is in order.

Stephen K. Lewis
Reservoir Engineer

ENGINEERING MEMORANDA

South Barrow Well No. 13
Backpressure and Drawdown Analysis
July 20-23, 1978

Presented herein are reservoir data and analyses derived from the drawdown and backpressure testing of South Barrow Well No. 13 performed from July 20 to July 23, 1978.

Table I contains basic well and formation data. Table II contains the results of the test analysis. Discussion of each analysis and conclusions is followed by data graphs and example calculations.

TABLE I -- WELL AND FORMATION DATA

1. Basal Unconformity Sand, Lower Cretaceous
   Barrow Sand, Early-Middle Jurassic

2. Perforations:

2224.0 - 2234.5	8 SPF
2315.0 - 2345.5	8 SPF
2356.5 - 2358.0	4 SPF
2358.0 - 2368.0	8 SPF
2368.0 - 2376.5	4 SPF
2383.0 - 2387.0	4 SPF

3.	Net Pay	h	= 32 feet
4.	Effective Porosity	ϕ	= 16.6 %
5.	Water Saturation	S_w	= 50%
6.	Gas Gravity	ϱ_g	= 0.567
7.	Pseudo Critical Pressure	P_{pc}	= 673 psia
8.	Pseudo Critical Temperature	T_{pc}	= 341 ^{o}R
9.	Reservoir Temperature	T	= 62^{o}F
10.	Static Reservoir Pressure (2373 ft md, 2385 ft KB)	P_c	= 859.103 psia

TABLE II -- TEST ANALYSIS

1. Pressure Drawdown Analysis

a.	Flow Capacity	kh	= 29.6347 md/ft
b.	Permeability	k	= 0.926086 md

c. Skin Factor — s = 2.505928

d. Skin Pressure Drop — ΔP_s = 163.5 psia

e. Effective Wellbore Radius — r_w^1 = 0.346799 inch

f. Radius of Investigation — r_{inv} = 67 feet

g. Average Gas Mobility — M = 77.95 md/cp

h. Actual Productivity Index — J_a = .608 McF/d/psi

i. Ideal Productivity Index — J_i = .916 McF/d/psi

j. Flow Efficiency — E_f = .6638

2. Backpressure Analysis

a. Absolute Open Flow — AOF = 360 McF/d

b. Backpressure Exponent — n = 1.0

c. Backpressure Coefficient — C = .00048777

3. Pressure Gradient Survey

a. Average Gas Gradient — = 0.01877 psi/ft

b. Gas Water Contact — = 2300 ft

DISCUSSION OF TEST PROCEDURE AND ANALYSES

The South Barrow No. 13 well is located at the southwestern limit of the currently producing area of the South Barrow Gas Field. The well is 2100 feet south of South Barrow No. 10 and 2791 feet southwest of South Barrow No. 11. The well was completed in January 1977 and was left in a secured shut-in condition after flow test attempts yielded no flow.

When testing operations began on July 20, 1978, the shut-in casing pressure was 798 psia. Wireline bottom-hole pressure tools were run and the well was opened to flow. As sufficiently small prover plates could not be located, only one flow rate was taken. After 8 hours the well was shut in and a 38 hour buildup was made. Tools were pulled with 500 foot gradient stops. On July 23, smaller prover plates were located and two flow rates were taken. Wellhead flowing pressures were recorded.

The data analyzed was that recorded by the Sperry Sun guage no. 231 which was hung at 2373 feet measured depth. All depths are measured from the tubing hanger which is at 12 feet, measured with respect to the kelly bushing.

Backpressure Analysis

Flow rates were calculated by the corrected Critical Flow Prover Method. Bottom hole pressure was measured on the first rate and calculated on the two lower rates using the average Compressibility Factors for a a Flowing Column Method as outlined in the Interstate Oil Compact Commission Manual of Back-pressure Testing of Gas Wells. As this method does not compensate for two-phase density, the resultant plot of $P_c^2 - P_t^2$ vs Q yields an exponent of 1.08. As this is beyond the theoretical maximum of 1.0, a slope of 1.0 is assumed through the last flow point. This yields an AOF of 360 McF/d.

Pressure Drawdown Analysis

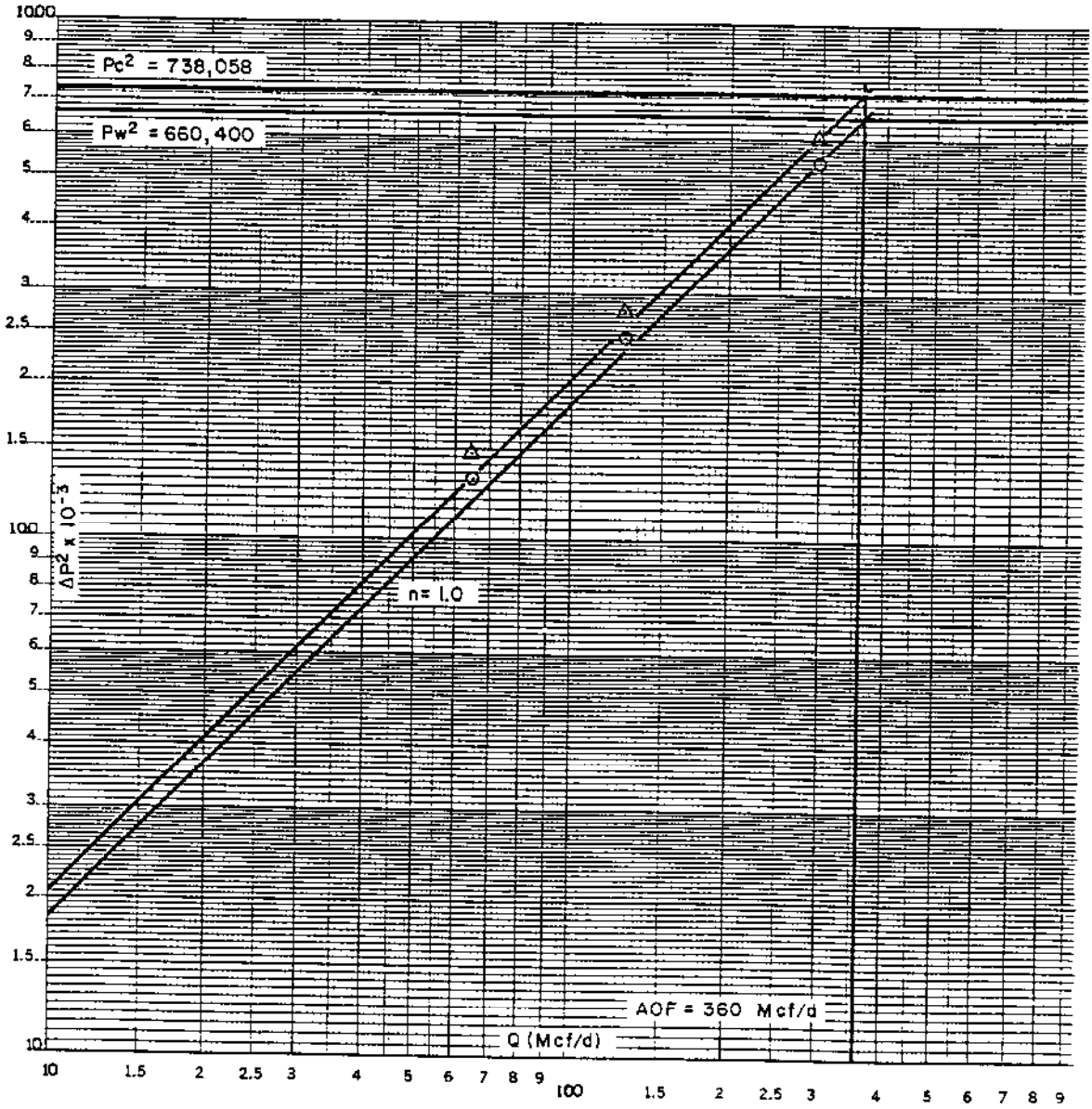
The pressure drawdown data measured on the first (highest) flow rate was analyzed using the semi log data plot of flowing bottom hole pressure versus time and standard analysis procedure. The derived flow capacity is 29.63 md ft with a skin factor of 2.5, a skin pressure drop of 163.5 psi, and an effective wellbore radius of 0.3468 inches.

Pressure Gradient Survey

The pressure gradient survey was made with stops every 500 feet. The assumed liquid gradient of .4423 psi/ft is based on an equivalent salinity of 21,500 ppm. The indicated gas water contact at the end of the buildup was 2300 feet.

CONCLUSIONS

Although the undamaged flow capacity of the formation in the area around South Barrow No. 13 may well be lower than in the north end of the field, the majority of the problem with this well is probably attributable to formation damage. The formation appears to be partially drained by the existing wells as is evidenced by the shut-in reservoir pressure of 859 psia which is 240 psi lower than the initial reservoir pressure. As the well would not flow initially but will flow after a year and a half, it appears that the formation is to some extent "self-healing." This is most likely due to dehydration of the interstitial shales by the methane.



SOUTH BARROW No. 13

$P_c^2 - P_t^2$ vs. Q

△ Calculated BHP

⊙ Measured WHP

SKL. 7/23/78

BACKPRESSURE DATA

South Barrow No. 13 - 7/20/78 & 7/23/78

I. First Rate: Choke = 3/16"

ϱ_g = .567 SIWHP = 812.65 psia

SIBHP = 859.103 psia FWHP = 344.65 psia

FPP = 339.00 psia FPT = 38°F

a. $Q = FPP \times F_p \times F_t \times F_{pv} \times F_g$

$Q = 338.65 \times .6237 \times 1.022 \times 1.030 \times 1.328$

$Q = 295.57$ McF/d

b. Wellhead $\Delta P^2 = (SIWHP)^2 - (FWHP)^2$

$= (812.65)^2 - (344.65)^2 = 541616$

c. Absolute $\Delta P^2 = (SIBHP)^2 - (FBHP)^2_{calc}$

$= (859.103)^2 - (363.28)^2 = 606086$

II. Second Rate: Choke = 1/16"

FWHP = 728 psia FPP = 692 psia

FPT = 46.6 °F $FBHP_{calc}$ = 768.696 psia

a. $Q = FPP \times F_p \times F_t \times F_{pv} \times F_g$

$Q = 692 \times .06569 \times 1.013 \times 1.056 \times 1.328$

$Q = 64.58$ McF/d

b. Wellhead $\Delta P^2 = (812.65)^2 - (728)^2 = 130416$

c. Absolute $\Delta P^2 = (859.103)^2 - (768.696)^2 = 147164$

III. Third Rate: Choke = 3/32"

FWHP = 643 psia FPP = 611 psia

FPT = 38°F $FBHP_{calc}$ = 678.90 psia

a. $Q = FPP \times F_p \times F_t \times F_{pv} \times F_g$

$= 611 \times .1446 \times 1.022 \times 1.059 \times 1.328$

= 126.98 MCF/D

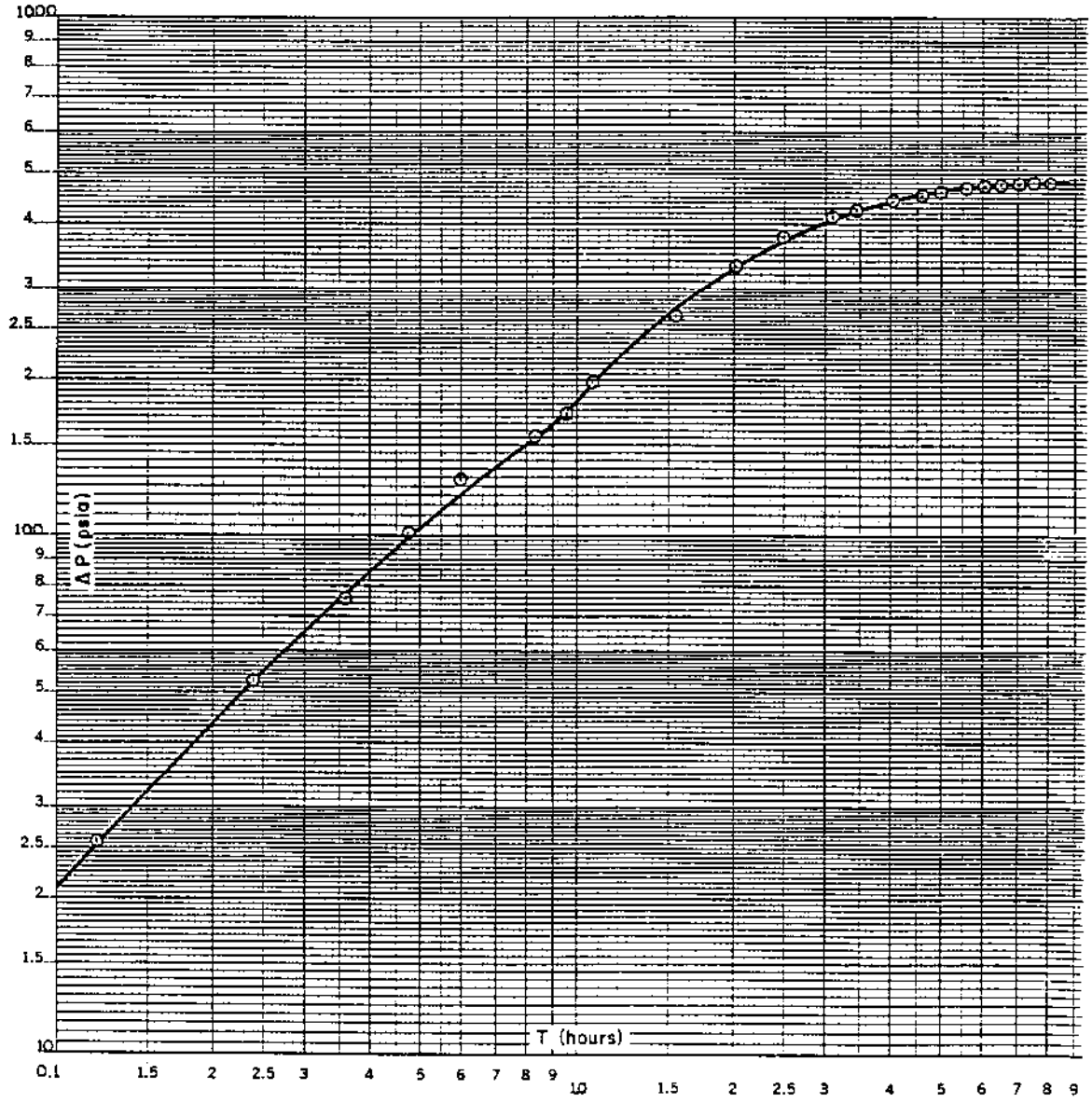
b. Wellhead $\Delta P^2 = (812.65)^2 - (643)^2 = 246951$

c. Absolute $\Delta P^2 = (859.103)^2 - (678.90)^2 = 277153$

Absolute Open Flow = 360 McF/d

Backpressure Exponent = n = 1.0

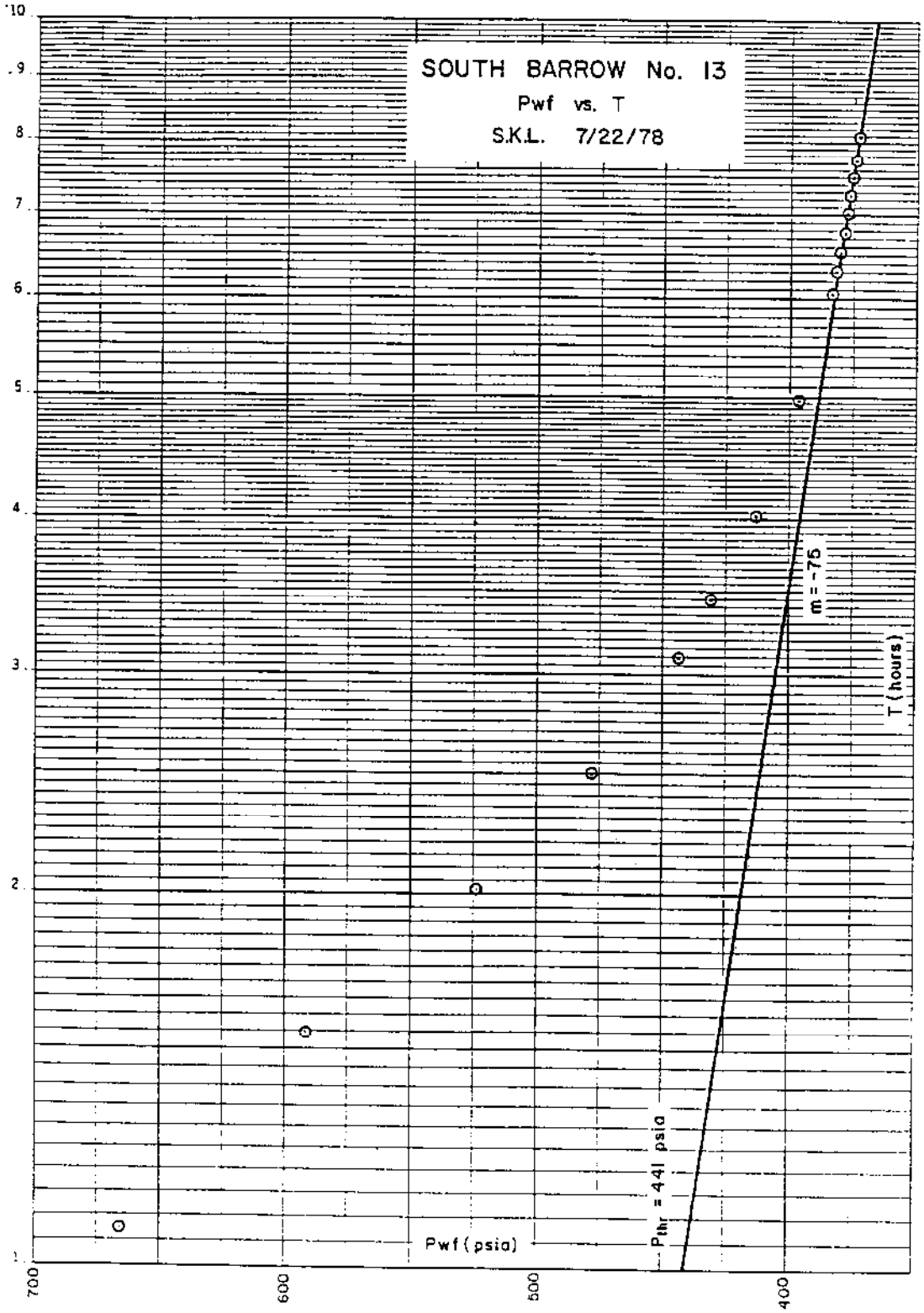
Backpressure Coefficient = C = .00048777



SOUTH BARROW No. 13

Pi - Pwf vs. T

S.K.L. 7/22/78


SOUTH BARROW No. 13
Pwf vs. T
S.K.L. 7/22/78
m = -75
T (hours)
Pwf (psia)
Pthr = 441 psia
10
9
8
7
6
5
4
3
2
1
700
600
500
400

PRESSURE DRAWDOWN ANALYSIS

Sperry Sun Tool #231 at 2373 ft MD (2385 ft KB)

P_i = 859.103 psia P_{wf} = 372.328 psia

P_{1hr} = 562.152 P_{pc} = 673 psia

T_{pc} = 341 ^{o}R ϕ = .166

S_w = .50 h = 32 ft

T = 62^{o}F m = -75 psi/cycle

I. $B_g = Z \frac{T}{T_{sc}} \frac{P_{sc}}{\frac{P_i + P_{wf}}{2}}$

$B_g = .913 \frac{522}{520} \frac{14.65}{\frac{859.103 + 372.328}{2}}$

$B_g = .021807$

$P_r = \frac{(P_{it} + P_{wf})/2}{P_{pc}}$

$P_r = .91488$

$T_r = \frac{T}{T_{pc}}$

$T_r = 1.530$

$\therefore Z = .913$

II. $\mu_g = \mu_i \times \frac{\mu_g}{\mu_i} = .0108 \times 1.1$

$\mu_g = .01188$

III. $C_g = \frac{1}{P_{cr}} \left[\frac{1}{P_r} - \frac{1}{Z} \left(\frac{\partial Z}{\partial P_r} \right)_{T_r} \right]$

$C_g = \frac{1}{673} \left[\frac{1}{.91488} - \frac{1}{.913} \left(\frac{-.961 + .875}{1} \right) \right]$

$C_g = .001764$

$C_t = C_g S_g + C_w S_w + C_f$

$C_t = .001764\ (.5) + 3.3 \times 10^{-6}(.5) + 3.0 \times 10^{-6}$

$C_t = .00088665$

IV. $kh = \frac{-28984\, q\, \mu_g\, B_g}{m}$ $\qquad q = 296$

$kh = \frac{-28984\ (296)\ .01188\ (.021807)}{-75}$ $\qquad m = -75$

$kh = 29.6347$ md ft

$k = .926086$ md

V. $S = 1.1513 \left[\frac{P_{1hr} - P_i}{m} - \log\left(\frac{k}{\phi\mu C_t r_w^2}\right) + 3.2275\right]$

$S = 1.1513 \left[\frac{441 - 859.1}{-75} - \log\left(.166\ (.01188)(.00088665)(.354167)^2\right) + 3.2275\right]$

$S = 2.505928$

VI. $\Delta P_s = -(n \times .87S) = -(-75 \times .87(2.505928))$

$\Delta P_s = 163.5118$ psi

VI. $r_w' = r_w e^{-S} = .346799$ inch

VII. $r_{inv} = \sqrt{\frac{.00105\ k\ T}{\phi\mu C_t}}$

$r_{inv} = \sqrt{\frac{.00105(.926086)(8.083)}{.166(.01188)(.00088665)}}$

$r_{inv} = 67$ ft.

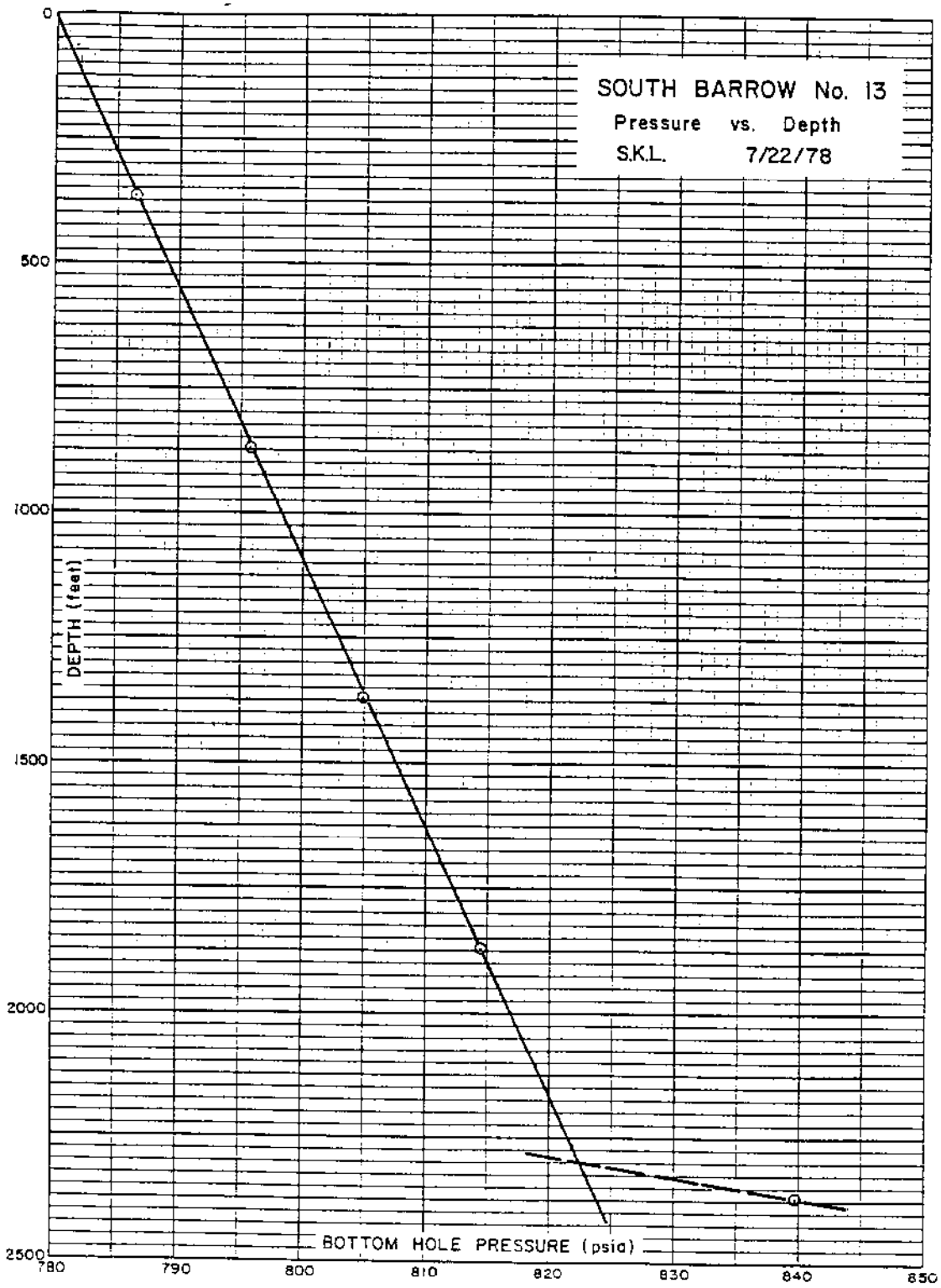
VIII. $M = \frac{k_g}{\mu_g} = \frac{.926086 \text{ md}}{.01188 C_p} = 77.95$ md/cp

IX. $J_a = \frac{q}{P_i - P_{wf}} = \frac{296}{859.1 - 372.3} = .608$ McF/d/psi

$J_i = \frac{q}{(P_i - P_{wf}) - \Delta P_s} = \frac{296}{(859.1 - 372.3) - 163.5}$

$= .916$ McF/d/psi

X. Flow Efficiency $= \frac{J_a}{J_i} = \frac{.608}{.916} = .6638$


SOUTH BARROW No. 13
Pressure vs. Depth
S.K.L. 7/22/78
DEPTH (feet)
0
500
1000
1500
2000
2500
BOTTOM HOLE PRESSURE (psia)
780
790
800
810
820
830
840
850

PRESSURE GRADIENT ANALYSIS

Depth (md)	Pressure	ΔP	ΔH	Gradient
2373	854.568			
1873	814.307	40.261	500	.0805
1373	804.948	9.359	500	.0187
873	795.746	9.202	500	.0184
373	786.151	9.595	500	.0192

Assumed Liquid Gradient = .4423 psi/ft

Gas Water Contact = 2300 ft